The 24th International Conference on Neural Information Processing (ICONIP 2017)

Final Program and Book of Abstracts

November 14 – 18, 2017, Guangzhou, China

Welcome Message from the General Chair

It is our great honor to welcome you to The 24th International Conference on Neural Information Processing (ICONIP 2017), to be held in Guangzhou, China, November 14–18, 2017. It is an annual event, organized since 1994 by the Asia Pacific Neural Network Assembly (now APNNS, Asia Pacific Neural Network Society). Over the past 24 years, ICONIP has been held in Australia, China, India, Japan, Korea, Malaysia, New Zealand, Qatar, Singapore, Thailand, and Turkey. ICONIP has now become a well-established conference series on neural information processing in the region and around the world, with growing popularity and increasing quality. With the increasing popularity of neural networks in recent years, we have a seen an increase in the number of submissions and in the quality of papers. Guangzhou, Romanized as Canton in the past, is the capital and largest city of southern China's Guangdong Province. It is also one of the five National Central Cities at the core of the Pearl River Delta, and it is a key national transportation hub and trading port. All participants of ICONIP 2017 will have a technically rewarding experience as well as memorable experiences in this great city!

ICONIP 2017 aims to provide a high-level international forum for scientists, researchers, educators, industrial professionals, and students worldwide to present state-of-the-art research results, address new challenges, and discuss trends in neural information processing and applications. It received 856 submissions from more than 50 countries and regions. Based on rigorous reviews, 563 papers were selected for publication in the proceedings. In addition to the contributed papers, several distinguished scholars (Professor Tamer Basar, Professor Zong-Ben Xu, Professor C. L. Philip Chen, Professor Kenji Doya, Professor Robert Kozma, Professor DeLiang Wang, Professor Jun Wang, Professor Paul J. Werbos, Professor Jin Xu, Professor Haibo He, and Professor James Lo) were invited to give plenary and invited lectures, providing us with recent hot research topics, latest developments and novel applications.

ICONIP 2017 is sponsored by Chinese Academy of Sciences, Guangdong University of Technology, South China University of Technology, Springer and IEEE/CAA Journal of Automatica Sinica. We wish to express our appreciation to all the individuals who have contributed to ICONIP 2017 in a variety of ways. Special thanks are extended to our colleagues for their thorough review of all submissions, which is vital to the success of this conference, and also to the members of the organizing committee and our volunteer students who have dedicated their time and efforts to planning, promoting, organizing and helping with the conference. Our special thanks go to distinguished plenary and invited lecturers, as well as all the authors for contributing their latest research work to the conference, and to all the participants in making ICONIP 2017 a memorable event.

Enjoy the conference and enjoy your stay in Guangzhou!

Derong Liu

ICONIP 2017 General Chair

Welcome Message from the Program Chairs

Welcome to ICONIP 2017! The 24th International Conference on Neural Information Processing is being held in Guangzhou, China, November 14–18, 2017. The international conference has a long tradition of focusing on both theory and applications of neural information processing. This year is no exception. The scope of this year's conference includes neural network theory and applications, computational neuroscience, machine learning and others. In addition to regular technical sessions with oral and poster presentations, the conference program will include invited sessions and tutorials on topics of current interest.

ICONIP 2017 received 856 submissions from 56 countries and regions. 563 papers have been accepted for either oral or poster presentation at the conference. The acceptance rate is 65.77%. Top 10 countries/regions (# submissions) (# accepted) are: China 566 (368), Australia 71 (46), Japan 57 (50), Korea 17 (13), Tunisia 17 (13), India 11 (4), France 10 (10), United Kingdom 10 (8), Hong Kong 10 (8), and New Zealand 9 (5), followed by United States, Germany, United Arab Emirates, Taiwan and Romania, each with more than 5 submissions. Papers presented at the conference cover a board spectrum of fields, such as machining learning, pattern recognition, speech processing, neurodynamics, neural data analysis, neuromorphic hardware, information security, sensing, intelligent robots and brain-like intelligence, biomedical engineering, computational finance, etc. The program booklet provides materials about the location of the session rooms, maps of the conference venue as well as the day-by-day program and abstracts of the plenary and invited lectures.

We would like to express our sincere appreciation and thanks to the technical program committee members and the reviewers for their great efforts in the paper review process, and also to the members of organizing committee and the volunteers who have dedicated a lot of time and efforts to promoting the conference. We would like to thank all the invited speakers and panelists, as well as all the authors for sharing their ideas, insights and latest research results with the ICONIP community. We would also like to thank all the participants and sponsors for their great contributions and strong supports to ICONIP 2017.

On behalf of the Program Committee, we thank you for attending ICONIP 2017 and hope that you enjoy the conference. Finally, if your travel plans permit, we would hope you to stay beyond the conference to enjoy visiting Guangzhou and the rest of China. We wish you a great conference and enjoyable visits in Guangzhou, China.

Welcome to Guangzhou!

ICONIP 2017 Program Chairs

Shengli Xie

Yuanqing Li

Dongbin Zhao

El-Sayed M. El-Alfy

ICONIP 2017 Program at a Galance (November 14 – 18, 2017)

Tuesday, November 14, 2017

08:00 - 20:00	**Registration (2nd floor) / 二楼**
08:30 - 12:00	**Tutorial 1:** *Information Theoretic Learning in Pattern Classification*, **Baogang Hu**, Zhujiang 2 (3rd floor) / 三楼珠江2厅 **Tutorial 2:** *Automatic Determination of Multi-layer Perception Neural Net Structure with Pseudoinverse Learning Algorithm*, **Ping Guo**, Zhujiang 3 (3rd floor) / 三楼珠江3厅
14:00 - 17:30	**Tutorial 3:** *Tensor Networks and Neural Networks*, **Zonglin Xu**, Zhujiang 2 (3rd floor) / 三楼珠江2厅 **Tutorial 4:** *Spiking Neural Networks and Deep Learning of Temporal and Spatio-temporal Data*, **Nikola Kasabov**, Zhujiang 3 (3rd floor) / 三楼珠江3厅 **Tutorial 5:** *Signal Processing and Machine Learning for Brain-Computer Interfaces*, **Dongrui Wu, Zhaohong Deng and Kup-Sze Choi**, Kaixuan 6 (3rd floor) / 三楼凯旋6厅
18:00 - 20:00	**Welcome reception**, Regal Gallery (2nd floor) / 二楼华苑厅

Wednesday, November 15, 2017

08:30 - 08:40	**Opening ceremony**
08:40 - 09:30	**Plenary lecture 1:** *Distributed Learning and Consensus Formation with Dynamic Networks*, **Tamer Basar**, Regal Gallery (2nd floor) / 二楼华苑厅
09:30 - 10:20	**Plenary lecture 2:** *Model Driven Deep Learning*, **Zongben Xu**, Regal Gallery (2nd floor) / 二楼华苑厅
10:20 - 10:40	Coffee break: 2nd floor, Exhibition Areas / 二楼展览区
10:40 - 11:30	**Plenary lecture 3:** *Beyond Deep Learning and Brain Research*, **Paul Werbos**, Regal Gallery (2nd floor) / 二楼华苑厅
11:30 - 12:20	**Plenary lecture 4:** *Deep Neural Networks for Supervised Speech Separation*, **DeLiang Wang**, Regal Gallery (2nd floor) / 二楼华苑厅
12:20 - 13:20	Lunch break: Emperor's Court (2nd floor) & Lotus Garden (1st floor) / 二楼帝苑厅和一楼荷苑

Room	Kaixuan 7 (3rd floor) 三楼凯旋7厅	Zhujiang 2 (3rd floor) 三楼珠江2厅	Zhujiang 3 (3rd floor) 三楼珠江3厅	Zhujiang 5 (3rd floor) 三楼珠江5厅	Zhujiang 7 (3rd floor) 三楼珠江7厅	Kaixuan 3 (3rd floor) 三楼凯旋3厅	Kaixuan 5 (3rd floor) 三楼凯旋5厅	Kaixuan 6 (3rd floor) 三楼凯旋6厅	Poster Area (2nd floor) 二楼海报张贴区
13:30 - 15:30	**WedA1**: Best paper award competition session (**Award Session**)	**WedA2**: Data mining and cybersecurity (**Workshop**)	**WedA3**: Active learning control of infinite-dimensional systems and its applications **(Invited Session)**	**WedA4**: Machine learning 1	**WedA5**: Deep learning 1	**WedA6**: Brain-computer interface	**WedA7:** Computational intelligence 1	**WedA8**: Computer vision 1	P1: Poster Session 1 (13:30 - 18:00)
15:30 - 16:00	Coffee break: 2nd floor, Exhibition Areas / 二楼展览区								
16:00 - 18:00	**WedB1**: Best student paper award competition session (**Award Session**)	**WedB2**: Reservoir computing and its applications, Spiking neural networks **(Invited Session)**	**WedB3**: Intelligent system modeling & control **(Invited Session)**	**WedB4**: Machine learning 2	**WedB5**: Deep learning 2	**WedB6**: Biomedical engineering	**WedB7**: Computational intelligence 2	**WedB8**: Computer vision 2	
18:00 - 20:00	Dinner: Emperor's Court (2nd floor) & Lotus Garden (1st floor) / 二楼帝苑厅和一楼荷苑								

Thursday, November 16, 2017

08:30 - 09:20	**Plenary lecture 5:** *What Can We further Learn from the Brain?*, **Kenji Doya**, Regal Gallery (2nd floor) / 二楼华苑厅
09:20 - 10:10	**Plenary lecture 6:** *Intelligent Control Based on Neurdynamic Optimization*, **Jun Wang**, Regal Gallery (2nd floor) / 二楼华苑厅
10:10 - 10:40	Coffee break: 2nd floor, Exhibition Areas / 二楼展览区
10:40 - 11:30	**Plenary lecture 7:** *Respiration and Higher Cognition - Energetic Conditions of Intelligence in Man and Machine*, **Robert Kozma**, Regal Gallery (2nd floor) / 二楼华苑厅
11:30 - 12:20	**Plenary lecture 8:** *Probe Machine: Theory, Implementation and Applications*, **Jin Xu**, Regal Gallery (2nd floor) / 二楼华苑厅
12:20 - 13:20	Lunch break: Emperor's Court (2nd floor) & Lotus Garden (1st floor) / 二楼帝苑厅和一楼荷苑

Room	Kaixuan 7	Zhujiang 2	Zhujiang 3	Zhujiang 5	Zhujiang 7	Kaixuan 3	Kaixuan 5	Kaixuan 6	Poster Area
13:30 - 15:30	**ThuA1:** Deep learning for computer vision: theory and applications **(Invited Session)**	**ThuA2**: Data mining and cybersecurity (**Workshop**)	**ThuA3**: Neuro-inspired learning and adaptation for optimization and control **(Invited Session)**	**ThuA4**: Neural data analysis	**ThuA5**: Data mining 1	**ThuA6**: Machine learning 3	**ThuA7**: Deep learning 3	**ThuA8**: Time series analysis	P2: Poster Session 2 (13:30 - 18:00)
15:30 - 16:00	Coffee break: 2nd floor, Exhibition Areas / 二楼展览区								
16:00 - 18:00	**ThuB1:** Dynamics of neural systems and implications to neural information processing **(Invited Session)**	**ThuB2**: Data-driven control for complex systems with power systems applications **(Invited Session)**	**ThuB3**: Neurodynamics	**ThuB4**: Big data analysis	**ThuB5**: Data mining 2	**ThuB6**: Machine learning 4	**ThuB7**: Deep learning 4	**ThuB8**: Social networks	
18:00 - 20:00	Dinner: Emperor's Court (2nd floor) & Lotus Garden (1st floor) / 二楼帝苑厅和一楼荷苑								

Friday, November 17, 2017

08:30 - 09:20	**Invited lecture 1**: *Learning-based Control: Opportunities and Challenges* , **Haibo He**, Kaixuan 7 (3rd floor) / 三楼凯旋7厅 **Invited lecture 2**: *Deep Learning and a New Approach for Machine Learning*, **James Lo**, Kaixuan 8 (3rd floor) / 三楼凯旋8厅
09:30 - 10:20	**Plenary lecture 9:** Generative and Discriminative Learnings: A Fuzzy Restricted Boltzmann Machine and Broad Learning System, **Philip Chen**, Regal Gallery (2nd floor) / 二楼华苑厅
10:20 - 10:40	Coffee break: 2nd floor, Exhibition Areas / 二楼展览区
10:40 - 12:00	**Panel Session:** *The Futrue of Deep Learning and Brain Research*, **Tamer Basar, Zong-Ben Xu, C. L. Philip Chen, Kenji Doya, Robert Kozma, DeLiang Wang, Jun Wang, Jin Xu, Cesare Alippi, Marios Polycarpou** (Moderator: Paul Werbos), Regal Gallery (2nd floor) / 二楼华苑厅
12:20 - 13:20	Lunch break: Emperor's Court (2nd floor) & Lotus Garden (1st floor) / 二楼帝苑厅和一楼荷苑

Room	Kaixuan 7	Zhujiang 2	Zhujiang 3	Zhujiang 5	Zhujiang 7	Kaixuan 3	Kaixuan 5	Kaixuan 6	Poster Area
13:30 - 15:30	**FriA1**: Computer vision 3	**FriA2**: Computational intelligence 3	**FriA3**: Robotics and control	**FriA4**: Pattern recognition 1	**FriA5**: Machine learning 5	**FriA6**: Time series analysis & Robotics control	**FriA7**: Sensory perception & Data mining & Information security	**FriA8**: Computational intelligence and its applications	P3: Poster Session 3 (13:30 - 18:00)
15:30 - 16:00	Coffee break: 2nd floor, Exhibition Areas / 二楼展览区								
16:00 - 18:00	**FriB1**: Reinforcement learning	**FriB2**: Computational intelligence 4	**FriB3**: Data mining 3	**FriB4**: Pattern recognition 2	**FriB5**: Machine learning and deep learning	**FriB6**: Computational finance	**FriB7**: Neuromorphic hardware & Speech processing	**FriB8**: Emotion and reward & Bioinformatics	
18:30 - 21:00	**Annual meeting of APNNS members and banquet**								

Saturday, November 18, 2017

09:00 - 12:00	Optional technical tour

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- Springer Lecture Notes in Computer Science
- IEEE/CAA Journal of Automatica Sinica

Conference Venue

ICONIP 2017 will be held at the Ramada Pearl Hotel Guangzhou. The Ramada Pearl Hotel by Wyndham brand is located in the proximity of the CBD of Guangzhou, beside tranquil and relaxing environment of Pearl River. It is 1km from Guangzhou Tower and Hai Xin Sha Asian Games Park, 5km from Guangzhou-Kowloon Express Railway Station, 35km from Baiyun International Airport, and 8km from Guangzhou International Convention Exhibition Center.

Hotel Address:
Ramada Pearl Hotel Guangzhou
9 Mingyue 1st Road
Guangzhou Middle Avenue
Yuexiu District
Guangzhou
China
Tel: +86-20-8600 9099

酒店地址：
广州越秀区广州大道中明月一路 9 号
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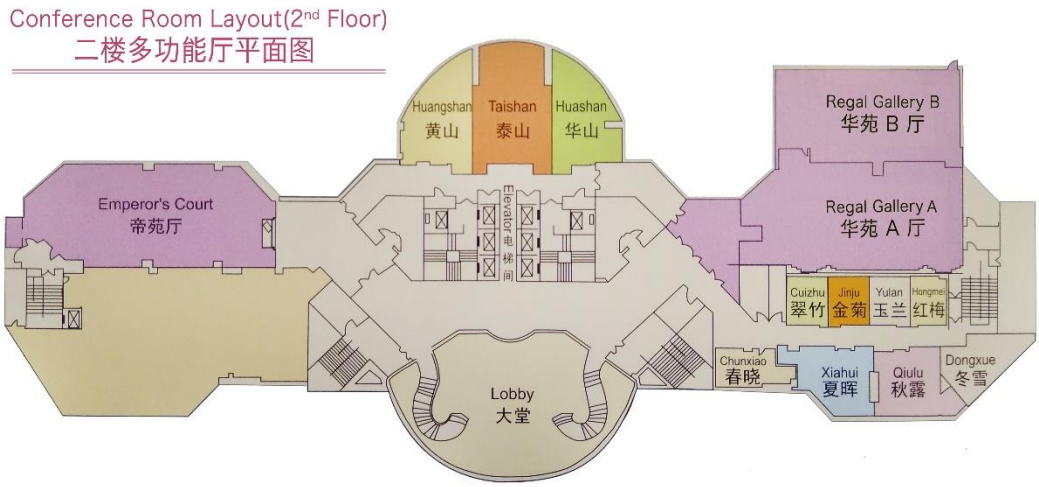
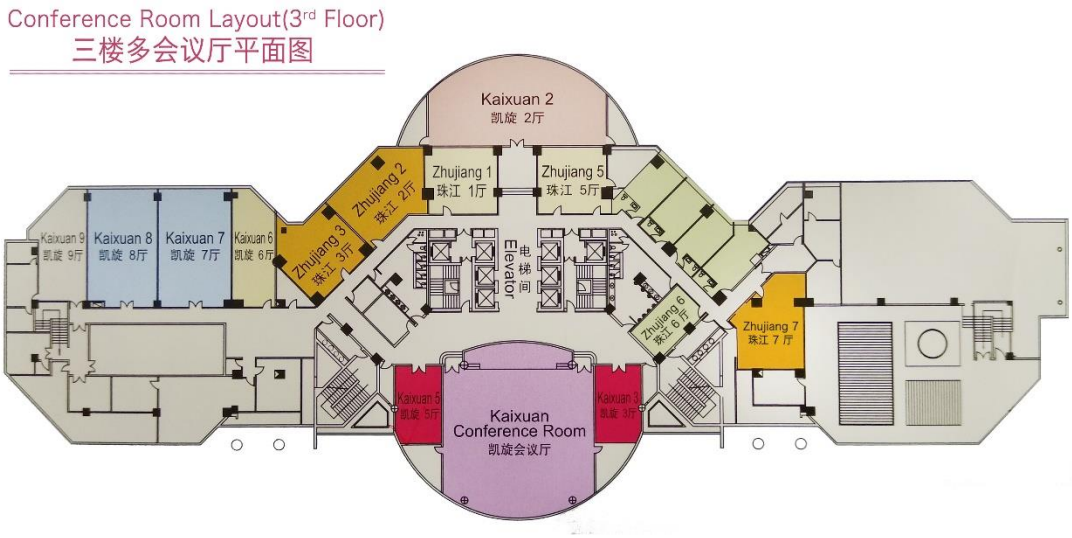
Floor Plan of the Ramada Pearl Hotel Guangzhou (2nd Floor)



Floor Plan of the Ramada Pearl Hotel Guangzhou (3rd Floor)



How to get to the Ramada Pearl Hotel Guangzhou (ICONIP 2017 Venue)

Please show the name of the hotel in Chinese to taxi drivers or others.

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地址：广州市越秀区广州大道中明月一路 9 号　　电话：+86-20-86009099

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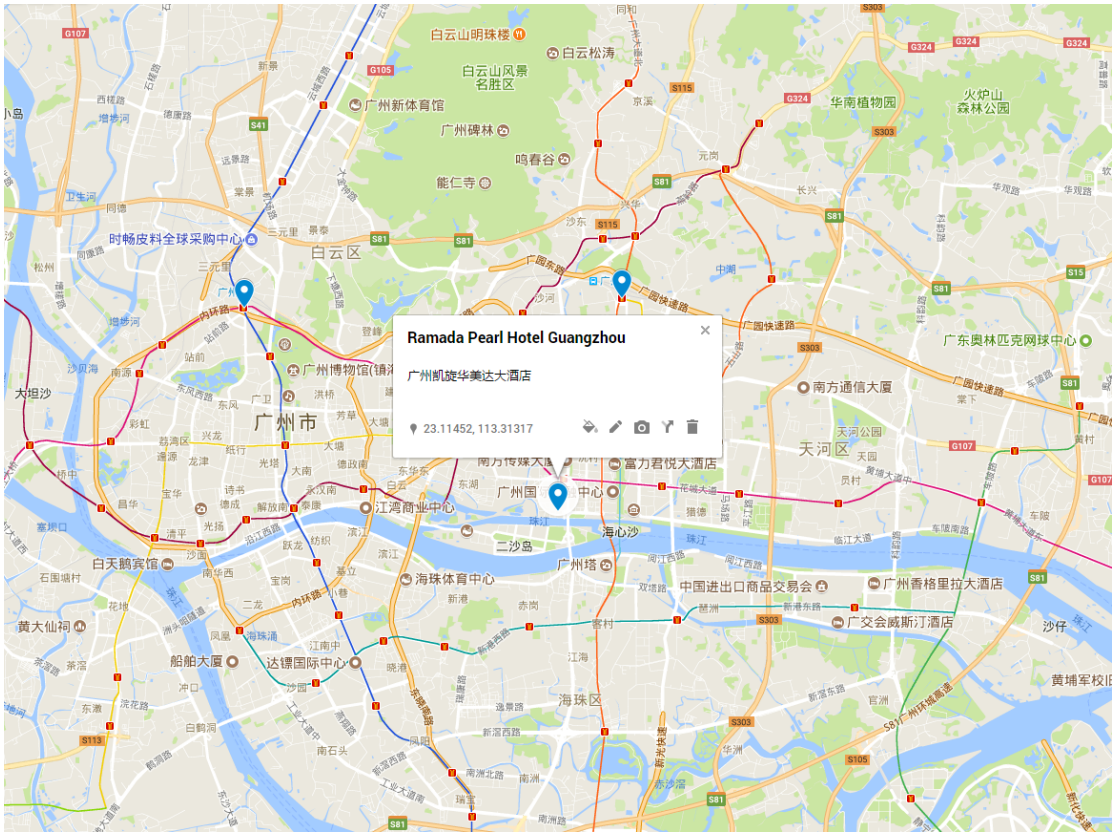

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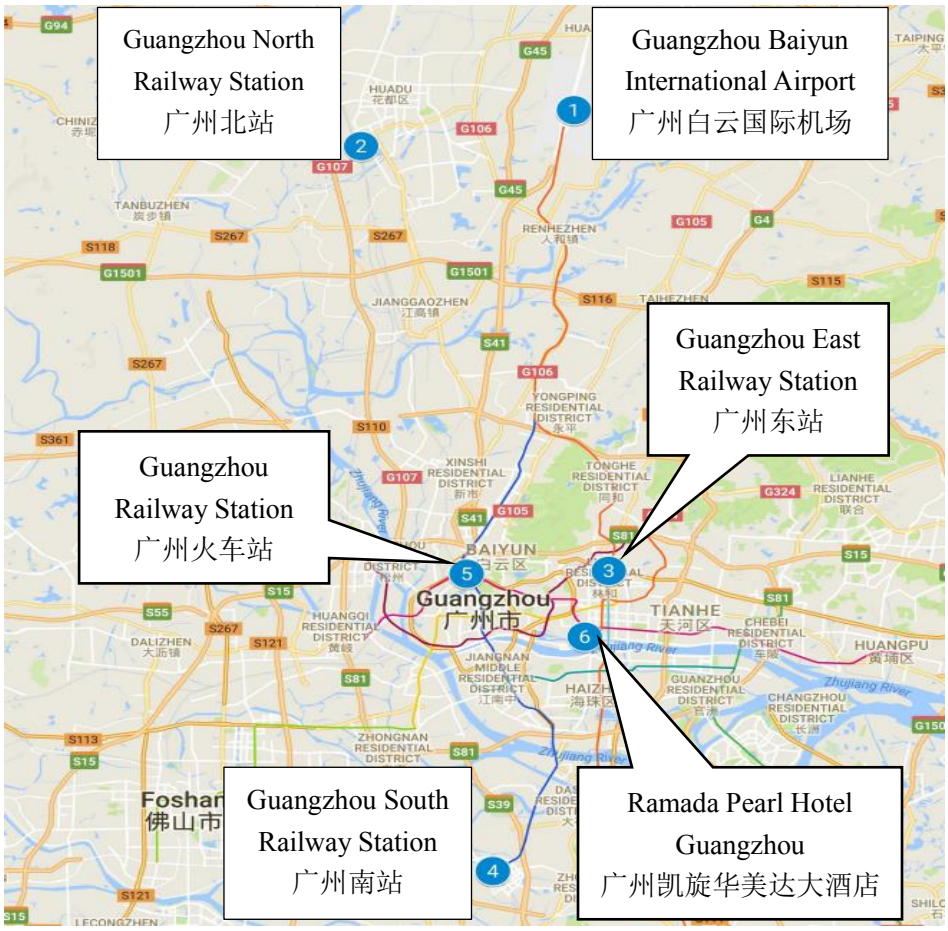
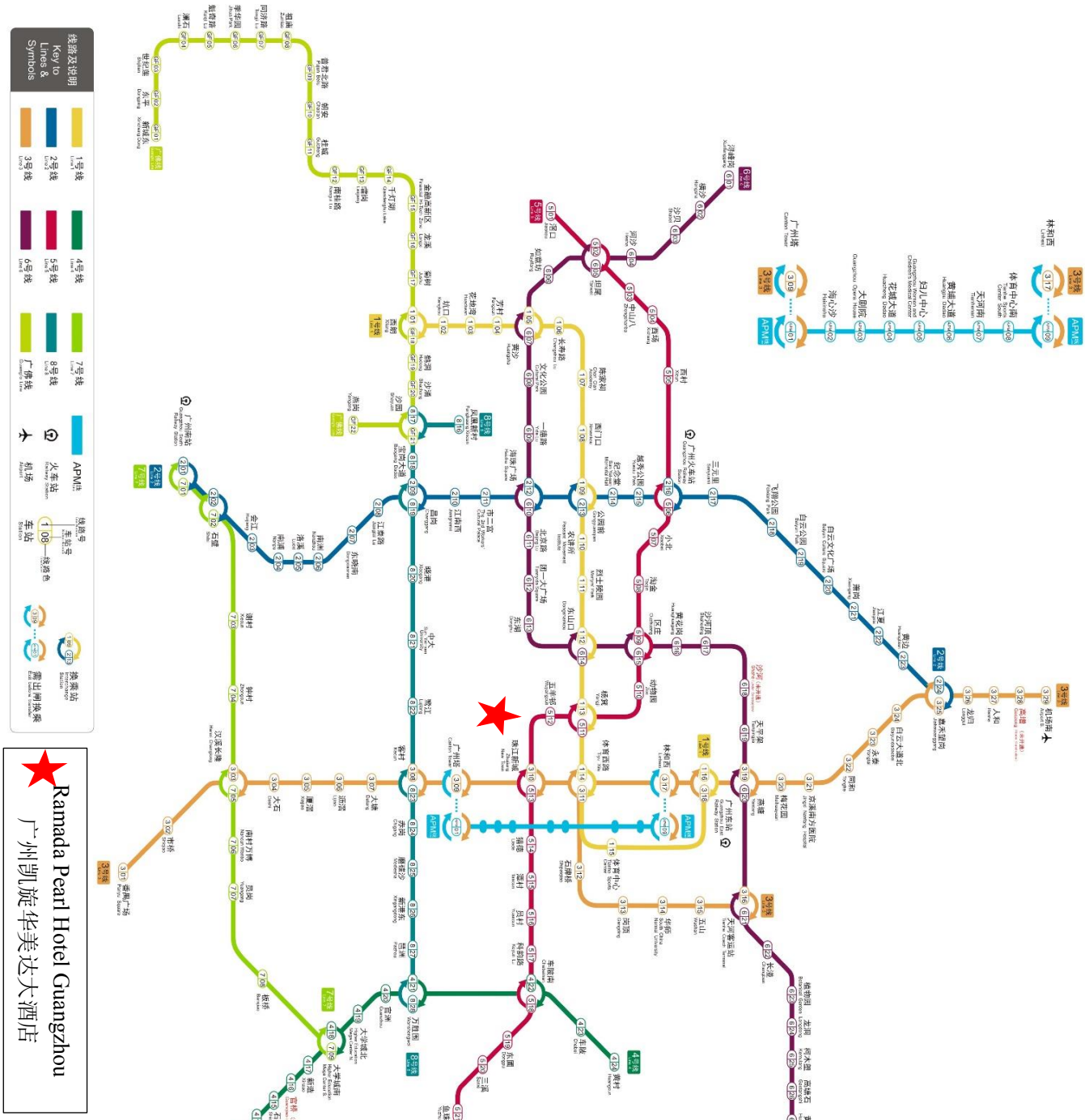
The location of the Ramada Pearl Hotel Guangzhou

起点(From)	距离 (Distance/km)	时间 (Time/mins)	方式(By)
广州白云国际机场 (Guangzhou Baiyun International Airport)	43.8	51	乘车 (By Car)
广州火车站 (Guangzhou Railway Station)	9.1	21	
广州东站 (Guangzhou East Railway Station)	5.0	18	
广州南站 (Guangzhou South Railway Station)	24.5	49	
广州北站 (Guangzhou North Railway Station)	45.2	77	



Guangzhou Metro Line Map



Registration Information

The ICONIP 2017 registration desk, located in the Ramada Pearl Hotel Guangzhou, will be open during:

- Nov. 14, 2017 (Tuesday) 08:00–20:00
- Nov. 15, 2017 (Wednesday) 08:30–17:00
- Nov. 16, 2017 (Thursday) 08:30–17:00
- Nov. 17, 2017 (Friday) 08:30–12:00

Each full registration includes USB proceedings, a welcome reception ticket, lunch tickets, and a banquet ticket.

Additional sets of USB proceedings and hardcopy proceedings may be purchased at the registration desk (100USD/700RMB for USB proceedings and 100USD/700RMB for one volume of hardcopy proceedings). In addition, each additional banquet ticket costs 60USD/400RMB.

Exhibition Information

The exhibition will be held from Nov. 15, 2017 (Wednesday) to Nov. 17, 2017 (Friday) with the following schedule:

- Nov. 14, 2017 (Tuesday) 14:00–17:00 Exhibit booth setup
- Nov. 15, 2017 (Wednesday) 08:30–17:00
- Nov. 16, 2017 (Thursday) 08:30–17:00
- Nov. 17, 2017 (Friday) 08:30–15:00
- Exhibition Area: 2nd floor by meeting rooms

Instructions for Oral and Poster Presentations

Oral Presentation:

- Oral Presentation Time: 15 minutes (including discussion).
- Each speaker is required to meet his/her session chair in the corresponding session room 10 minutes before the session starts and copy the slide file (PPT or PDF) to the session's computer.
- Please note that each session room will be equipped with an LCD projector, a screen, a pointer device, and a laptop or desktop computer with general presentation software such as Microsoft PowerPoint and Adobe Reader preinstalled. Please make sure that your files are compatible and readable with our operation system by using commonly used fonts and symbols. If you plan to use your own computer, please try the connection and make sure it works before your presentation. Make sure to bring your special connectors.

Poster Presentation:

- The author should print the poster (0.8m in width, 1.2m in height) by yourself in advance and bring it to the conference with you to the conference site for display.
- The conference will provide a poster board (0.95m in width, 2.4m in height) for each poster paper. The boards will be arranged in the order of papers in the final program. Tape and other materials will be provided on site, and volunteer-assistants will give necessary help. Posters are required to be condensed and attractive. The characters should be large enough so that they are visible from one meter away.
- Please note that during your poster session, the author should stay by your poster paper to explain and discuss your paper with visiting delegates.
- Please download and use the poster template from the conference website.

History of ICONIP

Congress	Venue	Data
The 24th International Conference on Neural Information Processing	Guangzhou, China	2017
The 23rd International Conference on Neural Information Processing	Kyoto, Japan	2016
The 22nd International Conference on Neural Information Processing	Istanbul, Turkey	2015
The 21st International Conference on Neural Information Processing	Kuching, Malaysia	2014
The 20th International Conference on Neural Information Processing	Daegu, Korea	2013
The 19th International Conference on Neural Information Processing	Doha, Qatar	2012
The 18th International Conference on Neural Information Processing	Shanghai, China	2011
The 17th International Conference on Neural Information Processing	Sydney, Australia	2010
The 16th International Conference on Neural Information Processing	Bangkok, Thailand	2009
The 15th International Conference on Neural Information Processing	Auckland, New Zealand	2008
The 14th International Conference on Neural Information Processing	Kitakyushu, Japan	2007
The 13th International Conference on Neural Information Processing	Hong Kong	2006
The 12th International Conference on Neural Information Processing	Taipei	2005

The 11th International Conference on Neural Information Processing	Calcutta, India	2004
The 10th International Conference on Neural Information Processing	Istanbul, Turkey	2003
The 9th International Conference on Neural Information Processing	Singapore	2002
The 8th International Conference on Neural Information Processing	Shanghai, China	2001
The 7th International Conference on Neural Information Processing	Taejon, Korea	2000
The 6th International Conference on Neural Information Processing	Perth, Australia	1999
The 5th International Conference on Neural Information Processing	Kitakyushu, Japan	1998
The 4th International Conference on Neural Information Processing	Dunedin, New Zealand	1997
The 3rd International Conference on Neural Information Processing	Hong Kong	1996
The 2nd International Conference on Neural Information Processing	Beijing, China	1995
The 1st International Conference on Neural Information Processing	Seoul, Korea	1994

Tutorials and Workshop

Tutorial I

Information Theoretic Learning in Pattern Classification

Baogang Hu
Institute of Automation, Chinese Academy of Sciences, China

Abstract – In this tutorial, I will start with my personal view on the study of machine learning. The issues can be considered as four modules connected in a hierarchical way as "what to learn?", "how to learn?", "what to evaluate?" and "what to adjust?". The first issue, also called "learning target selection", does not receive sufficient recognitions within our community if compared with the existing investigations on the subject of "feature selection". The tutorial will present the "information theoretical learning" (also termed ITL by Principe, et al. 2000, 2010) in relation to the issues. The objective of the tutorial is to demonstrate that ITL will not only present a fundamental understanding to the learning target selection, but also lead to new classification tools in machine learning.

The tutorial will focus on pattern classification in the basis on ITL. I will introduce the novel theory of abstaining learning for both Bayesian classifiers and mutual information classifiers. Abstaining, or a reject option in classification, is one of the most important behaviors in real-life decision making from humans, which may significantly reduce total cost or risk in applications. Based on the theory, I will introduce the cost-free learning from the real-world data sets in comparison with cost-sensitive learning. The significance of the cost-free learning is demonstrated in the background of class-imbalance problems when costs are unknown for both errors and rejects. The connections between the empirical measures and information measures are presented. The fundamental relations are upper bound and lower bound for both Bayesian error and non-Bayesian error with respect to conditional entropy in binary classifications. I will also demonstrate 24 information measures in the evaluation of abstaining binary classifications. The tutorial is concluded by the further discussions on the emergences of abstaining learning and cost-free learning in the context of "big-data" classifications.

Related Publications:

1. Hu, B.-G. and Wang, Y.: Evaluation Criteria Based on Mutual Information for Classifications Including Rejected Class. Acta Automatica Sinica, 34, 1396-1403, (2008).
2. Xing, H.-J. and Hu, B.-G.: Two-Phase Construction of Multilayer Perceptrons Using Information Theory. IEEE Transactions on Neural Networks, 20, 715-721, (2009).
3. Yuan, X.-T. and Hu, B.-G.: Robust Feature Extraction via Information Theoretic Learning, In: The 26th International Conference on Machine Learning (ICML 2009).
4. He, R., Zheng, W.-S. and Hu, B.-G.: Maximum Correntropy Criterion for Robust Face Recognition, IEEE Transactions on Pattern Analysis and Machine Intelligence. 33, 1561-1576, (2011).
5. He, R., Zheng, W.-S. and Hu, B.-G., X.-W. Kong: A Regularized Correntropy Framework for Robust Pattern Recognition. Neural Computation, 23, 2074-2100, (2011).

6. He, R., Hu, B.-G., Zheng, W.-S. and Kong, X.-W.: Robust Principal Component Analysis based on maximum Correntropy criterion. IEEE Transactions on Image Processing, 20, 1840-1494, (2011).
7. Hu, B.-G., He, R., and Yuan, X.-T.: Information-theoretic measures for objective evaluation of classifications. Acta Automatica Sinica, 38, 1160–1173, (2012).
8. Hu, B.-G.: What are the Differences between Bayesian Classifiers and Mutual-Information Classifiers?. IEEE Transactions on Neural Networks and Learning Systems, 25, 249-264, (2014).
9. Zhang, X., and Hu, B.-G.: A New Strategy of Cost-Free Learning in the Class Imbalance Problem. IEEE Transactions on Knowledge and Data Engineering, 26, 2872-2885, (2014).
10. He, R., Hu, B.-G., Yuan, X.-T., and Wang, L.: Robust Recognition via Information Theoretic Learning, Springer, (2014).
11. Hu, B.-G.: Information Theory and its Relation to Machine Learning. http://arxiv.org/abs/1501.04309, (2015).
12. Hu B.-G., and H.-J. Xing: An Optimization Approach of Deriving Bounds between Entropy and Error from Joint Distribution: Case Study for Binary Classifications. Entropy, 18, 1-19, (2016).

Dr. Bao-Gang Hu is currently a full Professor with NLPR (National Laboratory of Pattern Recognition), Institute of Automation, Chinese Academy of Sciences, Beijing, China. He received his M.S. degree from the University of Science and Technology, Beijing, China in 1983, and his Ph.D. degree from McMaster University, Canada in 1993. From 2000 to 2005, he was the Chinese Director of LIAMA (the Chinese-French Joint Laboratory supported by CAS and INRIA). His current research interests are pattern recognition and computer modeling.

Tutorial II

Automatic Determination of Multi-layer Perception Neural Net Structure with Pseudoinverse Learning Algorithm

Ping Guo
Beijing Normal University, China

Abstract – This tutorial includes the following objectives:

- Provide attendees with understanding of multi-layer perception (MLP) and stacked auto-encoders neural networks;
- Introduce one of the non-gradient descent algorithm – PseudoInverse Learning (PIL) algorithm;
- Learn how to choose the number of layer (deep) and hidden neuron (wide) of MLP neural networks;
- Understand the "divide and conquer" strategy for large scale data sets.

Ping Guo, IEEE and CCF senior member, Professor of School of Systems Sciences at Beijing Normal University, PhD advisor of School of Computer Science at Beijing Institute of Technology, Director of Image Processing & Patter Recognition Lab at Beijing Normal University, IEEE CIS Beijing Chapter Chair（2015–2016）. His research interesting includes computational intelligence theory and applications to pattern recognition, image processing, software reliability engineering, Astronomical big data analysis etc. He has published over 300 papers, two books entitled "Computational intelligence in software reliability engineering" and "Image semantic analysis", respectively. He is also received Science & Technology Award of 2012 Beijing Peoples' Government in "Studies of Regularization Method and their Applications". (Third Rank).

Dr. Ping Guo got his Master degree in Optics from the Department of Physics at Peking University, and the Ph.D. in Computer Science at the Chinese University of Hong Kong.

Tutorial III

Tensor Networks and Neural Networks

Zonglin Xu
University of Electronic Science & Technology, China

Abstract – In the big data area, multiway data are almost everywhere, e.g., recommendation systems, face recognition, sensor networks, etc. Tensor factorization is an important approach to multiway data analysis. The first part of this tutorial will first introduce canonical methods as well as recent developments of tensor factorization.

The second part will also generalize tensor decomposition methods to tensor networks and discuss the connections between tensor networks and deep neural networks.

Zenglin Xu is a Professor in School of Computer Science and Engineering at University of Electronic Science and Technology of China (UESTC). He is the founder and director of the Statistical Machine Intelligence and Learning (SMILE) Lab. He is a recipient of China Thousand Talents (Youth) Program. He obtained his PhD in Computer Science and Engineering from the Chinese University of Hong Kong. His research interest includes machine learning and its applications on social network analysis, health informatics, and cyber security analytics. He has published over 50 papers in prestigious journals and conferences such as NIPS, ICML, IJCAI, AAAI, IEEE PAMI, IEEE TNN, etc. He is also the recipient of the APNNS young researcher award, and the best student paper honorable mention of AAAI 2015. Dr. Xu has been a PC member or reviewer to a number of top conferences such as NIPS, ICML, AAAI, IJCAI, etc. He regularly servers as a reviewer to IEEE TPAMI, JMLR, PR, IEEE TNN, IEEE TKDD, ACM TKDD, etc.

Tutorial IV

Spiking Neural Networks and Deep Learning of Temporal and Spatio-Temporal Data

Nikola Kasabov
Auckland University of Technology, New Zealand

Abstract – The current development of the third generation of artificial neural networks - the spiking neural networks (SNN) along with the technological development of highly parallel hardware systems, makes it possible to learn complex temporal or spatio-temporal data in a more efficient, brain-like way and to predict future events [1,2].

The tutorial presents first fundamental principles of learning in SNN, including: spike data encoding; unsupervised and supervised learning in SNN; SNN for classification and regression. Then the talk introduces some brain-like SNN architectures and the principles of deep learning in them illustrated with an implementation, dubbed NeuCube [3,4]. Deep learning in a SNN does not require a fixed multilayer structure to be defined in advance and many iterations of training in this structure as it is the case with the current deep neural networks. The talk introduces also a methodology for the design and implementation of SNN application systems for deep learning, pattern recognition and predictive data modelling on temporal or spatio/spectro temporal data [5,11]. As an example, a SNN development system has been created for the development and testing of SNN application systems for temporal or spatio/spectro temporal data across domain areas [5,11] (http://www.kedri.aut.ac.nz/neucube/).

The deep learning approach with SNN is illustrated on benchmark problems and data with different characteristics and applications: brain data modelling in neuroinformatics; personalised modelling and event prediction in bioinformatics and neuroinformatics; brain-computer interfaces; multisensory data analysis and pattern recognition in real time, such as air pollution sensors and seismic sensors, predictive modelling of financial time series, deep learning of audio-visual data, fast moving object recognition, and others. The talk discusses parallel implementations of SNN systems on various computational platforms, including: PCs; GPUs; tensor flow machines; highly parallel neuromorphic hardware platforms [7, 8]. Such SNN applications are not only significantly more accurate and faster than traditional machine learning systems, including the current deep neural networks, but they lead to a significantly better understanding of the data and the processes that generated it and to a flexible, adaptive learning for on-line applications. New directions for the development of SNN systems are pointed towards a further integration of principles from the science areas of computational intelligence, bioinformatics and neuroinformatics and new applications across domain areas [9,10].

Related Publications:

1. EU Marie Curie EvoSpike Project (Kasabov, Indiveri): http://ncs.ethz.ch/projects/EvoSpike/
2. Schliebs, S., Kasabov, N.: Evolving spiking neural network-a survey. Evolving Systems, 4(2), 87-98, (2013).

3. Kasabov, N. NeuCube: A Spiking Neural Network Architecture for Mapping, Learning and Understanding of Spatio-Temporal Brain Data, Neural Networks, 52, 62-76 (2014).
4. Kasabov, N., Dhoble, K., Nuntalid, N., Indiveri, G.: Dynamic evolving spiking neural networks for on-line spatio- and spectro-temporal pattern recognition. Neural Networks, 41, 188-201, (2013).
5. Kasabov, N. et al.: A SNN methodology for the design of evolving spatio-temporal data machines, Neural Networks, 78, 1-14, (2016).
6. Kasabov, N., et al.: Evolving Spiking Neural Networks for Personalised Modelling of Spatio-Temporal Data and Early Prediction of Events: A Case Study on Stroke. Neurocomputing, 134, 269-279, (2014).
7. Furber, S. et al.: Overview of the SpiNNaker system architecture, IEEE Transactions on Computers, 62(12): 2454-2467, (2013).
8. Indiveri, G., Horiuchi, T.K. Frontiers in neuromorphic engineering, Frontiers in Neuroscience, 5, (2011).
9. Kasabov, N.: The Springer Handbook of Bio- and Neuroinformatics, Springer, (2014).
10. Kasabov, N.: Spiking Neural Networks and Deep Learning of Temporal and Spatio-Temporal Data, Springer, (2017).

Professor Nikola Kasabov is Fellow of IEEE, Fellow of the Royal Society of New Zealand, DVF of the Royal Academy of Engineering and the Scottish Infortmatics and Computing Association. He is the Director of the Knowledge Engineering and Discovery Research Institute (KEDRI), Auckland and Professor at the School of Engineering, Computing and Mathematical Sciences at Auckland University of Technology. Kasabov is a Past President and Governor Board member of the International Neural Network Society (INNS) and also of the Asia Pacific Neural Network Society (APNNS). He is a member of several technical committees of IEEE Computational Intelligence Society and a Distinguished Lecturer of the IEEE CIS (2012-2014). He is a Co-Editor-in-Chief of the Springer journal Evolving Systems and serves as Associate Editor of Neural Networks, IEEE TrNN, IEEE Tr CDS, Information Science, Applied Soft Computing and other journals. Kasabov holds MSc and PhD from the TU Sofia, Bulgaria. His main research interests are in the areas of neural networks, intelligent information systems, soft computing, bioinformatics, neuroinformatics. He has published more than 600 publications that include 12 books, 180 journal papers, 80 book chapters, 28 patents and numerous conference papers. His work has been sited more than 12,000 times, with an H-factor of 48. He has extensive academic experience at various academic and research organizations in Europe and Asia, including: TU Sofia, University of Essex UK, University of Otago, Advisor Professor at the Shanghai Jiao Tong University, Visiting Professor at ETH/University of Zurich and the RGU, UK. Prof. Kasabov has received a number of awards, among them: the APNNA 'Outstanding Achievements Award'; the INNS Gabor Award for 'Outstanding contributions to engineering applications of neural networks'; the EU Marie Curie Fellowship; the Bayer Science Innovation Award; the APNNA Excellent Service Award; the RSNZ Science and Technology Medal, and others. He has supervised to completion 48 PhD students. More information of Prof. Kasabov can be found on the KEDRI web site: http://www.kedri.aut.ac.nz

Tutorial V

Signal Processing and Machine Learning for Brain-Computer Interfaces

Dongrui Wu[1], Zhaohong Deng[2], and Kup-Sze Choi[3]
[1]Huazhong University of Science and Technology, China
[2]Jiangnan University, China
[3]Hong Kong Polytechnic University, China

Abstract – Brain-computer interfaces (BCIs) can use brain signals such as the scalp electroencephalogram (EEG) to enable people to communicate or control external devices. Thus, they can help people with devastating neuromuscular disorders such as amyotrophic lateral sclerosis, brainstem stroke, cerebral palsy, and spinal cord injury. However, there are still many challenges in their transition from laboratory settings to real-life applications, including the reliability and convenience of the sensing hardware, and the availability of high-performance and robust algorithms for signal analysis and interpretation.

This tutorial will focus on the latter challenge. We will introduce the basic concept of BCIs, their applications, and some recent advances in signal processing and machine learning for BCIs, including:

- Signal processing: spatial and temporal filtering
- Feature extraction: Riemannian geometry features
- Machine learning: active learning, deep learning, transfer learning, ensemble learning, fuzzy logic, etc.
- Their applications in both BCI classification and regression problems.

Related Publications:

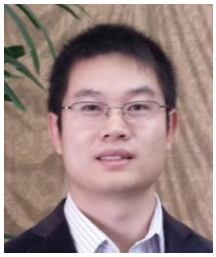
1. D. Wu, B. J. Lance, V. J. Lawhern, Stephen Gordon, Tzyy-Ping Jung and Chin-Teng Lin: EEG-Based User Reaction Time Estimation Using Riemannian Geometry Features. IEEE Transactions on Neural Systems and Rehabilitation Engineering, accepted, (2017).
2. D. Wu, J-T King, C-C Chuang, C-T Lin and T-P Jung: Spatial Filtering for EEG-Based Regression Problems in Brain-Computer Interface (BCI). IEEE Transactions on Fuzzy Systems, accepted, (2017).
3. D. Wu, V. Lawhern, S. Gordon, B. Lance and C-T Lin: Driver Drowsiness Estimation from EEG Signals Using Online Weighted Adaptation Regularization for Regression (OwARR). IEEE Transactions on Fuzzy Systems, in press, (2017).
4. D. Wu, :Online and Offline Domain Adaptation for Reducing BCI Calibration Effort. IEEE Transactions on Human-Machine Systems, 47 (4), 550-563, (2017).
5. D. Wu, V. Lawhern, D. Hairston and B. Lance: Switching EEG Headsets Made Easy: Reducing Offline Calibration Effort Using Active Weighted Adaptation Regularization. IEEE Transactions on Neural Systems and Rehabilitation Engineering, 24(11), 1125-1137, (2016).
6. Marathe, V. Lawhern, D. Wu, D. Slayback and B. Lance: Improved Neural Signal

Classification in a Rapid Serial Visual Presentation Task using Active Learning. IEEE Transactions on Neural Systems and Rehabilitation Engineering, 24(3), 333-343, (2016).

7. D. Wu, B. Lance, and T.D. Parsons: Collaborative Filtering for Brain-Computer Interaction Using Transfer Learning and Active Class Selection. PLoS ONE, 8(2), e56624 , (2013).
8. D. Wu: Active Semi-supervised Transfer Learning (ASTL) for Offline BCI Calibration. In: IEEE Int'l. Conf. on Systems, Man and Cybernetics, Banff, Canada, (2017).
9. D. Wu, V. Lawhern, S. Gordon, B. Lance and C-T Lin: Offline EEG-Based Driver Drowsiness Estimation Using Enhanced Batch-Mode Active Learning (EBMAL) for Regression. In: IEEE Int'l. Conf. on Systems, Man and Cybernetics, pp.730-736, Budapest, Hungary, (2016).
10. D. Wu, V. Lawhern, S. Gordon, B. Lance and C-T Lin: Spectral Meta-Learner for Regression (SMLR) Model Aggregation: Towards Calibrationless Brain-Computer Interface (BCI). In: IEEE Int'l. Conf. on Systems, Man and Cybernetics, pp. 743-749, Budapest, Hungary, (2016).
11. Yizhang Jiang, Zhaohong Deng, Fu-Lai Chung, Guanjin Wang, Pengjiang Qian, Kup-Sze Choi, Shitong Wang: Recognition of Epileptic EEG Signals Using a Novel Multiview TSK Fuzzy System. IEEE Trans. Fuzzy Systems, 25(1), 3-20, (2017).
12. Changjian Yang, Zhaohong Deng, Kup-Sze Choi, Shitong Wang: Takagi-Sugeno-Kang Transfer Learning Fuzzy Logic System for the Adaptive Recognition of Epileptic Electroencephalogram Signals. IEEE Trans. Fuzzy Systems, 24(5), 1079-1094, (2016).
13. Changjian Yang, Zhaohong Deng, Kup-Sze Choi, Yizhang Jiang, Shitong Wang: Transductive domain adaptive learning for epileptic electroencephalogram recognition. Artificial Intelligence in Medicine, 62(3), 165-177, (2014).
14. Guanjin Wang, Zhaohong Deng, Kup-Sze Choi: Detection of epilepsy with Electroencephalogram using rule-based classifiers. Neurocomputing, 228, 283-290, (2017).
15. Y. Jiang, Z. Deng, F.L. Chung, G. Wang, P. Qian, K.S. Choi, S. Wang: Recognition of Epileptic EEG Signals Using a Novel Multi-View TSK Fuzzy System. IEEE Transactions on Fuzzy Systems, 25(1), 3-20, (2017).
16. G. Wang, Z. Deng, K.S. Choi: Detection of epilepsy with Electroencephalogram using rule-based classifiers. Neurocomputing, 228, 283-290, (2017).
17. S. Liang, K.S. Choi, J. Qin, W.M. Pang, P.A. Heng.: Enhancing training performance for brain-computer interface with object-directed 3D visual guidance. International Journal of Computer Assisted Radiology and Surgery, 11(11), 2129-2137, (2016).
18. S. Liang. K.S. Choi, J. Qin, W.M. Pang, P.A. Heng: Improving the discrimination of hand motor imagery via virtual reality based visual guidance. Computer Methods and Programs in Biomedicine, 132, 63-74, (2016).
19. S. Liang, K.S. Choi, J. Qin, W.M. Pang, P.A. Heng: Discrimination of motor imagery tasks via information flow pattern of brain connectivity. In: The 4th International Conference

on Biomedical Engineering and Biotechnology (ICBEB 2015), Shanghai, China, 18-21, (2015). (Technology and Health Care, 24(s2), S795-S801, (2016)).

20. G. Wang, Z. Deng, K.S. Choi: Detection of Epileptic Seizure in EEG Signals with Rule-based Interpretation by Random Forest Approach. In: International Conference on Intelligent Computing (ICIC2015), Fuzhou, China, 20-23, (2015).
21. S. Liang, K.S. Choi, J. Qin, W.M. Pang, P.A. Heng: Effective user training for motor imagery based brain computer interface with object-directed 3D visual display. In: The 7th International Conference on Biomedical Engineering and Informatics (BMEI), Dalian, China, pp. 297-301, (2014).
22. S. Liang, K.S. Choi, J.Qin, W.M. Pang, P.A. Heng: Classification of motor imagery tasks using phase synchronization analysis of EEG based on multivariate empirical mode decomposition. In: The 4th IEEE International Conference on Information Science and Technology (ICIST 2014), Shenzhen, Guangdong, P.R. China, pp. 674-677, (2014).
23. K.S. Choi, Y. Zeng, J. Qin: Using sequential floating forward selection algorithm to detect epileptic seizure in EEG signals. In: The 11th International Conference on Signal Processing, Beijing, China, (2012).



Dr. Dongrui Wu received a B.E in Automatic Control from the University of Science and Technology of China in 2003, an M.Eng in Electrical and Computer Engineering from the National University of Singapore in 2005, and a PhD in Electrical Engineering from the University of Southern California (USC) in 2009. He was a Research Associate in the USC Institute for Creative Technologies and Signal Analysis and Interpretation Laboratory, a Lead Research Engineer in the Machine Learning Lab, GE Global Research, Niskayuna, NY, and Chief Scientist of several startups. He is now a Professor at the School of Automation, Huazhong University of Science and Technology, Wuhan, China.

Prof. Wu's research interests include affective computing, brain-computer interface, computational intelligence, and machine learning. He has over 90 publications (4100+ Google Scholar citations, h=34), including a book “Perceptual Computing” (Wiley-IEEE, 2010). He received IEEE International Conference on Fuzzy Systems Best Student Paper Award in 2005, IEEE Computational Intelligence Society (CIS) Outstanding PhD Dissertation Award in 2012, IEEE Transactions on Fuzzy Systems Outstanding Paper Award in 2014, and North American Fuzzy Information Processing Society (NAFIPS) Early Career Award in 2014. He was a finalist of IEEE Transactions on Affective Computing Most Influential Paper Award in 2015, and IEEE Brain Initiative Best Paper Award in 2016.

Prof. Wu is an Associate Editor of *IEEE Transactions on Fuzzy Systems* (2011-), *IEEE Transactions on Human-Machine Systems* (2014-), and *IEEE Computational Intelligence Magazine* (2017-). He was the lead Guest Editor of the IEEE Computational Intelligence Magazine Special Issue on Computational Intelligence and Affective Computing, and the lead Guest Editor of the IEEE Transactions on Fuzzy Systems Special Issue on Brain Computer Interface. He is a Senior Member of IEEE, an Executive Committee member of the Association for the Advancement of

Affective Computing (AAAC), a Board member of the NAFIPS, and a member of IEEE Systems, Man and Cybernetics Society Brain-Machine Interface Systems Technical Committee, IEEE CIS Fuzzy Systems Technical Committee, Emergent Technologies Technical Committee, and Intelligent Systems Applications Technical Committee. He has been Chair/Vice Chair of the IEEE CIS Affective Computing Task Force since 2012.

Dr. Zhaohong Deng received a Ph.D. degree in industry information technology and engineering from Jiangnan University, Wuxi, China, in 2008. He is currently a Professor in the School of Digital Media, Jiangnan University. His current research interests include uncertain and interpretable intelligent model, fuzzy systems, neural computing, and their applications in biochemical process modeling and biomedical signal processing. He is an Associate Editor of five international journals including Neurocomputing and PLOS ONE. He has published over 100 papers in international/national journals, including 22 papers in ACM/IEEE Transactions.

Dr. CHOI Kup-Sze (Thomas) received a B.Sc.(Hons) degree in Applied Physics, an M.Phil. degree in Electronic Engineering and a Ph.D. degree in Computer Science and Engineering. He is currently an Associate Professor of the School of Nursing, The Hong Kong Polytechnic University, as well as the Director of the Centre for Smart Health and the PolyU-Henry G. Leong Mobile Integrative Health Centre. Thomas has been engaging in multidisciplinary research in health care since 2000. His research interests include virtual reality and artificial intelligence, developing healthcare innovations in medicine, nursing and rehabilitation. His invention of haptic platform for occupational rehabilitation won a silver medal in the 42nd International Exhibition of Innovations of Geneva, Switzerland, 2014. He has recently started a new line of research in electroencephalography and brain-computer, aiming to capitalize on the technologies of virtual reality, haptics and machine learning to develop practical applications for health care purposes.

Workshop

Data Mining and Cybersecurity

Organizers: **Kaizhu Huang, Paul Pang, Tao Ban, Youki Kadobayashi, Jungsuk Song, Geong Sen Poh and Iqbal Gondal**

Abstract – CyberSecurity landscape is complex especially with massive data produced and innovation must continue. Changes in Cybersecurity require new types of skills in data science and analytics. Artificial Intelligence is a burgeoning industry, because it increases the efficiency and precision of tasks through machine learning and data analytics. With humans able to accomplish more work in less time, they are free to explore other domains. The purpose of the 10th International Data Mining and Cybersecurity Workshop (DMC2017) is to raise the awareness of cybersecurity, promote the potential of industrial applications, and give young researchers exposure to the main issues related to the topic and to ongoing works in this area. DMC 2017 will provide a forum for researchers, security experts, engineers, and students to present latest research, share ideas, and discuss future directions in the fields of data mining and cybersecurity.

In association to DMC2017, we have the 8th international Cybersecurity Data Mining Competition (CDMC2017) focusing on application of knowledge discovery techniques to solve advanced, real-world problems for Cybersecurity. The competition is open to multi-person teams worldwide. Contestants are invited to participate in solving a set of problems in fields of cybersecurity, text mining, image and pattern recognition, etc. For more information, including registration details, detailed problem descriptions, and contest rules please refer to our official contest website http://www.csmining.org/

Serving as a forum to bring together experts in the computational intelligence disciplines and researchers from the information security community, DCM2017 coupled with CDMC2017 competition presents the latest developments in the area of computational Intelligence for Cybersecurity, fostering computing technologies to counterattack emerging cyber threats. The event was initially originated as a special session at International Conference on Neural Information Processing (ICONIP2008) in New Zealand and ICONIP2009 in Bangkok. During the past years, we had DMC2011 in Hangzhou China, DM2012 in Doha Qatar, DMC2013 in Daegu South Korea, DMC2014 in Kuala Lumpur Malaysia, DMC2015 in Istanbul Turkey and DMC2016 in Kyoto Japan, respectively.

We look forward to having DMC2017 in Guangzhou China. In addition, we have AI x CyberSecurity Summit (ACSS 2017) as a special engagement of academia, industry and venture capital, which will be held on November 10 at Xi'an Jiaotong-Liverpool University. Please find the details of ACSS2017 via http://acss.csmining.org/.

Session 1 on Nov. 15, Room: Zhujiang 2 (3rd floor) / 三楼珠江 2 厅

1:30PM **Invited Talk**: *Randomized Algorithms for Efficient Learning with Big Data*

Irwin King

2:15PM *Winner Presentation of CDMC Competition*

To Be Announced

2:45PM *A Bayesian Posterior Updating Algorithm in Reinforcement Learning*

Fangzhou Xiong, Zhiyong Liu, Xu Yang, Biao Sun, Charles Chiu and Hong Qiao

3:00PM *A Linear Online Guided Policy Search Algorithm*

Biao Sun, Fangzhou Xiong, Zhiyong Liu, Xu Yang and Hong Qiao

3:15PM *Detection of Botnet Activities through the Lens of A Large-Scale Darknet*

Tao Ban, Lei Zhu, Jumpei Shimamura, Shaoning Pang, Daisuke Inoue and Koji Nakao

Session 2 on Nov. 16, Room: Zhujiang 2 (3rd floor) / 三楼珠江 2 厅

1:30PM **Invited Talk**: *The detection possibility of Cyber-threats using big data analysis and machine learning.*

Yuji Sekiya

2:15PM *Deep Mixtures of Factor Analyzers with Common Loadings: A Novel Deep Generative Approach to Clustering*

Xi Yang, Kaizhu Huang and Rui Zhang

2:30PM *Improve Deep Learning with Unsupervised Objective*

Shufei Zhang, Kaizhu Huang, Rui Zhang and Amir Hussain

2:45PM *Class-wised Image Enhancement for Moving Object Detection at Maritime Boat Ramps*

Jing Zhao, Shaoning Pang, Bruce Hartill and Sarrafzadeh Hossein

3:00PM *AI Web-Contents Analyzer for Monitoring Underground Marketplace*

Yuki Kawaguchi, Akira Yamada and Seiichi Ozawa

3:15PM *Detecting Black IP using for Classification and Analysis through Source IP of Daily Darknet Traffic*

Jinhak Park, Jangwon Choi, Jungsuk Song

Plenary and Invited Lectures

Plenary Lecture I

Distributed Learning and Consensus Formation with Dynamic Networks

Tamer Başar
University of Illinois at Urbana-Champaign, USA

Abstract – For a number of years now, there has been growing interest in developing algorithms for information processing and distribution, and computation in multi-agent systems, with interactions among agents taking place within neighborhoods over a network topology. Recently, distributed computation, learning and decision making problems of all types have arisen naturally, such as consensus problems, multi-agent coverage problems, rendezvous problems, multi-sensor localization, clock synchronization, and multi-robot formation control. They have found applications in different fields, including sensor networks, robotic teams, social networks (such as Google's PageRank), and electric power grids. This plenary talk will provide an overview of this development, focusing on distributed computation and learning as it applies to consensus problems. In a typical consensus process, the agents in a given group all try to agree on some quantity by communicating what they know only to their neighboring agents, dictated by an underlying network, whose associated graph could be time varying. A particular type of consensus process is the so-called distributed (belief) averaging (DA), where the goal is to compute the average of some values of a quantity of interest to the agents. The talk will present several recent results that pertain to DA, under different scenarios, such as constraints on communication and/or information processing capabilities of neighborhood agents (such as bandwidth and compute constraints, leading to quantized iterations), or flow of private streaming data to agents. One of the specific applications of the latter, that will be discussed, is distributed on-line parametric learning in a multiagent network, which constitutes an improved alternative to decentralized machine learning with no central agent to distribute the incoming stream of data. The talk will conclude with a brief discussion of some open problems in this general area.

Tamer Basar received B.S.E.E. degree from Robert College, Istanbul, in 1969, and M.S., M.Phil, and Ph.D. degrees in engineering and applied science from Yale University, in 1970, 1971 and 1972, respectively. He joined the University of Illinois at Urbana-Champaign (UIUC) in 1981, where he is with the Department of Electrical and Computer Engineering, is the Director of the Center for Advanced Study, and carries the academic titles of Swanlund Endowed Chair, Center for Advanced Study Professor of Electrical and Computer Engineering, Professor at the Coordinated Science Laboratory, Professor with the Information Trust Institute, and Affiliate Professor at the Department of Mechanical Science and Engineering. He has spent sabbatical years at Twente University of Technology (the Netherlands; 1978-79), and INRIA (France; 1987-88, 1994-95). Dr. Basar has authored or co-authored over 750 publications in the general areas of optimal, robust, and adaptive control; large-scale and decentralized systems and control; dynamic games; stochastic control; estimation theory; stochastic

processes; information theory; communication systems and networks; security and trust; and mathematical economics. His current research interests include stochastic teams and games; routing, pricing, and congestion control in communication networks; control over wired and wireless networks; sensor networks; formation in adversarial environments; mobile and distributed computing; risk-sensitive estimation and control; mean-field game theory; game-theoretic approaches to security in computer networks, including intrusion detection and response; energy systems, including the smart grid; social networks; and cyber-physical systems. Tamer Basar is a member of the National Academy of Engineering (of the USA). He was elected a Fellow of IEEE in 1983, and has served its Control Systems Society in various capacities, among which are: Past President (2001), President (2000), President-Elect (1999), Vice-President for Financial Affairs (1998), Vice-President for Publications (1997), the Editor for Technical Notes and Correspondence for its Transactions on Automatic Control (1992-1994), and as the general chairman (1992) and program chairman (1989) of its flagship conference (Conference on Decision and Control). He has also been active in IFAC (International Federation of Automatic Control), in the organization of several workshops and symposia, and as Editor and Deputy Editor-in-Chief of its flagship journal Automatica Automatica, from 1992 until 2003, and Editor-in-Chief and Chair of its editorial board from 2004 until 2014. During the period 1990-1994, he was the President of the International Society of Dynamic Games (ISDG) , and is currently the Series Editor of the Annals of ISDG (published by Birkhäuser), the Series Editor of Systems & Control: Foundations and Applications (published by Birkhäuser), the Series Editor of Static and Dynamic Game Theory: Foundations and Applications, an Editor of SpringerBriefs in Electronic and Computer Engineering: Control, Automation and Robotics, and Honorary Editor of Applied and Computational Mathematics. He is also on the editorial and advisory boards of a number of other international journals. He was the President of the American Automatic Control Council (2010-2011), Past President of AACC (2012-2013), and a member of the IFAC Council (2011-2014). Currently, he is the Chair of the Publications Committee of IFAC. Among some of the honors and awards he has received are (in reverse chronological order): IEEE Control Systems (Technical Field) Award (2014), Richard E. Bellman Control Heritage Award of the American Automatic Control Council (2006), Giorgio Quazza Medal of IFAC (2005), Outstanding Service Award of IFAC (2005), IFAC Fellow (2005), Center for Advanced Study Professorship at UIUC (2005), Hendrik W. Bode Lecture Prize of the IEEE Control Systems Society (2004), Tau Beta Pi Daniel C. Drucker Eminent Faculty Award of the College of Engineering of UIUC (2004), election to the National Academy of Engineering (of the USA) (2000), IEEE Millennium Medal (2000), Fredric G. and Elizabeth H. Nearing Distinguished Professorship at UIUC (1998), Axelby Outstanding Paper Award (1995) and Distinguished Member Award (1993) of the IEEE Control Systems Society, and Medal of Science of Turkey (1993).

Plenary Lecture II

Model-Driven Deep Learning

Zongben Xu
Xi'an Jiaotong University, China

Abstract – Deep learning (DL) has becoming a powerful, standard AI technology which helps to yield increasingly breakthroughs of learning system applications. As a representative of data driven approach, it faces however many challenges like contradictions between standardization and personalization, versatility and efficiency, the difficulties in design, anticipation and explanation for the results, and the serious dependence upon the amount and quality of training samples. On the other hand, the model-driven approach provides another learning paradigm that bases on the physical mechanism and prior modeling, which has the characteristics of determinacy and optimality while meets with obstacle of impossibility of precise modeling. In this talk we propose and formalize a data & model dual-driven learning approach, which define then the model driven deep learning (MDDL).

The model driven deep learning start with construction of a Model Family (MF), which is a rough description of solution of the problem under consideration, followed then by the design of an Algorithm Family (AF) which is a collection of iterations whose limit give the solution of the model family. The Algorithm Family then unfolded into Deep Architecture (DA) with which learning can be performed. We provide examples to substantiate the effectiveness and superiority of the MDDL over others. We particularly show the following advantages of MDDL: It recedes the requirement for precise modeling in model-driven learning, provides the sound methodology for the DL network design, making it easy to incorporate into prior knowledge to make DL more efficient, designable, predictable and interpretable, and also significantly reduce the number of samples needed for DL training. Based on this study, we conclude that MDDL has great potential in the future DL research and applications.

Zong-Ben Xu received his PhD degree in Mathematics in 1987 from Xi`an Jiaotong University, China. In 1998, he was a postdoctoral Research Fellow in the Department of Mathematics, The University of Strathclyde. He worked as a Research Fellow in the Department of Computer Science and Engineering from 1992 to 1994, and 1996 to 1997, at The Chinese University of Hong Kong; a visiting professor in the University of Essex in 2001, and Napoli University in 2002. He has been with the School of Mathematics and Statistics, Xi`an Jiaotong University since 1982, where he served as a professor of mathematics and computer science, Dean of Sciences (1997-2003), and VP of the university (2003-2014). From 2007 on, he was appointed as a Chief Scientist of National Basic Research Program of China (973 Project). and the Principle Scientist of Beijing Research Center for Mathematical and Information Sciences.

Professor Xu currently makes several important services for government and professional societies, including Consultant Expert for National (973) Program in Key Basic Science Research and Development (Information group), Ministry of Science and Technology of China; Evaluation Committee Member for Mathematics Degree, Academic Degree Commission of the Chinese Council; Committee Member in Scientific Committee of Education Ministry of China (Mathematics

and Physics Group); Director of the Teaching Guidance Committee for Mathematical Education in Universities, the Education Ministry of China; Chairman of the Expert Evaluation Committee for Natural Science Foundation of China (Applied Mathematics group); Editor-in-chief of the Textbooks on Information and Computational Sciences, Higher Education Press of China; Co-editor of more than 10 international journals.

Professor Xu has published over 280 academic papers on nonlinear functional analysis, optimization, intelligent information processing and machine learning, most of which are in international journals. His current research interests include sparsity modeling, machine learning and big data research. Professor Xu holds the title "Owner of Chinese PhD Degree Having Outstanding Achievements" awarded by the Chinese State Education Commission (CSEC) and the Academic Degree Commission of the Chinese Council in 1991. He is owner of the National Natural Science Award of China in 2007， and winner of CSIAM Su Buchin Applied Mathematics Prize in 2008. He delivered a 45 minute talk at the International Congress of Mathematicians (ICM 2010) upon the invitation of the congress committee. He was elected as a member of Chinese Academy of Science in 2011.

Plenary Lecture III

Beyond Deep Learning and Brain Research

Paul J. Werbos
Retired from the National Science Foundation, USA

Abstract – For many decades, mainstream AI refused to believe that deep learning with neural networks and backpropagation offer true brain-like general intelligence, despite numerous successes on tough engineering problems and mathematical advances. The tide changed in 2009 due to a $2 million grant I gave to Ng and LeCun, despite fierce objections which in today's government environment would have prevented the action. Empirical success on well-known challenge problems led to follow-ons by DARPA, then by Google, and then a flood of interest by competitors trying to keep up. This past year, new analysis of the best time-series data available for the brain shows that it fits the core principles of backpropagation and deep learning much better than it fits the Hebbian and spiking types of model inherited from the previous century. As the flood of deep learning, internet of things, RNN, BCI, CNN and security technology grows, it may grow out of control. It is urgent that we move quickly to develop and implement additional new technologies and paradigms, lest the current imbalances and instabilities engulf us all.

Paul J. Werbos received the B.A., M.Sc., and S.M. degrees in mathematical physics, international political economy, and economics from Harvard University, Cambridge, MA, and the London School of Economics, UK, in 1967,1968, and 1969, respectively, and the Ph.D. degree in applied mathematics from Harvard University. He is currently the Program Director for computational intelligence with the National Science Foundation, Arlington, VA, and seeks more proposals in that area. In his 1967 paper in Cybernetica, he first proposed the idea of approximating dynamic programming as a way to improve reinforcement learning, which is the key theme of the new book Handbook of Learning and Approximate Dynamic Programming (Wiley-IEEE Press, 2004). He is also best known for his 1974 Harvard University Ph.D. thesis, which first described the process of training artificial neural networks through backpropagation of errors. Dr. Werbos represents the Computational Intelligence Society on the IEEE-USA Energy Policy Committee and serves on the governing boards of International Neural Network Society, the IEEE Industrial Electronics Society, and the Millennium Project of the United Nations University, Tokyo, Japan. He was the recipient of the IEEE Neural Net Pioneer Award for the original invention of backpropagation.

Plenary Lecture IV

Deep Neural Networks for Supervised Speech Separation

DeLiang Wang
The Ohio State University, USA

Abstract – Speech separation, or the cocktail party problem, has evaded a solution for decades in speech and audio processing. Motivated by auditory perception, I have been advocating a new formulation to this old challenge that estimates an ideal time-frequency mask (binary or ratio). This new formulation has an important implication that the speech separation problem is open to modern machine learning techniques, and deep neural networks (DNNs) are particularly well-suited for this task due to their representational capacity. I will describe recent algorithms that employ DNNs for supervised speech separation. DNN-based mask estimation elevates speech separation performance to a new level, and produces the first demonstration of substantial speech intelligibility improvements for both hearing-impaired and normal-hearing listeners in background noise. These advances represent major progress towards solving the cocktail party problem.

Deliang Wang received the B.S. and M.S. degrees from Peking (Beijing) University, Beijing, China, in 1983 and 1986, respectively, and the Ph.D. degree from the University of Southern California, Los Angeles, CA, USA, in 1991, all in computer science. He was with the Institute of Computing Technology, Academia Sinica, Beijing, from 1986 to 1987. He has been with the Department of Computer Science and Engineering and the Center for Cognitive and Brain Sciences with The Ohio State University, Columbus, OH, USA, since 1991, where he is currently a Professor. He has been a Visiting Scholar with Harvard University, Oticon A/S (Denmark), Starkey Hearing Technologies, and Northwestern Polytechnical University (China). Dr. Wang's research interests include machine perception and neurodynamics. Among his recognitions are the Office of Naval Research Young Investigator Award in 1996, the 2005 Outstanding Paper Award from the IEEE Transactions on Neurak Networks, and the 2008 Helmholtz Award from the International Neural Network Society. In 2014, he was named University Distinguished Scholar by Ohio State University. He is the Co-Editor-in-Chief of Neural Networks.

Plenary Lecture V

What Can We further Learn from the Brain?

Kenji Doya
Okinawa Institute of Science and Technology Graduate University, Japan

Abstract – Deep learning is a prime example of how brain-inspired computing architecture can benefit artificial intelligence. But what else can we learn from the brain for bringing artificial intelligence to the next level? The brain can be seen as a multi-agent system composed of heterogeneous learners using different representations and algorithms. In navigation and control, the use of allocentric, egocentric, and intrinsic state representations offer different advantages. In reinforcement learning, the choice or mixture of model-free and model-based algorithms critically affects data efficiency and computational costs. Animals and humans appear to be able to utilize multiple representations and algorithms in highly flexible ways. How the brain realizes flexible selection and combination of relevant modules for a given situation is a major open problem in neuroscience and its solution should help developments of more flexible, general artificial intelligence.

Kenji Doya took BS in 1984, MS in 1986, and Ph.D. in 1991 at U. Tokyo. He became a research associate at U. Tokyo in 1986, U. C. San Diego in 1991, and Salk Institute in 1993. He joined Advanced Telecommunications Research International (ATR) in 1994 and became the head of Computational Neurobiology Department, ATR Computational Neuroscience Laboratories in 2003. In 2004, he was appointed as the Principal Investigator of Neural Computation Unit, Okinawa Institute of Science and Technology (OIST) and started Okinawa Computational Neuroscience Course (OCNC) as the chief organizer. As OIST established itself as a graduate university in 2011, he became a Professor and served as the Vice Provost for Research. He serves as the Co-Editor in Chief of Neural Networks since 2008 and a board member of Japanese Neural Network Society (JNNS) and Japan Neuroscience Society (JNSS). He served as the Program Co-Chair of International Conference on Neural Information Processing (ICONIP) 2007 and 2016, the Program Chair of JNSS meeting in 2010, and the General Chair of JNNS meeting in 2011. He received Tsukahara Award and JSPS Award in 2007 and MEXT Prize for Science and Technology in 2012, and joined the College of Fellows of International Neural Network Society in 2013. He lead the MEXT project on “Prediction and Decision Making” project from 2011 to 2016 and currently leads a new MEXT project “Artificial Intelligence and Brain Science”. He is interested in understanding the functions of basal ganglia and the cortical circuit based on the theory of reinforcement learning and Bayesian inference.

Plenary Lecture VI

Intelligent Control Based on Neurdynamic Optimization

Jun Wang
City University of Hong Kong, China

Abstract – Neurodynamic optimization play important roles intelligent control. In this talk, neurodynamics-based approaches will be presented for in synthesis and realization of intelligent control systems. First, the robust pole assignment of linear control systems will be introduced based on neurodynamic optimization. Then, neurodynimics-based reference or command governor optimization will be delineated. Next, nonlinear and robust model predictive control based neurodynamic optimization will be discussed. Simulation and experimental results will also be shown to demonstrate the efficacy and performance of the proposed approaches for the intelligent control of various dynamic systems.

Jun Wang received the B.S. degree in electrical engineering and the M.S. degree in systems engineering from the Dalian University of Technology, Dalian, China, in 1982 and 1985, respectively, and the Ph.D. degree in systems engineering from Case Western Reserve University, Cleveland, OH, USA, in 1991. Jun Wang is a Chair Professor of Computational Intelligence in the Department of Computer Science at City University of Hong Kong. Prior to this position, he held various academic positions at Dalian University of Technology, Case Western Reserve University, University of North Dakota, and Chinese University of Hong Kong. He also held various short-term or part-time visiting positions at the U.S. Air Force Armstrong Laboratory, Dayton, OH, USA, in 1995; RIKEN Brain Science Institute, Tokyo, in 2001, the Universite Catholique de Louvain, Louvain-la-Neuve, Belgium, in 2001, the Chinese Academy of Sciences, Beijing, China, in 2002, the Huazhong University of Science and Technology, Wuhan, China, from 2006 to 2007, Shanghai Jiao Tong University, Shanghai, China, as a Cheung Kong Chair Professor from 2008 to 2011, and the Dalian University of Technology, as a National Thousand-Talent Chair Professor, since 2011. His current research interests include neural networks and their applications. Prof. Wang was the recipient of the Research Excellence Award from the Chinese University of Hong Kong for 2008–2009, two Natural Science Awards (first class), respectively, from Shanghai Municipal Government in 2009 and the Ministry of Education of China in 2011, the Outstanding Achievement Award from the Asia Pacific Neural Network Assembly, the IEEE Transactions on Neural Networks Outstanding Paper Award in 2011, and the Neural Networks Pioneer Award in 2014 from the IEEE Computational Intelligence Society. He has been an Editor-in-Chief of the IEEE Transactions on Cybernetics since 2014 and served as an Associate Editor of the journal and its predecessor from 2003 to 2013. He was an Editorial Board Member of Neural Networks from 2012 to 2014. He also served as an Associate Editor of the IEEE Transactions on Neural Networks from 1999 to 2009 and the IEEE Transactions On Systems, Man, and Cybernetics—Part C from 2002 to 2005, and an Editorial Advisory Board Member of the International Journal of Neural Systems from 2006 to 2012. He was a Guest Editor of Special Issues of the European Journal of Operational Research in 1996, the International Journal of Neural Systems in 2007, and Neurocomputing in 2008. He served as the

President of the Asia Pacific Neural Network Assembly in 2006, the General Chair of the 13th International Conference on Neural Information Processing in 2006 and the IEEE World Congress on Computational Intelligence in 2008, and a Program Chair of the IEEE International Conference on Systems, Man, and Cybernetics in 2012. He has also served on several committees such as the IEEE Fellows Committee. He was an IEEE Computational Intelligence Society Distinguished Lecturer from 2010 to 2012 and 2014 to 2016.Jun Wang is the Chair Professor Computational Intelligence in the Department of Computer Science at City University of Hong Kong. Prior to this position, he held various academic positions at Dalian University of Technology, Case Western Reserve University, University of North Dakota, and the Chinese University of Hong Kong. He also held various short-term visiting positions at USAF Armstrong Laboratory, RIKEN Brain Science Institute, Dalian University of Technology, Huazhong University of Science and Technology, and Shanghai Jiao Tong University (Changjiang Chair Professor). He received a B.S. degree in electrical engineering and an M.S. degree in systems engineering from Dalian University of Technology and his Ph.D. degree in systems engineering from Case Western Reserve University. His current research interests include neural networks and their applications. He published over 200 journal papers, 15 book chapters, 11 edited books, and numerous conference papers in these areas. He is the Editor-in-Chief of the IEEE Transactions on Cybernetics. He also served as an Associate Editor of the IEEE Transactions on Neural Networks (1999-2009), IEEE Transactions on Cybernetics and its predecessor (2003-2013), and IEEE Transactions on Systems, Man, and Cybernetics – Part C (2002–2005), as a member of the editorial board of Neural Networks (2012-2014), editorial advisory board of International Journal of Neural Systems (2006-2013). He was an organizer of several international conferences such as the General Chair of the 13th International Conference on Neural Information Processing (2006) and the 2008 IEEE World Congress on Computational Intelligence, and a Program Chair of the IEEE International Conference on Systems, Man, and Cybernetics (2012). He is an IEEE Fellow, IAPR Fellow, and an IEEE Systems, Man and Cybernetics Society Distinguished Lecturer (2017-2018), and was an IEEE Computational Intelligence Society Distinguished Lecturer (2010-2012, 2014-2016). In addition, he served as President of Asia Pacific Neural Network Assembly (APNNA) in 2006 and many organizations such as IEEE Fellow Committee; IEEE Computational Intelligence Society Awards Committee; IEEE Systems, Man, and Cybernetics Society Board of Governors, He is a recipient of an IEEE Transactions on Neural Networks Outstanding Paper Award and APNNA Outstanding Achievement Award in 2011, Neural Networks Pioneer Award from IEEE Computational Intelligence Society in 2014, among other distinctions.

Plenary Lecture VII

Respiration and Higher Cognition - Energetic Conditions of Intelligence in Man and Machine

Robert Kozma
University of Memphis, USA

Abstract – Spatio-temporal neural oscillations in brains have been linked with various cognitive states, including sleep state, alertness, and a range of higher cognitive activities. These oscillations exhibit transient dynamics between metastable synchronized states with amplitude-modulated (AM) patterns and de-synchronized states with rapidly varying phase modulation (PM) effects. The origin of the underlying oscillatory dynamics is largely unknown. Recent experimental data indicate that respiration influences not only the olfactory cortex, but also neocortical areas, including visual, auditory, and somatosensory cortex. These surprising findings suggest that respiration acts as master clock exerting a subtle but unfailing synchronizing influence on the temporal organization of large-scale, dynamic cortical activity patterns and the cognitive, emotional, sensory and motor processes.

In this talk we describe the key role of respiration in uninterrupted neural activity, which can exist only via the perpetual flow of oxygen and energy sources through the highly intricate vascular system. Proper description of the metabolic processes in the neuron-glia system is crucial for understanding the mechanisms that underlie biological intelligence. Until recently, energy efficiency has not been considered a key aspect of AI, rather many AI approaches used "brute force" computing power to achieve the desired performance. However, brains teach us that a system that wastes energy cannot be truly intelligent. Energy limitations provide natural, embodied constraints on the brain operation that ultimately lead to the emergence of intelligence. Studying efficient energy consumption in brains helps us to design superior AI that is energy efficient.

Dr. Kozma holds a Ph.D. in Physics (Delft, The Netherlands, 1992), two M.Sc. degrees (Mathematics, Budapest, Hungary, 1988; Power Engineering, Moscow, Russia, 1982). He is Professor of Mathematical Sciences and Director of the Center of Large-Scale Integration and Optimization Networks (CLION), the University of Memphis, TN, USA. He is Visiting Professor at College of Information and Computer Sciences, University of Massachusetts Amherst, where he is Director of the Biologically-Inspired Neural and Dynamical Systems (BINDS) Lab, and leads the DARPA Program on Superior Artificial Intelligence. Previous affiliations include joint appointment with the Division of Neurobiology and the EECS at UC Berkeley (1998-2000), and visiting positions at NASA/JPL, Sarnoff Co., Princeton, NJ; Lawrence Berkeley Laboratory (LBL); and AFRL WPAFB, Dayton, OH. He has been Associate Professor at Tohoku University, Sendai, Japan, Lecturer at Otago University, Dunedin, New Zealand (. worked as Research Fellow at the Hungarian Academy of Sciences, Budapest, Hungary. His research is focused on computational neurodynamics, large-scale brain networks, and applying biologically motivated and cognitive principles for the development of intelligent systems. Dr. Kozma has published 8 books, 350+ papers, and 2 patents. His most recent book has been co-

authored by Walter J. Freeman III on “Cognitive Phase Transitions in the Cerebral Cortex - Enhancing the Neuron Doctrine by Modeling Neural Fields,” Springer, Germany (2016). Dr. Kozma’s research has been supported by NSF, NASA, JPL, AFRL, AFOSR, DARPA, FedEx, and by other agencies. Dr. Kozma is Fellow of IEEE and Fellow of the International Neural Network Society (INNS). He is President (2017-2018) of INNS, and serves on the Governing Board of IEEE Systems, Man, and Cybernetics Society (2016-2018). He has served on the AdCom of the IEEE Computational Intelligence Society (2009-2012) and the Board of Governors of the International Neural Network Society (2007-2012). He has been General Chair of IJCNN2009, Atlanta, USA. He is Associate Editor of Neural Networks, Neurocomputing, Cognitive Systems Research, and Cognitive Neurodynamics. Dr. Kozma is the recipient of “Gabor Award” of the International Neural Network Society (2011); the “Alumni Association Distinguished Research Achievement Award” (2010); he has been a “National Research Council (NRC) Senior Fellow” (2006-2008).

Plenary Lecture VIII

Probe Machine: Theory, Implementation and Applications

Jin Xu
Peking University, China

Abstract – As the electronic computer cannot efficiently solve large-scale NP-problems, exploring non-conventional computing model has become one of the most important research directions in the field of information processing. From the perspective of decomposability, the computer is a general purpose device built upon a computing model, and manufactured by certain materials that can be used to implement the specific computing model. For instance, today's electronic computer is conceptualized by Turing machine (TM), and composed of electronic components. The difficulty in solving large-scale NP-problems for an electronic computer is its computing model—TM. In a TM, the data is stored one next to another; in other words, data units are placed linearly. In this linear data placement mode, only adjacently placed data units can be processed simultaneously, which greatly limits its computation capability. Hence, it is necessary to break through these constraints and search for a new computing model that is fundamentally more powerful and efficient than TM. Accordingly, there is a central requirement for devising such a conceptually brand-new model—the model needs to be capable of simultaneously processing as many data units as possible. That is, the way of placing data should be non-linear, which is the main motivation that we propose the Probe Machine (PM). In this report, we will introduce the research progress of the PM respectively from the aspects of its theory, implementation, and applications.

Jin Xu was born in 1959. He received the Ph.D. degree from the Beijing Institute of Technology, Beijing, China. He is currently a Professor and Ph.D. Supervisor. His current research interests include artificial neural networks, theoretical computer science, graph theory and combinatorial optimization, and biocomputer.

Plenary Lecture IX

Generative and Discriminative Learnings: A Fuzzy Restricted Boltzmann Machine and Broad Learning System

C. L. Philip Chen
University of Macau, China

Abstract – In recent years, deep learning caves out a research wave in machine learning. With outstanding performance, more and more applications of deep learning in pattern recognition, image recognition, speech recognition, and video processing have been developed. This talk will introduce a generative learning algorithm – a Fuzzy Restricted Boltzmann Machine (FRBM) that is established by replacing real-valued weights and bias terms with symmetric triangular fuzzy numbers (STFNs) or Gaussian fuzzy numbers and corresponding learning algorithms. A theorem is concluded that all FRBMs with symmetric fuzzy numbers will have identical learning algorithm to that of FRBMs with STFNs.

The second part of the talk is to discuss a very fast and efficient discriminative learning – "Broad Learning". Without stacking the layer-structure, the designed neural networks expand the neural nodes broadly and update the weights of the neural networks incrementally when additional nodes are needed and when the input data entering to the neural networks continuously. The designed network structure and learning algorithm are perfectly suitable for modeling and learning big data environment. Experiments results in MNIST and handwriting recognition and NORB database indicate that the proposed BLS significantly outperforms existing deep structures in learning accuracy and generalization ability.

Dr. Chen is currently the Dean of the Faculty of Science and Technology, University of Macau, Macau, China and a Chair Professor of the Department of Computer and Information Science since 2010. He worked at U.S. for 23 years as a tenured professor, a department head and associate dean in two different universities. Dr. Chen's research areas are in systems, cybernetics and computational intelligence. He is a Fellow of the IEEE and AAAS. He was the President of IEEE Systems, Man, and Cybernetics Society (SMCS) (2012-2013). Currently, he is the Editor-in-Chief of IEEE Transactions on Systems, Man, and Cybernetics: Systems (2014-). He has been an Associate Editor of many IEEE Transactions, and currently he is an Associate Editor of IEEE Trans on Fuzzy Systems, IEEE Trans on Cybernetics, and IEEE/CAA Automatica Sinica. He is the Chair of TC 9.1 Economic and Business Systems of IFAC. He is also a Fellow of CAA and Fellow of HKIE and an Academician of International Academy of Systems and Cybernetics Science (IASCYS). In addition, he is an ABET (Accreditation Board of Engineering and Technology Education, USA) Program Evaluator for Computer Engineering, Electrical Engineering, and Software Engineering programs. Dr. Chen he received Outstanding Electrical and Computer Engineering Award in 2016 from his alma mater, Purdue University, West Lafayette, where he received his Ph.D. degree in 1988, after he received his M.S. degree in electrical engineering from the University of Michigan, Ann Arbor, in 1985.

Invited Lecture I

Learning-based Control: Opportunities and Challenges

Haibo He
University of Rhode Island, USA

Abstract – With the recent development of deep learning and hardware computing technologies, scientists and engineers will hopefully find efficient ways to design brain-like intelligent systems that are highly robust, adaptive, scalable, and fault-tolerant to uncertain and unstructured environments. Yet, developing such truly intelligent systems requires significant research on both fundamental understanding of brain intelligence as well as complex engineering design.

In this talk, I will present a new reinforcement learning (RL) and adaptive dynamic programing (ADP) framework for improved decision-making and control capability, named goalrepresentation ADP (GrADP). The two key questions addressed by this new type of GrADP include: (1) where does the reinforcement signal comes from; and (2) how to develop an internal goal representation. Compared to the existing methods with a manual or "handcrafted" reinforcement signal design, this GrADP framework can automatically and adaptively develop the internal goal representation over time. Under this framework, I will present numerous applications ranging from smart grid control to human-robot interaction to demonstrate its broader and far-reaching applications.

Haibo He is the Robert Haas Endowed Chair Professor and the Director of the Computational Intelligence and Self-Adaptive (CISA) Laboratory at the University of Rhode Island, Kingston, RI, USA. He has published one sole-author book (Wiley), edited 1 book (Wiley-IEEE) and 6 conference proceedings (Springer), and authored/co-authors over 260 peer-reviewed journal and conference papers, including several highly-cited papers and best papers.

He has served the IEEE Computational Intelligence Society (CIS) at various capacities, including Chair of IEEE CIS Emergent Technologies Technical Committee (ETTC) (2015) and Chair of IEEE CIS Neural Networks Technical Committee (NNTC) (2013 and 2014). He was the General Chair of 2014 IEEE Symposium Series on Computational Intelligence (IEEE SSCI'14), Technical Program Co-Chair of 2015 International Joint Conference on Neural Networks (IJCNN'15), among others. Currently, He is the Editor-in-Chief of IEEE Transactions on Neural Networks and Learning Systems.

He was a recipient of the IEEE International Conference on Communications (IEEE ICC) "Best Paper Award" (2014), IEEE CIS "Outstanding Early Career Award" (2014), National Science Foundation "Faculty Early Career Development (CAREER) Award" (2011), Providence Business News (PBN) "Rising Star Innovator" Award (2011), and "Best Master Thesis Award" of Hubei Province, China (2002).

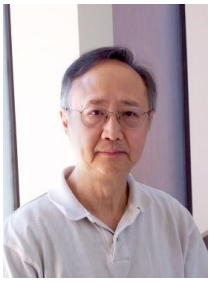
Invited Lecture II

Deep Learning and a New Approach for Machine Learning

James T. Lo,
University of Maryland, USA

Abstract – A basis of AI is machine learning, whose state of the art is mainly the highly publicized deep learning. Due to its unique features, deep learning seems irreplaceable in some applications. However, its development for other applications especially cognitive computing has been stagnant. In this talk, some fundamental shortcomings of deep learning will be examined in connection with big data.

A postulational approach based on 4 biological and 1 creationist/evolutionary postulates has yielded a computational model of biological neural networks and a cortex-like learning machine. The former has a logically coherent explanation of how the brain encodes, learns, memorizes, recalls and generalizes. The latter has avoided the fundamental shortcomings of deep learning. The new model and machine will briefly be introduced in the talk.



James Ting-Ho Lo is a Professor in the Department of Mathematics and Statistics of the University of Maryland Baltimore County. He received the BS degree from the National Taiwan University and the Ph.D. degree from the University of Southern California, and was a Postdoctoral Research Associate at Stanford and Harvard University. His research interests have included optimal filtering, system control and identification, active noise and vibration control, and machine learning. In 1992, he solved the long-standing notorious problem of optimal nonlinear filtering in its most general setting and obtained a best paper award. Subsequently, he conceived and developed adaptive neural networks with long- and short-term memories, accommodative neural network for adaptive processing without online processor adjustment, and robust/adaptive neural networks with a continuous spectrum of robustness; which constitute an effective systematic general approach to robust or/and adaptive processing for system control/identification/estimation and signal processing. He has been developing a convexification method for avoiding nonglobal minima in data fitting (e.g., training deep neural networks and estimating regression models), which is ready for application and is nearing a complete solution of the long-standing notorious "local minimum problem", a main obstacle in data fitting. In recent years, Dr. Lo has also been developing a low-order model of biological neural networks. The model comprises biologically plausible models of axonal/dendritic trees, synapses, spiking/nonspiking somas, unsupervised/supervised learning mechanisms, a maximal generalization scheme, and feedbacks with different delay duration; which integrate into a biologically plausible learning/retrieving algorithm and answer numerous fundamental questions in neuroscience.

Plenary Panel

The Future of Deep Learning and Brain Research

Moderator: Paul Werbos
Panelists: Tamer Basar, Zong-Ben Xu, C. L. Philip Chen, Kenji Doya, Robert Kozma, DeLiang Wang, Jun Wang, Jin Xu, Cesare Alippi and Marios Polycarpou

Deep learning and brain research are two of the hottest topics in the field of information sciences, especially in artificial intelligence. It is very important to analyze deep learning and brain research as well as to discuss their future.

Deep learning (also known as deep structured learning or hierarchical learning) is part of a broader family of machine learning methods based on learning data representations, as opposed to task-specific algorithms. Deep learning architectures such as deep neural networks, deep belief networks and recurrent neural networks have been applied to fields including computer vision, speech recognition, natural language processing, audio recognition, social network filtering, machine translation, and bioinformatics, where they produced results comparable to and in some cases superior to human experts. Note that the original goal of the neural network approach is to solve problems in the same way that a human brain would. Evidences suggest that the brain function arises from the activity of neural networks on several different scales, and that malfunctions caused by psychiatric and neurological disorders are due to faulty connectivity. In order to reveal how the brain works as well as to understand the pathophysiological mechanism of psychiatric and neurological disorders, it is necessary to integrate the multi-level network features inferred by various functional and anatomical brain imaging technologies at multiple temporal and spatial scales, as well as the interaction of the individual with social and the environmental factors. Therefore, it is important to conduct the brain-related research, which is also helpful to understand and construct the brain-inspired intelligence.

Brain-inspired intelligence is the grand challenge for achieving human-level artificial intelligence. The efforts on brain-inspired intelligence focus on understanding and simulating the cognitive brain at multiple scales as well as its applications to brain-inspired intelligent systems. This plenary panel aims to reviews the history, summarize the present status, and makes prospects for the future of deep learning and brain research, which is also the main topic of ICONIP 2017.

Best Paper Award Finalists

1. Best Paper Award Finalists

(1) Geo-Pairwise Ranking Matrix Factorization Model for Point-of-interest Recommendation
by Shenglin Zhao, Irwin King and Michael R. Lyu

(2) Pulsar Bayesian Model: A Comprehensive Astronomical Data Fitting Model
by Hang Yu, Qian Yin and Ping Guo

(3) Memorizing Transactional Databases Compressively in Deep Neural Networks for Efficient Itemset Support Queries
by Yi Ji and Yukio Ohsawa

(4) Online Hidden Conditional Random Fields to Recognize Activity-driven Behavior using Adaptive Resilient Gradient Learning
by Ahmad Shahi, Jeremiah D. Deng and J. Woodford Brendon

(5) Coevolution of Cooperation and Complex Networks via Indirect Reciprocity
by Aizhi Liu, Lei Wang, Yanling Zhang and Changyin Sun

(6) Deep Sequence-to-Sequence Neural Networks for Ionospheric Activity Map Prediction
by Noelie Cherrier, Thibaut Castaings and Alexandre Boulch

(7) Combatting Adversarial Inputs using a Predictive-Estimator Network
by Jeff Orchard and Louis Castricato

(8) Field Support Vector Regression
by Haochuan Jiang, Kaizhu Huang and Rui Zhang

2. Best Student Paper Award Finalists

(1) Improvement of Texture Clustering Performance in Complex-valued SOM by using Complex-valued Auto-encoder for Millimeter-wave Coherent Imaging
by Yuya Arima and Akira Hirose

(2) Tensorial Neural Networks and Its Application in Longitudinal Network Data Analysis
by Mingyuan Bai, Boyan Zhang and Junbin Gao

(3) Heterogeneous Features Integration in Deep Knowledge Tracing
by Lap Pong Cheung and Haiqin Yang

(4) Transfer Learning Enhanced Common Spatial Pattern Filtering for Brain Computer Interfaces (BCIs): Overview and a New Approach
by He He and Dongrui Wu

(5) Temporal Attention Neural Network for Video Understanding
by Jegyung Son and Minho Lee

(6) Average Reward Optimization with Multiple Discounting Reinforcement Learners
by Chris Reinke, Eiji Uchibe and Kenji Doya

(7) Multimodal Classification with Deep Convolutional-Recurrent Neural Networks for Electroencephalography
by Chuanqi Tan, Fuchun Sun, Wenchang Zhang, Jianhua Chen and Chunfang Liu

(8) Sleep Apnea Event Detection from Nasal Airflow using Convolutional Neural Networks
by Rim Haidar, Irena Koprinska and Bryn Jeffries

Technical Program

Wednesday, November 15, 1:30PM-6:00PM

Wednesday, November 15, 4:00PM-6:00PM

Thursday, November 16, 1:30PM-3:30PM

Thursday, November 16, 1:30PM-6:00PM

Thursday, November 16, 4:00PM-6:00PM

Friday, November 17, 1:30PM-3:30PM

Friday, November 17, 1:30PM-6:00PM

Friday, November 17, 4:00PM-6:00PM

Book of Abstracts

Wednesday, November 15, 1:30PM-3:30PM

Award Session: WedA1 Best paper award competition session

Wednesday, November 15, 1:30PM-3:30PM, Room: Kaixuan 7, Chairs: Jun Zhang and Haibo He

1:30PM *Geo-Pairwise Ranking Matrix Factorization Model for Point-of-interest Recommendation [#17864]*

Shenglin Zhao, Irwin King and Michael R. Lyu, The Chinese University of Hong Kong, Hong Kong

Point-of-interest (POI) recommendation that suggests new locations for people to visit is an important application in location-based social networks (LBSNs). Compared with traditional recommendation problems, e.g., movie recommendation, geographical influence is a special feature that plays an important role in recommending POIs. Various methods that incorporate geographical influence into collaborative filtering techniques have recently been proposed for POI recommendation. However, previous geographical models have struggled with a problem of \textit{ geographically noisy POIs}, defined as POIs that follow the geographical influence but do not satisfy users' preferences. We observe that users in the same geographical region share many POIs, and thus we propose the \textit{co-geographical influence} to filter \textit{geographically noisy POIs}. Furthermore, we propose the \textit{Geo Pairwise Ranking Matrix Factorization (Geo-PRMF)} model for POI recommendation, which incorporates \textit{co-geographical influence} into a personalized pairwise preference ranking matrix factorization model. We conduct experiments on two real-life datasets, i.e., Foursquare and Gowalla, and the experimental results reveal that the proposed approach outperforms state-of-the-art models.

1:45PM *Pulsar Bayesian Model: A Comprehensive Astronomical Data Fitting Model [#17387]*

Hang Yu, Qian Yin and Ping Guo, Beijing Normal University, China

Pulsar, as a hotspot in the field of astronomy, has a great help of electronic communications, cosmic media detection, and timing. Scientists expect to know the distributions that the data of pulsar features is most likely to be subject to. There are off-the-shelf approaches for scientific researchers to do that, while they are either not fully-using statistical properties or computing-resource- wasting. As an accurate and convenient solution to the problem, we propose a comprehensive fitting model with Bayesian prior knowledge to help scientists automatically fit pulsar data into the optimal expression.

2:00PM *Memorizing Transactional Databases Compressively in Deep Neural Networks for Efficient Itemset Support Queries [#17431]*

Yi Ji and Yukio Ohsawa, The University of Tokyo, Japan

Can a deep neural network memorize a database? Though deep artificial neural networks are remarkable for large memory capacity that makes fitting any dataset possible, memorizing a database is a novel learning task unlike other popular tasks which intrinsically model mappings rather than ``memorize'' information internally. We give a positive answer to the question by showing that through training with maximal/minimal and frequent/infrequent patterns of a transactional database, a dynamically constructed deep net can support random itemset support queries with relatively high precision in regard to data compression ratio. Due to the compressive memorization, the amount of transactions in the database becomes irrelevant to the query time cost in our efficient method. We further discuss the potential interpretation of learnt database representation by analyzing corresponding statistical features of the database and activation patterns of the neural network.

2:15PM *Online Hidden Conditional Random Fields to Recognize Activity-driven Behavior using Adaptive Resilient Gradient Learning [#17460]*

Ahmad Shahi, Jeremiah D. Deng and J. Woodford Brendon, University of Otago, New Zealand

In smart home applications, accurate sensor-based human activity recognition is based on learning patterns online from collections of sequential sensor events. A more challenging problem is to discover and learn unknown activities that have not been observed or predefined. This is because in a real-world environment, it is impractical to presume that users/residents will only accomplish a set of predefined activities over a long-term period. To address the issues of classifying sequential data where there are multiple sensor-based activities which might be overlapping, we propose an online Hidden Conditional Random Field (OHCRF) using Resilient Gradient Algorithm (RGA) to recognize human activity behaviors. The discriminative nature of our OHCRF models the sequential observations of an online stream, resolving the level of biased data and over-fitting. The proposed adaptive RGA approach is used to update OHCRF's parameters for online learning. Compared with Stochastic Gradient Descent (SGD), the proposed adaptive RGA converges faster, and has an efficient and transparent adaptation process. Experimentally, we demonstrate that our proposed approach can outperform the state-of-the-art methods for sequential sensor-based activity recognition involving datasets acquired from residents in smart home test-beds.

2:30PM *Coevolution of Cooperation and Complex Networks via Indirect Reciprocity [#17277]*

Aizhi Liu, Lei Wang, Yanling Zhang and Changyin Sun, University of Science and Technology Beijing, China; Southeast University, China

Most previous research on indirect reciprocity was in well-mixed population. Distinguishing the interacting network from learning network provides a chance to study indirect reciprocity in networks. Unlike previous research, we propose a coevolution model of cooperation and complex networks via indirect reciprocity, where an individual can interact globally but update strategy locally. Based on this model, we describe the simulation results of coevolution, including the effects of rewiring mechanism on the evolution of cooperation, and how the evolution of cooperation affects networks restructure. Results show that rewiring mechanism favors the evolution of cooperation and the evolution of cooperation can restructure social networks. To understand and explain the results in detail, we graphically depict the snapshots of coevolution process. These findings facilitate us to further understand the evolution of cooperation and the restructure of complex networks.

2:45PM *Deep Sequence-to-Sequence Neural Networks for Ionospheric Activity Map Prediction [#17541]*

Noelie Cherrier, Thibaut Castaings and Alexandre Boulch, The French national aerospace research center, France

The ability to predict the ionosphere activity is of interest for several applications such as satellite telecommunications or Global Navigation Satellite Systems (GNSS). A few studies have proposed models able to predict Total Electron Content (TEC) values of the ionosphere locally over measuring stations, but not worldwide for most of them. We propose a method using Deep Neural Networks (DNN) to predict a sequence of

global TEC maps consecutive to an input sequence of past TEC maps, by combining Convolutional Neural Networks (CNNs) with convolutional Long Short-Term Memory (LSTM) networks. The numerical experiments show that the approach provides significant improvement over methods implemented for benchmarking and is competitive with state-of-the-art methods while providing global TEC predictions. The proposed architecture can be adapted to any sequence-to-sequence prediction problem.

3:00PM *Combatting Adversarial Inputs using a Predictive-Estimator Network [#17820]*
Jeff Orchard and Louis Castricato, University of Waterloo, Canada

Deep classification networks have shown great accuracy in classifying inputs. However, they fall prey to adversarial inputs, random inputs chosen to yield a classification with a high confidence. But perception is a two-way process, involving the interplay between feedforward sensory input and feedback expectations. In this paper, we construct a predictive estimator (PE) network, incorporating generative (predictive) feedback, and show that the PE network is less susceptible to adversarial inputs. We also demonstrate some other properties of the PE network.

3:15PM *Field Support Vector Regression [#17707]*
Haochuan Jiang, Kaizhu Huang and Rui Zhang, Xi'an Jiaotong-Liverpool University, China

In regression tasks for static data, existing methods often assume that they were generated from an identical and independent distribution (i.i.d.). However, violation can be found when input samples may form groups, each affected by a certain different domain. In this case, style consistency exists within a same group, leading to degraded performance when conventional machine learning models were applied due to the violation of the i.i.d. assumption. In this paper, we propose one novel regression model named Field Support Vector Regression (F-SVR) without i.i.d. assumption. Specifically, we perform a style normalization transformation learning and the regression model learning simultaneously. An alternative optimization with final convergence guaranteed is designed, as well as a transductive learning algorithm, enabling extension on unseen styles during the testing phase. Experiments are conducted on two synthetic as well as two real benchmark data sets. Results show that the proposed F-SVR significantly outperforms many other state-of- the-art regression models in all the used data sets.

Workshop: WedA2 Data mining and cybersecurity workshop

Wednesday, November 15, 1:30PM-3:30PM, Room: Zhujiang 2, Organizers: Kaizhu Huang, Paul Pang, Tao Ban, Youki Kadobayashi, Jungsuk Song, Geong Sen Poh, Iqbal Gondal

2:45PM *A Bayesian Posterior Updating Algorithm in Reinforcement Learning [#17266]*
Fangzhou Xiong, Zhiyong Liu, Xu Yang, Biao Sun, Charles Chiu and Hong Qiao, Institute of Automation, Chinese Academy of Science, China; University of Science and Technology Beijing, China; School for Higher and Professional Education, Hong Kong

Bayesian reinforcement learning (BRL) is an important approach to reinforcement learning (RL) that takes full advantage of methods from Bayesian inference to incorporate prior information into the learning process when the agent interacts directly with environment without depending on exemplary supervision or complete models of the environment. BRL tackles the problem by expressing prior information in a probabilistic distribution to quantify the uncertainty, and updates these distributions as evidences are collected. However, the expected total discounted rewards cannot be obtained instantly to maintain these distributions after each transition the agent executes. In this paper, we propose a novel idea to adjust immediate rewards slightly in the process of Bayesian Q-learning updating by introducing a state pool technique which could improve total rewards when this pool resets appropriately. We show experimentally on several fundamental BRL problems that the proposed method can perform substantial improvements over other traditional strategies.

3:00PM *A Linear Online Guided Policy Search Algorithm [#17709]*
Biao Sun, Fangzhou Xiong, Zhiyong Liu, Xu Yang and Hong Qiao, University of Science and Technology Beijing, China; Institute of Automation, Chinese Academy of Sciences, China

In reinforcement learning (RL), the guided policy search (GPS), a variant of policy search method, can encode the policy directly as well as search for optimal solutions in the policy space. Even though this algorithm is provided with asymptotic local convergence guarantees, it can not work in a online way for conducting tasks in complex environments since it is trained with a batch manner which requires that all of the training samples should be given at the same time. In this paper, we propose an online version for GPS algorithm, which can learn policies incrementally without complete knowledge of initial positions for training. The experiments witness its efficacy on handling sequentially arriving training samples in a peg insertion task.

3:15PM *Detection of Botnet Activities through the Lens of A Large-Scale Darknet [#17835]*
Tao Ban, Lei Zhu, Jumpei Shimamura, Shaoning Pang, Daisuke Inoue and Koji Nakao, National Institute of Information and Communications Technology, Japan; Unitec Institute of Technology, New Zealand; clwit Inc., Japan

The growing cyber-threats from botnets compel us to devise proper countermeasures to detect infected hosts in an efficient and timely manner. In this paper, botnet-host identification is approached from a new perspective: by exploring the temporal coincidence in botnet activ- ities visible in the darknet, botnet probing campaigns and botnet hosts can be detected with high accuracy and efficiency. The insights to bot- net behavioral characteristics and automated detection results obtained from this study suggest a promising expedient for botnet take-down and host reputation management on the Internet.

Invited Session: WedA3 Active learning control of infinite-dimensional systems and its applications

Wednesday, November 15, 1:30PM-3:30PM, Room: Zhujiang 3, Organizers: Yu Liu and Wei He, Chairs: Wei He and Yu Liu

1:30PM *Three-Dimensional Vibrations Control Design for a Single Point Mooring Line System with Input Saturation [#17625]*

Weijie Xiang, Wei He, Xiuyu He, Shuanfeng Xu, Guang Li and Changyin Sun, University of Science and Technology Beijing, China; Beijing Institute of Control Engineering, China; Queen Mary University of London, England; Southeast University, China

This paper presents a boundary control design for a single point mooring line system with input saturation in three-dimensional (3D) space. The system is described by some partial differential equations (PDEs) and ordinary differential equations(ODEs). The control strategy proposed in this paper at the tip payload of the mooring line and the control design uses Lyapunov's direct method (LDM) to ensure the stability of the system. In order to compensate the input saturation, we propose an auxiliary system. With the proposed boundary control, the mooring system's uniform boundedness under the effect of external environment is obtained. The presented boundary control is implementable with feasible equipment because all information in the system can be gained and calculated through various sensors or by applying a backward difference algorithm. Simulation results are provided to prove that the controller is effective in regulating the vibration of the system.

1:45PM *Boundary Iterative Learning Control of an Euler-Bernoulli Beam System [#17650]*

Yu Liu, Xiao Deng, Fang Guo and Wei He, South China University of Technology, China; University of Science and Technology Beijing, China

In this article, through combining boundary control, adaptive technique with iterative learning control, a control strategy is developed for improving the tracing accurate and achieving the vibration suppression for the Euler-Bernoulli beam system. The dynamics of Euler-Bernoulli beam system can be written as partial-ordinary differential equations. With designed adaptive iterative learning control strategy, the unexpected spillover problem is suppressed and the learning convergence of iterative learning control is also mathematically achieved. Finally, the validity is illustrated by numerical simulation results.

2:00PM *Adaptive Control of an Output Constrainted Riser [#17651]*

Fang Guo and Yu Liu, South China University of Technology, China

In this paper, the vibration control problem of an output constrainted riser is addressed. An adaptive Lyapunov-based barrier control is formulated for reducing the flexible riser's vibration by applying integral-barrier Lyapunov function, backstepping technique and adaptive technique. The unexpected spillover problem is suppressed under the designed control. The numerical simulation results illustrate the availability of formulated control.

2:15PM *Vibration Suppression of an Axially Moving System with Restrained Boundary Tension [#17652]*

Zhijia Zhao, Yu Liu and Kun Sun, Guangzhou University, China; South China University of Technology, China

In this paper, we concentrate on the vibration suppression of an axially moving string system subject to the restrained boundary tension. By introducing an appropriate barrier Lyapunov function, a boundary control is constructed to stabilize the vibration and insure that the boundary tension is maintained within limits. The derived control can guarantee the uniformly bounded stability of the closed-loop system and the satisfaction of the boundary tension constraint. Finally, the simulations validate the results.

2:30PM *A High Accurate Vision Algorithm on Measuring Arbitrary Contour [#17731]*

Hongwei Xie, Kun Sun, Yu Liu and Jiaxiang Luo, Guangzhou University, China; South China University of Technology, China

In order to measure the error of arbitrary contours, a high accurate visual algorithm is proposed. Firstly, a subpixel edge extraction algorithm based on local grayscale fitting is used to extract subpixel contours. And then we use the coarse-to-fine matching strategy, which uses the shape context feature of contours to perform coarse matching, and then based on iterative closest points to complete fine matching step. Finally, the neighborhood algorithm is proposed to calculate the contour error. Experiments show that the accuracy of this algorithm can reach 0.5 pixel, and this algorithm can apply to error measurement of any shape of contours.

WedA4 Machine learning 1

Wednesday, November 15, 1:30PM-3:30PM, Room: Zhujiang 5, Chairs: Wenlian Lu and Andrew Chi Sing Leung

1:30PM *Semi-supervised Coefficient-based Distance Metric Learning [#17420]*

Zhangcheng Wang, Ya Li and Xinmei Tian, University of Science and Technology of China, China

Distance metric learning plays an important role in real-world applications, such as image classification and clustering. Previous works mainly learn distance metric through learning a Mahalanobis metric or learning a linear transformation. In this paper, we propose to learn a distance metric from a new perspective. We first randomly generate a set of base vectors and then learn a linear combination of these vectors to approximate the target metric. Compared with previous distance metric learning methods, we only need to learn the coefficients of these base vectors instead of learning the target metric or the linear transformation. Consequently, the number of variables needed to be determined is the same as the number of base vectors, which is irrelevant to the dimension of the data. Furthermore, considering the situation that labeled samples are insufficient in same cases, we extend our proposed distance metric learning method into a semi-supervised learning framework. Additionally, an optimization algorithm is proposed to accelerate training of our proposed methods. Experiments are conducted on several datasets and the results demonstrate the effectiveness of our proposed method.

1:45PM *A Generalized I-ELM Algorithm for Handling Node Noise in Single-hidden Layer Feedforward Networks [#17363]*

Hiu Tung Wong, Andrew Chi Sing Leung and Sam Kwong, City University of Hong Kong, Hong Kong

The incremental extreme learning machine (I-ELM) algorithm provides a low computational complexity training mechanism for single-hidden layer feedforward neworks (SLFNs). However, the original I-ELM algorithm does not consider the node noise situation, and node noise may greatly degrade the performance of a trained SLFN. This paper presents a generalized node noise resistant I-ELM (GNNR-I-ELM) for SLFNs. We first define a noise resistant training objective function for SLFNs. Afterwards, we develop the GNNR-I-ELM algorithm which adds τ nodes into the network at each iteration. The GNNR-I-ELM algorithm estimates the output weights of the newly additive nodes and does not change all the previously trained output weights. Its noise tolerant ability is much better than that of the original I-ELM. Besides, we prove that in terms of the training set mean squared error of noisy networks, the GNNR-I-ELM algorithm converges.

2:00PM *A Comparison of Supervised Machine Learning Algorithms for Classification of Communications Network Traffic [#17637]*

Pramitha Perera, Yu-Chu Tian, Colin Fidge and Wayne Kelly, Queensland University of Technology, Australia

Automated network traffic classification is a basic requirement for managing Quality of Service in communications networks. This research compares the performance of six widely-used supervised machine learning algorithms for classifying network traffic. The evaluations were conducted for classification of five distinct network traffic classes and two feature selection techniques. Our comparative results show that the Random Forest and Decision Tree algorithms are promising classifiers for network traffic in terms of both classification accuracy and computational efficiency.

2:15PM *Adaptive Lp (0<p<1) Regularization: Oracle Property and Applications [#17220]*

Yunxiao Shi, Xiangnan He, Han Wu, Zhongxiao Jin and Wenlian Lu, Fudan Uuniversity, China; Fudan University, China; SAIC Motor Corporation Limited, China

In this paper, we propose adaptive Lp (0<p<1) estimators in sparse, high-dimensional, linear regression models when the number of covariates depends on the sample size. Other than the case of the number of covariates is smaller than the sample size, in this paper, we prove that under appropriate conditions, these adaptive Lp estimators possess the oracle property in the case that the number of covariates is much larger than the sample size. We present a series of experiments demonstrating the remarkable performance of this estimator with adaptive Lp regularization, in comparison with the L1 regularization, the adaptive L1 regularization, and non-adaptive Lp regularization with 0<p<1, and its broad applicability in variable selection, signal recovery and shape reconstruction.

2:30PM *Fuzzy Self-organizing Incremental Neural Network for Fuzzy Clustering [#17331]*

Tianyue Zhang, Baile Xu and Furao Shen, Nanjing University, China

In this paper, a neural network named fuzzy self-organizing incremental neural network (fuzzy SOINN) is presented for fuzzy clustering with following four characteristics: fuzzy, incremental learning, topological representation and resistance to noise. No predefined structures of clusters is required due to the self-adjusting nodes and edges which fit the learning data incrementally. A removal of nodes and edges promises the robustness of the network to the noisy data. Experiments on artificial and real-world data prove the validity of the clustering method.

2:45PM *Topology Learning Embedding: A Fast and Incremental Method for Manifold Learning [#17416]*

Tao Zhu, Furao Shen, Jinxi Zhao and Yu Liang, Nanjing University, China

In this paper, we propose a novel manifold learning method named topology learning embedding (TLE). The key issue of manifold learning is studying data's structure. Instead of blindly calculating the relations between each pair of available data, TLE learns data's internal structure model in a smarter way: it constructs a topology preserving network rapidly and incrementally through online input data; then with the Isomap-based embedding strategy, it achieves out-of-sample data embedding efficiently. Experiments on synthetic data and real-world handwritten digit data demonstrate that TLE is a promising method for dimensionality reduction.

3:00PM *Quality Control for Crowdsourced Multi-Label Classification using RAkEL [#17547]*

Kosuke Yoshimura, Yukino Baba and Hisashi Kashima, Kyoto University, Japan

The quality of labels is one of the major issues in crowdsourced labeling tasks. A convenient method for ensuring the quality of labels is to assign the same labeling task to multiple workers and aggregate the labels. Several statistical aggregation methods for single-label classification tasks have been proposed; however, for multi-label classification tasks has not been well studied. Although the existing aggregation methods for single-label classification tasks can be applied to the multi-label classification tasks, they are not designed to incorporate relationships among classes, or they require large computation time. To address these issues, we propose to use RAndom k-labELsets (RAkEL). By incorporating an existing aggregation method for single-label classification tasks into RAkEL, we propose a novel quality control method for crowdsourced multi-label classification. We demonstrate that our method achieves better quality than the existing methods with real data especially when spammers are included in the worker pool.

3:15PM *A Self-adaptive Growing Method for Training Compact RBF Networks [#17559]*

Baile Xu, Furao Shen, Jinxi Zhao and Tianyue Zhang, Nanjing University, China

Radial Basis Function (RBF) network is a neural network model widely used for supervised learning tasks. The prediction time of a RBF network is proportional to the number of nodes in its hidden layer, while there is also a positive correlation between the number of nodes and the predication accuracy. In this paper, we propose a new training algorithm for RBF networks in order to construct high accuracy networks with as few nodes as possible. The proposed method starts with an empty network, selecting a best node from candidates iteratively until the training error reduces to a threshold or the number of nodes reaches a limit. Then the network is further optimized with a supervised fine-tuning method. Experimental results indicate that the proposed method could achieve better performances than traditional algorithms when training same sized RBF networks.

WedA5 Deep learning 1

Wednesday, November 15, 1:30PM-3:30PM, Room: Zhujiang 7, Chairs: Qinglai Wei and Xiaolin Hu

1:30PM *Training Very Deep Networks via Residual Learning with Stochastic Input Shortcut Connections [#17284]*

Oyebade Oyedotun, Abd El Rahman Shabayek, Djamila Aouada and Bjorn Ottersten, University of Luxembourg, Luxembourg

Many works have posited the benefit of depth in deep networks. However, one of the problems encountered in the training of very deep networks is feature reuse; that is, features are 'diluted' as they are forward propagated through the model. Hence, later network layers receive less informative signals about the input data, consequently making training less effective. In this work, we address the problem of feature reuse by taking inspiration from an earlier work which employed residual learning for alleviating the problem of feature reuse. We propose a modification of residual learning for training very deep networks to realize improved generalization performance; for this, we allow stochastic shortcut connections of identity mappings from the input to hidden layers. We perform extensive experiments using the USPS and MNIST datasets. On the USPS dataset, we achieve an error rate of 2.69% without employing any form of data augmentation (or manipulation). On the MNIST dataset, we reach a comparable state-of-the-art error rate of 0.52%. Particularly, these results are achieved without employing any explicit regularization technique.

1:45PM *Two-Stage Temporal Multimodal Learning for Speaker and Speech Recognition [#17579]*

Qianli Ma, Lifeng Shen, Ruishi Su and Jieyu Chen, South China University of Technology, China; University of California, United States

Temporal information prevails in multimodal sequence data, such as video data and speech signals. In this paper, we propose a two-stage learning to model the temporal information in multimodal sequences. At the first learning stage, static representative features are extracted from each modality at every time step. Then joint representations across various modalities are effectively learned within a joint fusion layer. The second one is to transfer the static features into corresponding dynamical features by jointly learning the temporal information and dependencies between different time steps with a Long Short-Term Memory (LSTM). Compared with previous multimodal methods, the proposed model is efficient in learning temporal joint representations. Evaluated on Big Bang Theory speaker recognition dataset and AVLetters speech recognition dataset, our model proves to outperform other methods.

2:00PM *SLICE: Structural and Label Information Combined Embedding for Networks [#17641]*

Yiqi Chen and Tieyun Qian, Wuhan University, China

This paper studies the problem of learning representations for network. Existing approaches embed vertices into a low dimensional continuous space which encodes local or global network structures. While these methods show improvements over traditional representations on node classification tasks, they ignore label information until the learnt embeddings are used for training classifier. That is, the process of representation learning is separated from the labels and lacks such information. In this paper, we propose a novel method which learns the embeddings for vertices under the supervision of labels. Motivated by the idea of label propagation, our approach extends the traditional label propagation to the deep neural network field. The embedding of a node could contain the structural and label information by broadcasting the label information during the training process. We conduct extensive experiments on two real network datasets. Results demonstrate that our approach outperforms both the state-of-the-art graph embedding and label propagation approaches by a large margin.

2:15PM *Image Recognition with Histogram of Oriented Gradient Feature and Pseudoinverse Learning Auto-Encoders [#17802]*

Sibo Feng, Shijia Li, Ping Guo and Qian Yin, Beijing Normal University, China

Neural network is an artificial intelligence technology which achieve good results in computer vision, natural language processing and other related fields. Currently the most used model for image recognition is convolutional neural networks, however, it has complex structure, there many group open sources of code but it is difficult to reuse. Moreover, most of training algorithm of the model is based on the gradient descent which takes a lot of time to adjust parameters. In order to solve these problems, this paper presents a model combining the histogram of oriented gradient and the pseudoinverse learning autoencoders. Our model does not require any iterative optimization, the number of the neurons and the number of hidden layers are automatically determined in the model. At the same time, our model has a simple structure, do not requires a huge amount of computing resources. Experimental results show that our model is superior to other baseline models.

2:30PM *An STDP-Based Supervised Learning Algorithm for Spiking Neural Networks [#17810]*

Zhanhao Hu, Tao Wang and Xiaolin Hu, Tsinghua University, China; Huawei Technology, China

Compared with rate-based artificial neural networks, Spiking Neural Networks (SNN) provide a more biological plausible model for the brain. But how they perform supervised learning remains elusive. Inspired by recent works of Bengio et al., we propose a supervised learning algorithm based on Spike-Timing Dependent Plasticity (STDP) for a hierarchical SNN consisting of Leaky Integrate-and-fire (LIF) eurons. A time window is designed for the presynaptic neuron and only the spikes in this window take part in the STDP updating process. The model is trained on the MNIST dataset. The classification accuracy approach that of a Multilayer Perceptron (MLP) with similar architecture trained by the standard back-propagation algorithm.

2:45PM *Morph-CNN: A Morphological Convolutional Neural Network for Image Classification [#17874]*

Dorra Mellouli, Tarek.M Hamdani, Mounir Ben Ayed and Adel M Alimi, University of Sfax, Tunisia

Deep neural networks, an emergent type of feed forward networks, have gained a lot of interest especially for computer vision problems such as analyzing and understanding digital images. In this paper, a new deep learning architecture is proposed for image analysis and recognition. Two key ingredients are involved in our architecture. First, we used the convolutional neural network, as it is well adapted for image processing since it is the most used form of stored documents. Second, a morphological feature extraction is integrated mainly thanks to its positive impact on enhancing image quality. We have validated our Morph-CNN on multi digits recognition. A study of the impact of morphological operators on the performance measure was conducted.

3:00PM *An End-to-End Approach for Bearing Fault Diagnosis based on a Deep Convolution Neural Network [#17862]*

Liang Chen, Yuxuan Zhuang, Jinghua Zhang and Jianming Wang, Soochow University, China; Suzhou Asia-Pacific Metals co. LTD, China

Traditional methods for bearing fault diagnosis mostly utilized a shallow model like support vector machine (SVM) that required professional machinery skills and much of knowledge. Deep models like Deep belief network (DBN) had shown its advantage in fault feature extraction without prior knowledge. In this paper, an end-to-end approach based on deep convolution neural network (DCNN) is presented. The approach embodying the idea of end to end diagnosis has only one simple and elegant convolution neural network and don't need any exquisite hierarchical structure that was used in the traditional methods. The samples of time-domain signals are input into the proposed model without any frequency transformation, and the approach can diagnosis bearing fault types and fault sizes simultaneously as output. Experimental researches had shown that the approach has the advantages such as a simple structure, less iteration and real-time, while its accuracy on the diagnosis of fault types and fault sizes can still be guaranteed.

3:15PM *Layer-wise Training to Create Efficient Convolutional Neural Networks [#17463]*

Linghua Zeng and Xinmei Tian, University of Science and Technology of China, China

Recent large CNNs have delivered impressive performance but their storage requirement and computational cost limit a wide range of their applications in mobile devices and large-scale Internet industry. Works focusing on storage compression have led a great success. Recently how to reduce computational cost draws more attention. In this paper, we propose an algorithm to reduce computational cost, which is often solved by sparsification and matrix decomposition methods. Since the computation is dominated by the convolutional operations, we focus on the compression of convolutional layers. Unlike sparsification and matrix decomposition methods which usually derive from mathematics, we receive inspiration from transfer learning and biological neural networks. We transfer the knowledge in state-of-the- art large networks to compressed small ones, via layer-wise training. We replace the complex convolutional layers in large networks with more efficient modules and keep their outputs in each-layer consistent. Modules in the compressed small networks are more efficient, and their design draws on biological neural networks. For AlexNet model, we achieve 3.62x speedup, with 0.11% top-5 error rate increase. For VGG model, we achieve 5.67x speedup, with 0.43% top-5 error rate increase.

WedA6 Brain-computer interface

Wednesday, November 15, 1:30PM-3:30PM, Room: Kaixuan 3, Chairs: Dongrui Wu and Xu Huang

1:30PM *Real-time fMRI-based Brain Computer Interface: A Review [#17480]*

Yang Wang and Dongrui Wu, Huazhong University of Science and Technology, China

In recent years, the rapid development of neuroimaging technology has been providing many powerful tools for cognitive neuroscience research. Among them, the functional magnetic resonance imaging (fMRI), which has high spatial resolution, acceptable temporal resolution, simpler calibration, and shorter preparation time, has been widely used in brain research. Compared with the electroencephalogram (EEG), real-time fMRI-based brain computer interface (rtfMRI-BCI) not only can perform decoding analysis across the whole brain to control external devices, but also allows a subject to voluntarily self- regulate specific brain regions. This paper reviews the basic architecture of rtfMRI-BCI, the emerging machine learning based data analysis approaches (also known as multi-voxel pattern analysis), and the applications and recent progresses of rtfMRI-BCI.

1:45PM *Intent Recognition in Smart Living Through Deep Recurrent Neural Networks [#17215]*

Xiang Zhang, Lina Yao, Chaoran Huang, QuanZheng Sheng and Xianzhi Wang, University of New South Wales, Australia; Macquarie University, Australia; Singapore Management Univerisity, Australia

Electroencephalography (EEG) signal based intent recognition has recently attracted much attention in both academia and industries, due to helping the elderly or motor-disabled people controlling smart devices to communicate with outer world. However, the utilization of EEG signals is challenged by low accuracy, arduous and time- consuming feature extraction. This paper proposes a 7-layer deep learning model to classify raw EEG signals with the aim of recognizing subjects' intents, to avoid the time consumed in pre-processing and feature extraction. The hyper-parameters are selected by an Orthogonal Array experiment method for efficiency. Our model is applied to an open EEG dataset provided by PhysioNet and achieves the accuracy of 0.9325 on the intent recognition. The applicability of our proposed model is further demonstrated by two use cases of smart living (assisted living with robotics and home automation).

2:00PM *A Computational Investigation of an Active Region in Brain Network Based on Stimulations with Near-Infrared Spectroscopy [#17150]*

Xu Huang, Raul Fernandez Rojas, Allan C. Madoc, Keng-Liang Ou and Sheikh Md. Rabiul Islam, University of Canberra, Australia; Commonwealth Bank, Australia; Taipei Medical University, Taiwan; Khulna University, Bangladesh

Near-infrared spectroscopy (NIRS) has been widely used in medical imaging to observe oxygenation and hemodynamic responses in the cerebral cortex. In this paper, the major target is reporting our current study about the computational investigation of functional near infrared spectroscopy (fNIRS) in the somatosensory region with noxious stimulations. Based on signal pro-cessing technologies within communication network, the related technologies are applied, including cross correlation analysis, optic flow, and wavelet. The visual analysis exposed pain-related activations in the primary somatosensory cortex (S1) after stimulation which is consistent with similar studies, but the cross correlation results strongly evidenced dominant channels on both cerebral hemispheres. Our investigation also demonstrated that the spatial distribution of the cortical activity origin can be described by the hemodynamic responses in the cerebral cortex after evoked stimulation using near infrared spectroscopy. The current outcomes of this computational investigation explore that it is good potential to be employed to deal with pain assessment in human subjects.

2:15PM *Optimized Echo State Network with intrinsic plasticity for EEG-based Emotion Recognition [#17876]*

Rahma Fourati, Boudour Ammar, Chaouki Aouiti, Javier Sanchez-Medina and Adel M Alimi, University of Sfax, Tunisia; University of Carthage, Tunisia; University of Las Palmas de Gran Canaria, Spain

Reservoir Computing (RC) is a paradigm for efficient training of Recurrent Neural Networks (RNNs). The Echo State Network (ESN), a type of RC paradigm, has been widely used for time series forecasting. Whereas, few works exist on classification with ESN. In this paper, we shed light on the use of ESN for pattern recognition problem, i.e. emotion recognition from Electroencephalogram (EEG). We show that the reservoir with its recurrence is able to perform the feature extraction step directly from the EEG raw. Such kind of recurrence rich of nonlinearities allows the projection of the input data into a high dimensional state space. It is well known that the ESN fails due to the poor choices of its initialization. Nevertheless, we show that pretraining the ESN with the intrinsic plasticity rule remedies the shortcoming of randomly initialization. To validate our approach, we tested our system on the benchmark DEAP and the results were promising.

2:30PM *A new hybrid feature selection algorithm applied to driver's status detection [#17702]*

Pengfei Ye, Lanlan Chen and Ao Zhang, East China University of Science and Technology, China

This research introduces a framework based on multimodal feature analysis and hybrid feature selection algorithm for improving the recognition rate of driver's status. In order to provide rich information about physiological conditions of human operators, a variety of physiological features are widely extracted from time, spectral, wavelet and nonlinear domains. The redundant and noisy parts of the original feature set could negatively influence the identification performance and occupy limited computing resource. Therefore, a new hybrid feature selection approach is proposed to handle the high dimensionality of feature space and improve classification precision simultaneously. Decision Tree and Sparse Bayesian Learning were employed to generate the initial feature subset that could be further optimized by the adaptive tabu search with Fisher classifier. Finally, three-level driver's stress statuses were discriminated by using support vector machine. Our experimental results show that the proposed algorithm has achieved satisfactory identification rate of driver's status with compact feature vector.

2:45PM *Deep Learning Method for Sleep Stage Classification [#17730]*

Ling Cen, Zhuliang Yu, Yun Tang, Wen Shi, Tilmann Kluge and Wee Ser, Nanyang Technological University, Singapore; South China University of Technology, China; Austrian Institute of Technology, Austria

When humans fall asleep, they go through five sleep stages, i.e. wakefulness, stages of non-rapid eye movement consisting of N1, N2 and N3, and rapid eye movement (REM). Monitoring the proportion and distribution of sleep stages can help to diagnose sleep disorder and measure sleep quality. Traditional process of sleep scoring by well-trained experts is quite subjective and time-consuming. Automatic sleep staging analysis has demonstrated a lot of usefulness and attracted increasing attentions. With the massively growing size of accessible data and the rapid development of computational power, Deep Learning (DL) has achieved significant improvement in a lot of areas. In this work, an intelligent system for sleep stage classification is developed by using polysomnographic (PSG) data including electroencephalogram (EEG), electrooculogram (EOG) and electromyogram (EMG) based on a DL architecture. In our method, the Convolutional Neural Network (CNN) is employed as the feature detector, which is combined with a Hidden

Markov Model (HMM) for its strengths of dealing with temporal data. Experiment results have shown a performance improvement compared to those methods with hand-crafted features or unsupervised feature learning by Deep Brief Learning (DBN).

3:00PM *Composite and Multiple Kernel Learning for Brain Computer Interface [#17088]*

Minmin Miao, Hong Zeng and Aimin Wang, Southeast University, China

High-performance feature engineering and classification algorithms are significantly important for motor imagery (MI) related brain-computer interface (BCI) applications. In this research, we offer a new composite kernel support vector machine (CKSVM) based method to extract significant common spatial pattern (CSP) feature components from multiple temporal-frequency segments in a data-driven manner. Furthermore, we firstly introduce a multiple kernel discriminant analysis (MKDA) method for MI EEG classification. The experimental results on BCI competition IV data set 2b clearly showed the effectiveness of our method outperforming other similar approaches in the literature.

3:15PM *EEG-Based Driver Drowsiness Estimation Using Convolutional Neural Networks [#17628]*

Yuqi Cui and Dongrui Wu, Huazhong University of Science and Technology, China

Deep learning, including convolutional neural networks (CNNs), has started finding applications in brain-computer interfaces (BCIs). However, so far most such approaches focused on BCI classification problems. This paper ex- tends EEGNet, a 3- layer CNN model for BCI classification, to BCI regression, and also utilizes a novel spectral meta-learner for regression (SMLR) approach to aggregate multiple EEGNets for improved performance. Our model uses the power spectral density (PSD) of EEG signals as the input. Compared with raw EEG inputs, the PSD inputs can reduce the computational cost significantly, yet achieve much better regression performance. Experiments on driver drowsiness estimation from EEG signals demonstrate the outstanding performance of our approach.

WedA7 Computational intelligence 1

Wednesday, November 15, 1:30PM-3:30PM, Room: Kaixuan 5, Chairs: Corina Rotar and Luda Werbos

1:30PM *Multi-robot task allocation based on cloud ant colony algorithm [#17043]*

Xu Li, Zhengyan Liu and Fuxiao Tan, Fuyang Teachers College, China

In this paper, an improved ant colony algorithm based on cloud model is proposed to study the multi-robot task allocation problem. The improvement of the proposed algorithm mainly includes the construction of adaptive control mechanism, pheromone updating mechanism and task point selection mechanism. Some important optimization operators are designed such as eval-uation of pheromone distribution, determination of suboptimal solution and se-lection of task point. Simulation results show that the proposed algorithm can obtain high-quality solution and fast convergence, the effect is significant.

1:45PM *Using Hidden Markov Model to Predict Human Actions with Swarm Intelligence [#17333]*

Zhicheng Lu, Vera Yuk Ying Chung, Henry Wing Fung Yeung, Seid Miad Zandavi, Weiming Zhi and Wei-Chang Yeh, The University of Sydney, Austria; The University of Sydney, Australia; Department of Engineering Science, The University of Auckland, New Zealand; National Tsing Hua University, China

This paper proposed a novel algorithm which named Randomized Particle Swarm Optimization (RPSO) to optimize HMM for human activity prediction. The experiments designed in this paper are the classification of human activity using two data sets. The first testing data is from the TUM Kitchen Data Set and the other is the Human Activity Recognition using the Smartphone Data Set from UCI Machine Learning Repository. Based on the comparison of the accuracies for the conventional HMM and optimized HMM, a conclusion can be drawn that the proposed RPSO can help HMM to achieve higher accuracy for human action recognition. Our results show that RPSO-HMM can improve 15% accuracy in human activity recognition and prediction when compared to the traditional HMM.

2:00PM *H-PSO-LSTM: Hybrid LSTM trained by PSO for Online Handwriter Identification [#17359]*

Hounaida Moalla, Walid Elloumi and Adel M Alimi, University of Sfax, Tunisia

The automatic writer's recognition from his manuscript is a topical issue handling online writing. Recurrent neural networks (RNNs) are an effective means of solving such problem. More specifically, RNN networks with Long and Short Term Memory (LSTM) represent an ideal mean for writer's recognition. Intuitively, LSTM networks are based on the gradient method for their learning processes. In addition, an LSTM node presents a complex data processing machine. Our hybrid approach combining LSTM and PSO (H-PSO-LSTM) presents the purpose of this paper and increases the performance of the network. Experiments were carried out on a Biometrics Ideal Test (BIT) bilingual database (Chinese and English). The BIT deals with a large number of writers (between 130 and 188). With H-PSO-LSTM, we were able to improve the learning performance accuracy to 91.9% instead of 81.2%.

2:15PM *Selection mechanism in artificial bee colony algorithm: A comparative study on numerical benchmark problems [#17539]*

Xinyu Zhou, Mingwen Wang, Jianyi Wan and Hui Wang, Jiangxi Normal University, China; Nanchang Institute of Technology, China

Artificial bee colony (ABC) is a very effective and efficient swarm-based intelligence optimization algorithm, which has attracted a lot of attention in the community of evolutionary algorithms. Until now, many different variants of ABC have been proposed, and most of them are concentrated on improvement of the solution search equation. However, few works have been focused on the selection mechanism in the onlooker bee phase which is an important component of ABC. In this paper, hence, we present a comparative study on the selection mechanism to investigate its effect on the performance of ABC. Six different selection mechanisms are included in the comparison, and 21 well-known benchmark problems are used in the experiments. Results show that the fitness rank-based mechanisms perform better.

2:30PM *Feature Extraction for the Identification of Two-Class Mechanical Stability Test of Natural Rubber Latex [#17127]*

Weng Kin Lai, Kee Sum Chan, Chee Seng Chan, Kam Meng Goh and Jee Keen Raymond Wong, Tunku Abdul Rahman University College, Malaysia; University of Malaya, Malaysia

Rubber latex concentrate is a popular raw material widely used for making many common household and industrial products. As its quality is not consistent due to either, the source, weather, storage time, etc. there is a need to be able to measure its quality. A common measure of its quality is the mechanical stability, which is defined as the time at the first onset of flocculation when the latex is subjected to physical stress. Currently, the assessment is performed manually by trained personnel, closely adhering to the specifications defined by the ISO 35 standard mechanical stability test that is widely adopted by the rubber industry. Nevertheless, there is some level of subjectivity involved as the test heavily depends on the human eyesight as well as the technician's experience. In this paper, we proposed a new feature set for a computer vision-based mechanical stability classification system that is based on the current standard test.

We investigated this with several features as well as a new feature set that is based on the particle size. These were classified with a feedforward neural network. Experimental results demonstrated that the proposed system was able to provide good classification accuracies for this two-class MST problem.

2:45PM *Distributed Recurrent Neural Network Learning via Metropolis-Weights Consensus [#17878]*
Najla Slama, Walid Elloumi and Adel M Alimi, University of Sfax, Tunisia

When data are shared among arbitrarily connected machines, the training process became an interesting challenge where each node is initialized with a specific scalar value, so it present a problem of computing their average taking into account interconnectivity between agents in order to ensure that the objective process converges as the centralized counterpart, the decentralized average consensus (DAC) is the most popular strategy due to its low-complexity. In this paper a random topology is choosing to validate a network of agents with a given probability of interconnectivity between every pair of neighbors nodes, the global regularized least-square problem requires an optimization procedure to solve it with decentralized fashion then, the question is what is the optimal output weight vector that we have to choose for the test task, here the DAC intervenes to encourage all agents having the same vectors or we will be on the case of local training, so we must choose appropriately the DAC strategy in order that all agents converge to the same state. The contribution key is to apply the Metropolis-Weights as a strategy of average consensus to compute the mean of the updates of nodes at each step with several tests, this protocol demonstrate convergence of the consensus algorithm for network without packet losses. Experimental results on prediction and identification tasks show a favorable performance in terms of accuracy and efficiency

3:00PM *CACO-LD: Parallel Continuous Ant Colony Optimization with Linear Decrease Strategy for Solving CNOP [#17099]*
Shijin Yuan, Yunyi Chen and Bin Mu, Tongji University, China

Increasing intelligence algorithms have been applied to solve conditional nonlinear optimal perturbation (CNOP), which is proposed to study the predictability of numerical weather and climate prediction. Currently, swarm intelligence algorithms have much lower stability and efficiency than single individual intelligence algorithms, and the validity of CNOP (in terms of CNOP magnitude and CNOP pattern) obtained by swarm intelligence algorithms is not as good as that obtained by single individual intelligence algorithms. In this paper, we propose an improved parallel swarm intelligence algorithm, continuous ant colony optimization with linear decrease strategy (CACO-LD), to solve CNOP. To verify the validity of the CACO-LD, we apply it to study El Nino-Southern Oscillation (ENSO) event with Zebiak-Cane (ZC) model. Experimental results show that the CACO-LD can achieve better CNOP magnitude, better CNOP pattern with much higher stability than the modified artificial bee colony algorithm (MABC) and the continuous tabu search algorithm with sine maps and staged strategy (CTS-SS), which respectively are the latest best swarm intelligence algorithm and single individual intelligence algorithm for solving CNOP. Moreover, when using 32 processes, the parallel CACO-LD runs 3.9 times faster than the parallel MABC, and is competitive with the parallel CTS-SS in efficiency.

3:15PM *Knowledge Graph Based Question Routing for Community Question Answering [#17385]*
Zhu Liu, Kan Li and Dacheng Qu, Beijing Institute of Technology, China

Community-based question answering(CQA) such as Stack Overflow and Quora face the challenge of providing unsolved questions with high expertise users to obtain high quality answers, which is called question routing. Many existing methods try to tackle this by learning user model from structure and topic information, which suffer from the sparsity issue of CQA data. In this paper, we propose a novel question routing method from the viewpoint of knowledge graph embedding. We integrate topic representations with network structure into a unified Knowledge Graph Question Routing framework, named as KGQR. The extensive experiments carried out on Stack Overflow data suggest that KGQR outperforms other state-of-the-art methods.

WedA8 Computer vision 1

Wednesday, November 15, 1:30PM-3:30PM, Room: Kaixuan 6, Chairs: Xiuling Zhou and Sung Bae Cho

1:30PM *Robust Visual Tracking via Occlusion Detection Based on Depth-layer Information [#17285]*
Xiaoguang Niu, Zhipeng Cui, Shijie Geng, Jie Yang and Yu Qiao, Shanghai Jiao Tong University, China

In this paper, we propose a novel occlusion detection algorithm based on depth-layer information for robust visual tracking. The scene can be classified into the near, the target and the far layer. We find that when occlusion happens, some background patches in the near layer will move into the target region and hence occlude the target. Based on this feature of occlusion, we propose an algorithm which exploits both temporal and spatial context information to discriminate occlusion from target appearance variation. Using the framework of particle filter, our algorithm divides the background region around the target into multiple patches and tracks each of them. The background patch that occludes the target is identified collaboratively by the tracking results of both background and target trackers. Then the occlusion is evaluated with the target visibility function. If occlusion is detected, the target template stops updating. Comprehensive experiments in OTB-2013 and VOT-2015 show that our tracker achieves comparable performance with other state-of-art trackers.

1:45PM *Mixture of matrix normal distributions for color image inpainting [#17703]*
Xiuling Zhou, Jing Wang, Ping Guo and C. L. Philip Chen, Beijing City University, China; Peking University, China; Beijing Normal University, China; University of Macau, China

Gaussian mixture model is commonly used as image prior model to solve image restoration problem. However, vector representation leads to lose the inherent spatial relevant information and cause unstable estimation. In this paper, a mixture of matrix normal distributions (MMND) based image restoration algorithm is proposed, which incorporates the hidden structural information into prior image modeling. MMND is used as the prior image model and expectation maximization algorithm is used to optimize the maximum posterior criterion. Experiments conducted on color images indicate that MMND can achieve better peak signal to noise ratio(PSNR) as compared to other state-of-the-art methods.

2:00PM *Revisiting Faster R-CNN: A Deeper Look at Region Proposal Network [#17182]*
Guangxing Han, Xuan Zhang and Chongrong Li, Tsinghua University, China

Currently, state-of-the-art object detectors are based on Faster R-CNN. We firstly revisit Faster R-CNN and explore problems in it, e.g., coarseness of feature maps for accurate localization, fixed-window feature extraction in RPN and insensitivity for small scale objects. Then a novel object detection network is proposed to address these problems.

Specifically, we utilize a two-stage cascade multi-scale proposal generation network to get high accurate proposals: an original RPN is adopted to initially generate coarse proposals, then another network with multi-layer features and RoI pooling layer are introduced to refine these proposals. We also generate small scale proposals in the second stage simultaneously. After that, a detection network with multi-layer features further classifies and refines proposals. A novel 3-step joint training algorithm is introduced to optimize our model. Experiments on PASCAL VOC 2007 and 2012 demonstrate the effectiveness of our network.

2:15PM *A Novel Ant Colony Detection using Multi-Region Histogram for Object Tracking [#17191]*

Seid Miad Zandavi, Feng Sha, Vera Yuk Ying Chung, Zhicheng Lu and Weiming Zhi, The University of Sydney, Australia; University of Auckland, New Zealand

Efficient object tracking become more popular in video processing do-main. In recent years, many researchers have developed excellent models and methods for complicated tracking problems in real environment. Among those approaches, object feature definition is one of the most important component to obtain better accuracy in tracking. In this paper, we propose a novel multi-region feature selection method which defines histogram values of basic areas and random areas (MRH) and combined with continuous ant colony filter detection to represent the original target. The proposed approach also achieves smooth tracking on different video sequences, especially with Motion Blur problem. This approach is designed and tested in MATLAB2016b environment. The experiment result demonstrates better and faster tracking performance and shows continuous tracking trajectory and competitive outcomes regarding to traditional methods.

2:30PM *A Lagrange Programming Neural Network Approach for Robust Ellipse Fitting [#17361]*

Hao Wang, Ruibin Feng, Andrew Chi Sing Leung and H.C. So, City University of Hong Kong, Hong Kong

Ellipse fitting aims at constructing an elliptical equation that best fits the scattering points collected from an edge detection process. However, the edge detection process may introduce some noisy scattering points. This paper proposes a robust ellipse fitting model based on the Lagrange programming neural network (LPNN) framework. We formulate the ellipse fitting problem as a constrained optimization problem. The objective function contains an ℓ_1- norm term which can effectively suppress the effect of outliers. Since the LPNN framework cannot handle non-differentiable objective functions, we introduce an approximation for the ℓ_1-norm term. Besides, the local stability of the proposed LPNN method is discussed. Simulation results show that the proposed ellipse fitting algorithm can effectively reduce the influence of outliers.

2:45PM *Object Tracking Based on Mean Shift Algorithm and Kernelized Correlation Filter Algorithm [#17377]*

Huazheng Zhou, Xiaohu Ma and Lina Bian, Soochow University, China

In order to solve the problems of motion blur and fast motion, a new robust object tracking algorithm using the Kernelized Correlation Filters (KCF) and the Mean Shift (MS) algorithm, called KCFMS is presented in this paper. The object tracking process can be described as: First, we give the initial position and size of the object and use the Mean Shift algorithm to obtain the position of the object. Second, the Kernelized Correlation Filtering algorithm is used to obtain the position of the object in the same frame. Third, we use the cross update strategy to update the object models. In order to improve the tracking speed as much as possible, our object tracking algorithm works only over one layer. This hybrid algorithm has a good tracking effect on the target fast motion and motion blur. We present extensive experimental results on a number of challenging sequences in terms of efficiency, accuracy and robustness.

3:00PM *Deep Encoding Features for Instance Retrieval [#17465]*

Zhiming Ding, Zhengzhong Zhou and Liqing Zhang, Shanghai Jiao Tong University, China

In this paper, we propose a novel approach for instance retrieval. Compared with traditional retrieval pipeline, we first locate several candidate regions of target object with a region proposal network (RPN), instead of exhausting sliding window method. The candidate regions are detected through the trained RPN. Then we obtain the region-wise convolutional feature maps (CFMs) by forwarding them through a ROI pooling layer. Our feature encoding representation builds on the common sense that similar patterns have similar activations on feature maps. The target object is regarded as a combination of several meaningful patterns. In this way, we represent an image with the combination of encoded descriptors corresponding to the subsets of the proposed region. We also implement reranking algorithm to refine the proposed region in local retrieval. Through extensive experiments, we demonstrate the suitability of our feature encoding representation for instance retrieval, achieving comparable performance on both Oxford and Paris buildings benchmarks.

3:15PM *Uncalibrated Trinocular-microscope Visual Servo Control Strategy [#17684]*

Xuewei Wang, Qun Gao and Fucheng You, Beijing Institute of Graphic Communication, China; Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, China

Considering that both calibtating accurate the camera parameters and establishing a precise robot kinematics model are hardly, the uncalibrated tri- nocular-microscope visual servoing control strategy used for achieving precise positioning of the cylindrical target is proposed in this paper. Firstly, using Canny-algorithm, polar coordinate scanning and Ransac Least-Square fitting to extract the features of the target image and Moving-edge algorithm is used to realize real-time tracking of the target. Secendly, dynamic Quasi-Newton algorithm is adopted to estimate the image Jacobian matrix of the trinocular- microscope visual system. Thirdly, use the variance minimization strategy of the target pose error function to control the end movement of positioning robot, and use the strategy of iterative least-squares to improve the stability of the whole system. Further more, obtain the initial value of image Jacobian matrix according to the target moving which is in form of discrete linear independence movement near the desired pose. Finally, the dynamic residuals are adjusted in order to achieve precise positioning of the target under the condition that the basic platform of the positioning robot is in disturbance. Experimental results demonstrate the effectiveness of the proposed strategy.

Wednesday, November 15, 1:30PM-6:00PM

Plenary Poster Session: P1 Poster Session 1

Wednesday, November 15, 1:30PM-6:00PM, Room: Poster Area, Chairs: Bin Xu and Zhigang Zeng

P101 *Symbolic Solutions to Division by Zero Problem via Gradient Neurodynamics [#17617]*

Yunong Zhang, Huihui Gong, Jian Li, Huanchang Huang and Ziyu Yin, Sun Yat-sen University, China

Division by zero (DBZ) problem, or say, division singularity problem, has perplexed scientists and engineers in many fields for centuries. How to solve DBZ problem has actually been discussed for more than 1200 years. Despondingly, plenty of efforts failed to solve DBZ problem effectively, and it is still considered as a formidable conundrum. This paper introduce an extension of the division operation from a time-varying perspective. Most problems in science and engineering fields are time-varying, and thus the extension is reasonable and practical. Furthermore, by employing the neat gradient-based neurodynamics (or say, gradient neurodynamics) equation different times, a series of different ``symbolic'' solutions are proposed. Note that the proposed symbolic solutions have the ability to conquer DBZ problem. The symbolic solutions to DBZ problem may promote the development of more complete singularity-conquering applications.

P102 *An Image Enhancement Algorithm Based on Fractional-order Relaxation Oscillator [#17393]*

Xiaoran Lin, Shangbo Zhou, Hongbin Tang and Ying Qi, Chongqing University, China

In this paper, a cortex rhythms mimicking in fractional-order Relaxation oscillator is implemented and the existence of the rhythm is proved. Furthermore, the Quasi Gamma Curve (QGC) model is established based on the fraction-order Relaxation oscillator in the rhythm oscillation and we certify that the property of QGC model is similar to that of Gamma Curve by curve fitting methods. The proposed model is utilized to enhance the low contrast images. Different quantity measures demonstrate that the proposed model is effective.

P103 *Improving Generalization Capability of Extreme Learning Machine with Synthetic Instances Generation [#17124]*

Wei Ao, Yulin He, Joshua Zhexue Huang and Yu-Peng He, Shenzhen University, China; China Petroleum Pipeline Engineering Company Limited, China

In this paper, instead of modifying the framework of Extreme learning machine (ELM), we propose a learning algorithm to improve generalization ability of ELM with Synthetic Instances Generation (SIGELM). We focus on optimizing the output-layer weights via adding informative synthetic instances to the training dataset at each learning step. In order to get the required synthetic instances, a neighborhood is determined for each high-uncertainty training sample and then the synthetic instances which enhance the training performance of ELM are selected in the neighborhood. The experimental results based on 4 representative regression datasets of KEEL demonstrate that our proposed SIGELM obviously improves the generalization capability of ELM and effectively decreases the phenomenon of over-fitting.

P104 *Stochastic Online Kernel Selection with Instantaneous Loss in Random Feature Space [#17396]*

Zhizhuo Han and Shizhong Liao, Tianjin University, China

Online kernel selection is critical to online kernel learning. However, the time complexity of existing online kernel selection algorithms of each round is linear with respect to the number of examples already arrived. This is not efficient for online learning. To address this issue, we propose a novel stochastic online kernel selection algorithm via the random feature mapping and using the instantaneous loss. This algorithm has only constant time complexity at each round and theoretical guarantee. Formally, the algorithm first maps the arriving example into the random feature space. Then the algorithm updates the kernel parameter and the weights of the classifier simultaneously using SGD (stochastic gradient descent) to minimize the instantaneous loss. We also prove that the algorithm enjoys a sub-linear regret bound. Experimental results on benchmark datasets demonstrate that the proposed algorithm is effective and efficient.

P105 *Hybrid RVM Algorithm Based on the Prediction Variance [#17453]*

Fang Liu, Fei Zhao, Mi Tong, Yan Yang and Zhenhao Yu, National Engineering Laboratory of Fiber Optic Sensing Technology, China; Wuhan University of Technology,, China; Key Laboratory of Fiber Optic Sensing Technology and Information Processing of Ministry of Education, China

Relevance Vector Machine (RVM) is an important learning method in the field of machine learning for its sparsity, global optimality and the ability to solve nonlinear problems by using kernel functions. Biased wavelets are localized in time and infrequency but, unlike wavelets, have adjustable nonzero mean. The proposed hybrid algorithm employs a family of biased wavelets to construct the kernel functions of RVM, which makes the kernel of RVM more flexible. RVM models are trained according to the diversity of the signal, and the predicted variance are selected in the hybrid algorithm to improve the accuracy. Test results show that RVM with the biased wavelet kernel is able to get increased prediction precision considering data features and the predicted variance is an efficient metric to construct the hybrid algorithm.

P106 *Incremental extreme learning machine via fast random search method [#17615]*

Zhihui Lao, Zhiheng Zhou and Junchu Huang, South China University of Technology GuangZhou, China

Since extreme learning machine (ELM) was proposed, it has been found that some hidden nodes in ELM may play a very minor role in the network output. To avoid this problem, enhanced random search based incremental extreme learning machine (EI-ELM) is proposed. However, we find that the EI-ELM's training time is too long. In addition, EI-ELM can only add hidden nodes one by one. This paper proposes a fast method for EI- ELM (referred to as FI-ELM). At each learning step, several hidden nodes are randomly generated and the hidden nodes selected by the multiresponse sparse regression (MRSR) are added to the existing network. The output weights of the network are updated by a fast iterative method. The experimental results show that compared with EI-ELM, FI-ELM spends less time on training. Taking this advantage, FI-ELM can generate more hidden nodes to find the hidden node leading to larger residual error decreasing.

P107 *Using Flexible Neural Trees to Seed Backpropagation [#17779]*

Peng Wu and Jeff Orchard, University of Jinan, China; University of Waterloo, Canada

Neural networks are a powerful computational architecture for modeling data, but optimizing the connection weights can be very difficult. Flexible neural trees (FNTs) are good at finding a globally near-optimal network to fit a dataset, using evolutionary algorithms and particle swarm optimization. We show that putting the two methods to- gether can yield very good results. The FNT solution can be embedded into a larger neural network that is then optimized using backpropaga- tion. The combination of the two methods outperforms either method alone.

P108 *Learning Deep Neural Network Based Kernel Functions for Small Sample Size Classification [#17295]*

Tieran Zheng, Jiqing Han and Guibin Zheng, Harbin Institute of Technology, China

Kernel learning is to learn a kernel function based on the set of all sample pairs from training data. Even for small sample size classification tasks, the set size is mostly large enough to make a complex kernel that holds lots of parameters being well optimized. Hence, the complex kernel can be helpful in improving classification performance via providing more meaningful feature representation in kernel induced feature space. In this paper, we propose to embed a deep neural network (DNN) into kernel functions, taking its output as kernel parameter to adjust the feature representations adaptively. Two kind of DNN based kernels are defined, and both of them are proved to satisfy the Mercer theorem. Considering the connection between kernel and classifier, we optimize the proposed DNN based kernels by exploiting the GMKL alternating optimization framework. A stochastic gradient descent (SGD) based algorithm is also

proposed, which still implements alternating optimization in each iteration. Furthermore, an incremental batch size method is given to reduce gradient noise gradually in optimization process. Experimental results show that our method performed better than the typical methods.

P109 *The Sample Selection Model Based on Improved Autoencoder for the Online Questionnaire Investigation [#17647]*

Yijie Pang, Shaochun Wu and Honghao Zhu, Shanghai University, China

This paper presents the sample selection model based on improved autoencoder to solve low response rate in the online questionnaire investigation industry. This model utilizes the improved autoencoder to extract the samples' features and uses the softmax classifier to predict the samples' loyalty. Furthermore, the autoencod-er is improved with three steps: first, the number of middle hidden layer nodes is determined by Singular Value Decomposition (SVD); second, the loss function of the autoencoder is improved with the information gain ratio; finally, the con-cept of Random Denoising Autoencoder (RDA) is introduced to enhance the ro-bustness of the model. Through the selection model, samples with high loyalty will be picked out to answer the questionnaire so that the response rate can be improved. Experiments are performed to determine the feasibility and effective-ness of the model. Compared with the BP neural networks, the prediction accura-cy of our model is totally improved about 8.5% and the success rate of sending questionnaires is also improved about 15%.

P110 *Hybrid Collaborative Recommendation via Semi-AutoEncoder [#17243]*

Shuai Zhang, Lina Yao, Xiwei Xu, Sen Wang and Liming Zhu, University of New South Wales, Australia; Commonwealth Scientific and Industrial Research Organisation, Australia; Griffith University, Australia

In this paper, we present a novel structure, Semi-AutoEncoder, based on AutoEncoder. We generalize it into a hybrid collaborative filtering model for rating prediction as well as personalized top-n recommendations. Experimental results on two real-world datasets demonstrate its state-of-the- art performances.

P111 *Time Series Classification with Deep Neural Networks Based on Hurst Exponent Analysis [#17401]*

Xinjuan Li, Jie Yu, Lingyu Xu and Gaowei Zhang, Shanghai University, China

Time series classification is an important task in time series analysis. Thus, many methods have been developed for the task. However, the quality of features is difficult to measure and there is no distance measurement method for most areas. And these methods cannot extract the long-term dependency feature from time series. In order to solve these problems, we propose a new time series classification model, Long short-term memory networks and Convolution Neural Networks (LCNN). First, the model can automatically extract features from the time series. Second, LCNN solves the long- term dependence problem by introducing Long short-term memory networks (LSTM) into time series classification tasks. Third, LCNN adopts multi-branch structure to down- sampling and Gaussian noise to process the original time series, which improves the classification performance. In addition, we use the Hurst exponent to measure the long-term dependency in time series. All experiments show that LCNN improves the classification performance and is well suited for small datasets.

P112 *A Nonnegative Projection Based Algorithm for Low-Rank Nonnegative Matrix Approximation [#17400]*

Peitao Wang, Zhaoshui He, Kan Xie, Junbin Gao and Michael Antolovich, Guangdong University of Technology, China; The University of Sydney Business School, Australia; Charles Sturt University, Australia

Nonnegative matrix factorization/approximation (NMF/NMA) is a widely used method for data analysis. So far, many multiplicative update algorithms have been developed for NMF. In this paper, we propose a nonnegative projection based NMF algorithm, which is different from the conventional multiplicative update NMF algorithms and decreases the objective function by performing Procrustes rotation and nonnegative projection alternately. The experiment results demonstrate that the new algorithm converges much faster than traditional ones.

P113 *Multi-view Label Space Dimension Reduction [#17644]*

Qi Hu, Pengfei Zhu, Changqing Zhang and Qinghua Hu, Tianjin University, China

In multi-label classification, the explosion of the label space makes the classic multi-label classification models computationally inefficient and degrades the classification performance. To alleviate the curse of dimensionality in label space, many label space dimension reduction (LSDR) algorithms have been developed in last few years. Whereas, they are all designed for single-view learning and ignore that one sample can be represented from different views. In this paper, we propose a multiview LSDR model for multi-label classification. The weights of different views are learned and then multi-view label embedding results are combined by the learned weights. Experiments on benchmark datasets show that the proposed multi-view learning model outperforms the best singleview model and the majority voting method.

P114 *Robust Kernel Approximation for Classification [#17251]*

Fanghui Liu, Xiaolin Huang, Cheng Peng, Jie Yang and Nikola Kasabov, Shanghai Jiao Tong University, China; Auckland University of Technology, New Zealand

This paper investigates a robust kernel approximation scheme for support vector machine classification with indefinite kernels. It aims to tackle the issue that the indefinite kernel is contaminated by noises and outliers, i.e. a noisy observation of the true positive definite (PD) kernel. The traditional algorithms recovery the PD kernel from the observation with the small Gaussian noises, however, such way is not robust to noises and outliers that do not follow a Gaussian distribution. In this paper, we assume that the error is subject to a Gaussian-Laplacian distribution to simultaneously dense and sparse/abnormal noises and outliers. The derived optimization problem including the kernel learning and the dual SVM classification can be solved by an alternate iterative algorithm. Experiments on various benchmark data sets show the robustness of the proposed method when compared with other state-of-the-art kernel modification based methods.

P115 *Multiple Scale Canonical Correlation Analysis Networks for Two-view Object Recognition [#17034]*

Xinghao Yang and Weifeng Liu, China University of Petroleum (East China), China

With the rapid development of representation learning, deep learning has been proved to be an effective technique to extract high level features. Many variants have been reported including convolutional neural network (CNN), principle component analysis networks (PCANet) and canonical correlation analysis networks (CCANet). The representative CCANet utilizes CCA to learn two- view multi-stage filter banks and achieves significant superiority to PCANet for object recognition. However, CCANet tends to only use the output feature of the last convolutional stage, which ignores the previous different scale features. To surmount this problem, in this paper, we present a novel method dubbed multiple scale canonical correlation analysis networks (MS-CCANet). Specifically, the MS-CCANet learns more discriminative information by stacking multi-scale features of

all the convolutional stages together. Extensive experiments are conducted on ETH-80 dataset to verify the effectiveness of MS- CCANet. The results demonstrate that the proposed MS-CCANet outperforms the state-of-art methods including PCANet and CCANet.

P116 *Iterative local hyperlinear learning based Relief for feature weight estimation [#17241]*

Xiaojuan Huang, Li Zhang, Bangjun Wang, Zhao Zhang and Fanzhang Li, Soochow University, China

Feature weighting is considered as an important machine learning approach to deal with the problem of estimating the quality of attributes for pattern classification applications. Local Hyperlinear Learning based Relief (LH-Relief) was shown to be very efficient in estimating attributions in high-dimensional data involving irrelevant noises. However, the convergence of LH-Relief can not be guaranteed. In this paper, we propose an innovative feature weighting algorithm to solve the problem of LH-Relief, called Iterative Local Hyperlinear Learning based Relief (ILH-Relief). ILH-Relief is based on LH-Relief using classical margin maximization. The key idea is to estimate the feature weights through local approximation and gradient descent. To demonstrate the viability and the effectiveness of our formulation for feature selection in supervised learning, we perform extensive experiments on both UCI and Microarray datasets. The proposed algorithm can save at least half of feature ranking time with a better classification performance compared with other feature weighting methods.

P117 *Projected Kernel Recursive Least Squares Algorithm [#17044]*

Ji Zhao and Hongbin Zhang, University of Electronic Science and Technology of China, China

In this paper, a novel sparse kernel recursive least squares algorithm, namely the Projected Kernel Recursive Least Squares (PKRLS) algorithm, is proposed. In PKRLS, a simple online vector projection (VP) method is used to represent the similarity between the current input and the dictionary in a feature space. The use of projection method sufficiently applies the information contained in data to update our solution. Compared with the quantized kernel recursive least squares (QKRLS) algorithm, which is a kind of kernel adaptive filter using vector quantization (VQ) in input space, simulation results validate that PKRLS can achieve a comparable filtering performance in terms of sparse network sizes and testing mean square error.

P118 *Resource Allocation and Optimization Based on Queuing Theory and BP Network [#17613]*

Hong Tang, Delu Zeng, Xin Liu, Jiabin Huang and Yinghao Liao, Sun Yat-sen University, China; South China University of Technology, China; Xiamen University, China

In this article, we present a resource allocation and optimization strategy for data center based on resource utilization prediction with back-propagation (BP) neural network, aiming to improve the resource utilization. We handle resource contention among virtual machines with resource migrating to improve the resource utilization under the assumption of different functional applications integrated in each server. With the BP network predicted resources utilization and throughput rate of SFC (Service Function Chain), we adjust and optimize the resource configuration in virtual resource pool and servers, which further improves resource utilization in data center. Our experiments show that the proposed dynamic resource allocation and optimization strategy performs effectively. And also the BP network achieves more accuracy prediction compared with linear regression model.

P119 *Locality-sensitive Term Weighting for Short Text Clustering [#17772]*

Chu-Tao Zheng, Sheng Qian, Wen-Ming Cao and Hau-San Wong, City University of Hong Kong, Hong Kong

To alleviate sparseness in short text clustering, considerable researches investigate external information such as Wikipedia to enrich feature representation, which requires extra works and resources and might lead to possible inconsistency. Sparseness leads to weak connections between short texts, thus the similarity information is difficult to be measured. We introduce a special term-specific document set---potential locality set---to capture weak similarity. Specifically, for any two short documents within the same potential locality, the Jaccard similarity between them is greater than 0. In other words, the adjacency graph based on these weak connections is a complete graph. Further, a locality-sensitive term weighting scheme is proposed based on our potential locality set. Experimental results show the proposed approach builds more reliable neighborhood for short text data. Compared with another state-of- the-art algorithm, the proposed approach obtains better clustering performances, which verifies its effectiveness.

P120 *Self-Advised Incremental One-Class Support Vector Machines: an Application in Structural Health Monitoring [#17535]*

Ali Anaissi, Khoa Nguyen, Thierry Rakotoarivelo, Yang Wang and Makki Alamdar Mehri, The University of Sydney, Australia; Data61-CSIRO, Australia; New South Wales, Australia

Incremental One-Class Support Vector Machine (OCSVM) methods provide critical advantages in practical applications, as they are able to capture variations of the positive samples over time. This paper proposes a novel self-advised incremental OCSVM algorithm, which decides whether an incremental step is required to update its model or not. As opposed to existing method, this novel online algorithm does not rely on any fixed threshold, but it uses the slack variables in the OCSVM as proxies for data in order to determine which new data points should be included in the training set and trigger an update of the model's coefficients. This new online OCSVM algorithm was extensively evaluated using real data from Structural Health Monitoring (SHM) case studies. These results showed that this new online method provided significant improvements in classification error rates, was able to assimilate the changes in the positive data distribution over the time, and maintained a high damage detection accuracy in these SHM cases.

P121 *Batch Process Fault Monitoring Based on LPGD-kNN And its Applications in Semiconductor Industry [#17773]*

Ting Li, Dongsheng Yang, Qinglai Wei and Huaguang Zhang, Northeastern university, China; Northeastern University, China; University of Chinese Academy of Sciences, China

In order to address the high dimensionality and multiple conditions of batch process data, a method of LPGD-kNN is proposed in this article. Firstly, standardization of local neighborhood(LNS) is processed to overcome the pretreated data character of multiple conditions. Them, Locality Preserving Projection(LPP) which can extract adaptive transformation matrix of the High modal batch data to form a new modeling data is applied in this method. Different from the traditional k-nearest neighbor(kNN) which extracting similarity information by Euclidean distance, Geodesic distance based kNN method is proposed for fault detection with constructing statistical indicators. Improved Dijkstra (IDijkstra) algorithm is constructed to calculate the Geodesic distance between every training data, so as to characterize the shortest distance of the nonlinear data within local areas accurately. Finally, the improved LPGD-kNN algorithms is applied in semiconductor industry examples and the effectiveness of the proposed method has been verified by comparison.

P122 *Selective Ensemble Random Neural Networks Based on Adaptive Selection Scope of Input Weights and Biases for Building Soft Measuring Model [#17305]*

Jian Tang and Junfei Qiao, Beijing University of Technology, China

Random neural networks (RNNs) prediction model is built with a specific randomized algorithm by employing a single hidden layer structure. Duo to input weights and biases are randomly assigned and output weights are analytically calculated, it is widely used in different applications. Most of RNNs-based soft measuring models assign the random parameter scope to default range . However, this cannot ensure the universal approximation

capability of the resulting model. In this paper, selective ensemble (SEN)-RNN algorithm based on adaptive selection scope of input weights and biases is proposed to construct soft measuring model. Bootstrap and genetic algorithm optimization toolbox are used to construct a set of SEN-RNN models with different random parameter scope. The final soft measuring model is adaptive selected in terms of the best generation performance among these SEN models. Simulation results based on housing benchmark dataset of UCI and dioxin concentration dataset of municipal solid waste incineration validate the proposed approach.

P123 *Energy-Balanced Distributed Sparse Kernel Machine in Wireless Sensor Network [#17837]*

Xinrong Ji, Yibin Hou, Cuiqin Hou, Fang Gao and Shulong Wang, Beijing University of Technology, China

In wireless sensor networks, classification and regression are very fundamental tasks. To reduce and balance the energy consumption of nodes during training classifiers or regression machines, a distributed incremental learning problem of kernel machine by using 1-norm regularization is studied, and an energy-balanced distributed learning algorithm for the sparse kernel machine is proposed. In this proposal, a novel incremental learning algorithm and an energy-balanced node selection strategy that takes into account the residual energy of node, the number of been accessed and the neighbors number of node are used. Simulation results show that this proposal can obtain pretty consistent prediction correct rate with the batch learning algorithm, and it can get a very simple model. Meanwhile, it has significant advantages with respect to the communication costs and the iterations. Moreover, it can reduce and balance the energy consumption of nodes.

P124 *Training Deep Autoencoder via VLC-Genetic Algorithm [#17227]*

Qazi Sami Ullah Khan, Jianwu Li and Shuyang Zhao, Beijing Institute of Technology, China

Recently, both supervised and unsupervised deep learning techniques have accomplished notable results in various fields. However neural networks with back-propagation are liable to trapping at local minima. Genetic algorithms have been popular as a class of optimization techniques which are good at exploring a large and complex space in an intelligent way to find values close to the global optimum. In this paper, a variable length chromosome genetic algorithm assisted deep autoencoder is proposed. Firstly, the training of autoencoder is done with the help of variable length chromosome genetic algorithm. Secondly, a classifier is used for the classification of encoded data and compare the classification accuracy with other state-of-the-art methods. The experimental results show that the proposed method achieves competitive results and produce sparser networks.

P125 *Knowledge Memory Based LSTM Model for Answer Selection [#17309]*

Weijie An, Qin Chen, Yan Yang and Liang He, East China Normal University, China

Recurrent neural networks (RNN) have shown great success in answer selection task in recent years. Although the attention mechanism has been widely used to enhance the information interaction between questions and answers, knowledge is still the gap between their representations. In this paper, we propose a knowledge memory based RNN model, which incorporates the knowledge learned from the data sets into the question representations. Experiments on two benchmark data sets show the great advantages of our proposed model over that without the knowledge memory. Furthermore, our model outperforms most of the recent progress in question answering.

P126 *Breast Cancer Malignancy Prediction using Incremental Combination of Multiple Recurrent Neural Networks [#17440]*

Dehua Chen, Guangjun Qian, Cheng Shi and Qiao Pan, Donghua University, China

Breast cancer is the most common cancer among women worldwide. An early detection of malignant of breast cancer, followed by proper treatment, can great improve the survival rate of patients. Re-cently, the deep learning based malignancy prediction models for breast cancer have been proposed. However, these models are usually trained with single type of clinical text, which are still not effective enough to predict breast cancer malignancy. In this paper, we follow the deep in-cremental learning framework and propose a prediction model of breast cancer malignancy by incremental combination of multiple recurrent neural networks. Specially, the model first uses multiple recurrent neu-ral networks (RNNs) for generating features from the multi- types of clinical text including B-ultrasound, X-rays, Computed Tomography (CT), and Nuclear Magnetic Resonance Imaging (MRI), and then com-bines the generated features in an incremental way. Finally, we add one more recurrent neural network layer for classifying benign and malig-nant of breast cancer based on combined generated features.

P127 *TinyPoseNet: A Fast and Compact Deep Network for Robust Head Pose Estimation [#17568]*

Shanru Li, Liping Wang, Shuang Yang, Yuanquan Wang and Chongwen Wang, Beijing Institute of Technology, China; Purple Bull Funds, China; Institute of Computing Technology, Chinese Academy of Sciences, China; Hebei University of Technology, China

As an inherent attribute of human, head pose plays an important role in many tasks. In this paper, we formulate head pose estimation in different directions as a multi-task regression problem, and propose a fast, compact and robust head pose estimation model, named TinyPoseNet. Specifically, we combine the tasks of head pose estimation in different directions into one joint learning task and design the whole model based on the principle of "being deeper" and "being thinner" to obtain a tiny model with specially designed types and particular small numbers of filters. We perform thorough experiments on 3 types of test sets and compare our method with others from several different aspects, including the accuracy, the speed, the compactness and so on. In addition, we introduce large angle data in Multi-PIE to verify the ability of dealing with large-scale pose in practice. All the experiments demonstrate the advantages of the proposed model.

P128 *An Ultrasonic Image Recognition Method for Papillary Thyroid Carcinoma based on Depth Convolution Neural Network [#17713]*

Wei Ke, Yonghua Wang, Pin Wan, Weiwei Liu and Hailiang Li, Guangdong University of Technology, China; Sun Yat-sen University, China; Sun Yat-Sen University, China

The ultrasonic image of thyroid papillary carcinoma is characterized by two dimensional gray scale, low resolution, and complicated internal tissue struc- ture. The characteristics of thyroid papillary carcinoma are not obvious and it is difficult to be distinguished. In this paper, the convolution neural network (CNN) theory is introduced for the automatic identification of the ultrasonic image of thyroid papillary carcinoma. Based on the improvement of the Faster RCNN, a detection method for the identification of ultrasonic image features of papillary thyroid carcinoma is proposed, that is, by connecting the fourth and fifth layers of the shared convolution layer in the Faster RCNN, and then normalizing. Secondly, multi-scale ultrasonic images are used in the input. Finally, thyroid papillary carcinoma is classified according to several major characteristics of its ultrasound image.so that the detailed ul-trasound image diagnostic report can be received. The experimental results show that the recognition accuracy of the Faster RCNN is higher, the training time is shorter and the efficiency is higher compared with that of the original Faster RCNN.

P129 *Relation Classification via Target-Concentrated Attention CNNs [#17342]*

Jizhao Zhu, Jianzhong Qiao, Xinxiao Dai and Xueqi Cheng, Northeastern University, China; Shenyang Open University, China; Institute of Computing Technology, Chinese Academy of Sciences, China

Relation classification is a key natural language processing task that receives much attentions these years. The goal is to assign pre-defined relation labels to the nominal pairs marked in given sentences. It is obvious that different words in a sentence are differentially informative. Moreover, the importance of words is highly relation-dependent, i.e., the

same word may be differentially important for different relations. To include sensitivity to this fact, we present a novel model, referred to as TCA-CNN, which takes the attention mechanism at the word level to pay different attention to individual words according to the semantic relation concentrated when constructing the representation of a sentence. Experimental results show that TCA-CNN achieves a comparable performance compared with the state-of-the-art models on the SemEval 2010 relation classification task.

P130 *CNN-LSTM Neural Network Model for Quantitative Strategy Analysis in Stock Markets [#17495]*

Shuanglong Liu, Chao Zhang and Jinwen Ma, Peking University, China

In this paper, the convolutional neural network and long short-term memory (CNN- LSTM) neural network model is proposed to analyse the quantitative strategy in stock markets. Methodically, the CNN-LSTM neural network is used to make the quantitative stock selection strategy for judging stock trends by using the CNN, and then make the quantitative timing strategy for improving the profits by using the LSTM. It is demonstrated by the experiments that the CNN-LSTM neural network model can be successfully applied to making quantitative strategy, and achieving better returns than the basic Momentum strategy and the Benchmark index.

P131 *Learning Inverse Mapping by AutoEncoder based Generative Adversarial Nets [#17265]*

Junyu Luo, Yong Xu, Chenwei Tang and Jiancheng Lv, Sichuan University, China

The inverse mapping of GANs'(Generative Adversarial Nets) generator has a great potential value. Hence, some works have been developed to construct the inverse function of generator by directly learning or adversarial learning. While the results are encouraging, the problem is highly challenging and the existing ways of training inverse models of GANs have many disadvantages, such as hard to train or poor performance. Due to these reasons, we propose a new approach based on using inverse generator (IG) model as encoder and pre-trained generator (G) as decoder of an AutoEncoder network to train the IG model. In the proposed model, the difference between the input and output, which are both the generated image of pre-trained GAN's generator, of AutoEncoder is directly minimized. The optimizing method can overcome the difficulty in training and inverse model of an non one-to-one function. We also applied the inverse model of GANs' generators to image searching andtranslation. The experimental results prove that the proposed approach works better than the traditional approaches in image searching.

P132 *Fast and Accurate Image Super Resolution by Deep CNN with Skip Connection and Network in Network [#17418]*

Jin Yamanaka, Shigesumi Kuwashima and Takio Kurita, ViewPLUS Inc, Japan; Hiroshima University, Japan

We propose a highly efficient and faster Single Image Super-Resolution (SISR) model with Deep Convolutional neural networks (Deep CNN). Deep CNN have recently shown that they have a significant reconstruction performance on single-image super-resolution. Current trend is using deeper CNN layers to improve performance. However, deep models demand larger computation resources and is not suitable for network edge devices like mobile, tablet and IoT devices. Our model achieves state of the art reconstruction performance with almost 10 times lower calculation cost by Deep CNN with Residual Net, Skip Connection and Network in Network (DCSCN). A combination of Deep CNNs and Skip connection layers is used as a feature extractor for image features on both local and global area. Parallelized 1x1 CNNs, like the one called Network in Network, is also used for image reconstruction. That structure reduces the dimensions of the previous layer's output for faster computation with less information loss, and make it possible to process original images directly. Also we optimize the number of layers and filters of each CNN to significantly reduce the calculation cost. Thus, the proposed algorithm not only achieves the state of the art performance but also achieves faster and efficient computation.

P133 *Three-Means Ternary Quantization [#17256]*

Jie Ding, JunMin Wu and Huan Wu, University of Science and Technology of China, China

Deep Convolution Neural Networks (DCNNs) have achieved state-of-the-art results in a wide range of tasks, especially in image recognition and object detection. However, millions of parameters make it difficult to be deployed on embedded devices with limited storage and computational capabilities. In this paper, we propose a new method called Three-Means Ternary Quantization (TMTQ), which can quantize the weights to ternary values {-a1,0,+a2} during the forward and backward propagations. Scaling factors {a1,a2} are used to reduce the loss of quantization. We evaluate this method on MNIST, CIFAR-10 and ImageNet datasets with different network architectures. The results show that the performance of our ternary models obtained from TMTQ is only slightly worse than full precision models but better than recently proposed binary and ternary models. Meanwhile, our TMTQ method achieves up to about 16x model compression rate compared with the 32-bits full precision counterparts, for we just use ternary weights (2-bits) and fixed scaling factors during the inference.

P134 *Bio-inspired Deep Spiking Neural Network for Image Classification [#17676]*

Jingling Li, Weitai Hu, Ye Yuan, Hong Huo and Tao Fang, Shanghai Jiao Tong University, China

Spiking neural networks (SNNs) are a kind of data-driven and event-driven hierarchical networks, and they are closer to the biological mechanism than other traditional neural networks. In SNNs, signals are transmitted as spikes between neurons, and spike transmission is easily implemented on hardware platform for large-scale real-time deep network computing. However, the unsupervised learning methods for spike neurons, such as the STDP learning methods, generally are ineffective in training deep spiking neural networks for image classification application. In this paper, the network parameters (weights and bias) obtained from training a convolution neural network (CNN), are converted and utilized in a deep spiking neural network with the similar structure as the CNN, which make the deep SNN be capable of classifying images. Since the CNN is composed of analog neurons, there will be some transfer losses in the process of conversion. After the main sources of transfer losses are analyzed, some reasonable optimization strategies are proposed to reduce the losses while retain a higher accuracy, such as max-pooling, softmax and weight normalization. The deep spiking neural network proposed in this paper is closer to the biological mechanism in the design of neurons and our work is helpful for understanding the spike activity of the brain. The proposed deep SNN is evaluated on CIFAR and MNIST benchmarks and the experimental results have shown that the proposed deep SNN outperforms the state-of-the-art spiking network models.

P135 *A Feature Learning Approach for Image Retrieval [#17292]*

Junfeng Yao, Yao Yu, Yukai Deng and Changyin Sun, University of Science and Technology Beijing, China; Southest University, China

Extraction of effective image features is the key to the content-based image re- trieval task. Recently, deep convolutional neural networks have been widely used in learning image features and have achieved top results. Based on CNNs, metric learning methods like contrastive loss [1] and triplet loss [2] have been proved ef-fective in learning discriminative image features. In this paper, we propose a new supervised signal to train convolutional neural networks. This step could ensure that the features obtained are well differentiated in space, which is very suitable for image retrieval task. We give an example on MNIST [3] to illustrate the intent of this loss function. Also, we evaluate our method on two datasets including CUB-200-2011 [4], CARS196 [5]. The experimental results show that the re-trieval effect is fairly good on this two datasets. Besides, our loss function is much easier to implement and train.

P136 *Very Deep Neural Networks for Hindi/Arabic Offline Handwritten Digit Recognition [#17562]*

Rolla Almodfer, Shengwu Xiong, Mohammed Mudhsh and Pengfei Duan, Wuhan University of Technology, China

Handwritten Digit Recognition(HDR) has become one of the challenging areas of research in the field of document image processing during the last few decades. In this paper, inspired by the success of the very deep state-of-the- art VGGNet, we proposed VGG_No for HDR. VGG_No is fast and reliable, which improved the classification performance effectively. Besides, this model has also reduced the overall complexity of VGGNet. VGG_No constructed by thirteen convolu-tional layers, two max-pooling layers, and three fully connected layers. A Cross-Validation analysis has been performed using the 10-Fold Cross-Validation strategy, and 10-Fold classification accuracies of 99.57% and 99.69% have been obtained for ADBase database and MNIST database, respectively. The classifica-tion performance of VGG_No is superior to existing techniques using multi-classifiers since it has achieved better results using very simple and homogeneous architecture.

P137 *Offensive Sentence Classification using Character-level CNN and Transfer Learning with Fake Sentences [#17551]*

Suin Seo and Sung-Bae Cho, Yonsei University, Korea (South)

There are two difficulties in classifying offensive sentences: One is the modifiability of offensive terms, and the other is the class imbalance which appears in general offensive corpus. Solving these problems, we propose a method of pre-training fake sentences generated as character-level to convolution layers preventing under-fitting from data shortage, and dealing with the data imbalance. We insert the offensive words to half of the randomly generated sentences, and train the convolution neural networks (CNN) with theses sentences and the labels of whether offensive word is included. We use the trained filter of CNN for training new CNN given original data, resulting in the increase of the amount of training data. We get higher F1-score with the proposed method than that without pre-training in three dataset of insult from kaggle, Bullying trace, and formspring.

P138 *Aggregating Class Interactions for Hierarchical Attention Relation Extraction [#17423]*

Kaiyu Huang, Si Li and Guang Chen, Beijing University of Posts and Telecommunications, China; Beijing university of posts and telecommunications, China

Distantly supervised relation extraction is a powerful learning method to recognize relations of entity pairs. However, wrong label problem is inevitable among large-scale training data. In this work we propose a hierarchical attention neural network to effectively alleviate the impact of noise instances. Moreover under distantly supervised scenario, connections and dependencies widely appear among relation classes, which we call class interactions. Previous end-to-end methods that treated the relations as independent failed to make use of these interactions. To better utilize these important interactions, we propose a soft target as training objective to learn class relationships jointly. Experiments show that our model outperforms state-of-the-art methods.

P139 *Firefly Algorithm for Demand Estimation of Water Resources [#17148]*

Hui Wang, Zhihua Cui, Wenjun Wang, Xinyu Zhou, Jia Zhao, Li Lv and Hui Sun, Nanchang Institute of Technology, China; Taiyuan University of Science and Technology, China; Jiangxi Normal University, China

Firefly algorithm (FA) is an efficient swarm intelligence optimization technique, which has been used to solve many engineering optimization problems. In this paper, we present a new FA (called NFA) variant for demand estimation of water resources in Nanchang city of China. The performance of the standard FA highly depends on its control parameters. To tackle this issue, a dynamic step factor strategy is proposed. In NFA, the step factor is not fixed and it is dynamically updated during the search process. Three models in different forms (linear, exponential and hybrid) are developed based on the structure of social and economic conditions. Water demand in Nanchang city from 2003 to 2015 is considered as a case study. The data from 2003 to 2012 is used for finding the optimal weights, and the rest data (2013-2015) is for testing the models. Simulation results show that three FA variants can achieve promising performance. Our proposed NFA outperforms the standard FA and memetic FA (MFA), and the prediction accuracy is up to 97.91%.

P140 *OutIntSys - a Novel Method for the Detection of the Most Intelligent Cooperative Multiagent Systems [#17354]*

Sabri Arik, Laszlo-Barna Iantovics and Sandor-Miklos Szilagyi, Istanbul University, Turkey; Petru Maior University, Romania

The increased intelligence of a computing system could allow more efficient and/or flexible and/or accurate solving of problems with different difficulties like: NP-hard problems, problems that have missing or erroneous data etc. We consider that even if there is no unanimous definition of the systems' intelligence, the machine intelligence could be measured. In our research, we will understand by intelligent systems the intelligent cooperative multiagent systems (CMASs). Even in a CMAS composed of simple agents an increased intelligence emerges many times at the system's level. We propose a novel method called OutIntSys for the detection of the systems which has a statistically extremely low and extremely high intelligence, called systems with outlier intelligence, from a set of intelligent systems that solves the same type(s) of problems. The proposed method has practical applicability in choosing of the most intelligent CMASs from a set of CMASs in solving difficult problems. To prove the effectiveness of the OutIntSys method we realized a study that included six intelligent CMASs with similar type of operation, composed of simple computing agents specialized in solving a difficult NP-hard problem. OutIntSys does not detect any outlier intelligence. It detected just CMASs whose MIQ is further from the rest but that cannot be considered as outliers. This was expectable based on the fact that the CMASs operation was very similar. We performed a comparison with two recent metrics for measuring the machine intelligence presented in the scientific literature.

P141 *A Randomized Algorithm for Prediction Interval Using RVFL Networks Ensemble [#17426]*

Bara Miskony and Dianhui Wang, La Trobe University, Australia

Prediction Intervals (PIs) can specify the level of uncertainty related to point- based prediction. Most Neural Network (NN)-based approaches for constructing PIs suffer from computational expense and some restrictive assumptions on data distribution. This paper develops a randomized algorithm for PIs building with good performance in terms of both effectiveness and efficiency. To achieve this goal, a neural network ensemble with random weights is employed as a learner model, and a novel algorithm for generating teacher signals is proposed. Our proposed Randomized Algorithm for Prediction Intervals (RAPI) constructs an NN ensemble with two outputs, representing the lower and upper bounds of PIs, respectively. Experimental results with comparisons over nine benchmark datasets indicate that RAPI performs favourably in terms of coverage rate, specificity and efficiency.

P142 *A Memetic Algorithm for Community Detection in Bipartite Networks [#17809]*

Xiaodong Wang and Jing Liu, Xidian University, China

Community detection is a basic tool to analyze complex networks. However, there are more community detection methods in unipartite networks while just a few methods in bipartite networks (BNs). In this paper, we develop a memetic algorithm (MACD-BNs) to identify communities in BNs. We use MACD-BNs to optimize two extended measures Baber modularity (QB) and modularity densi-ty (QD) on real-life and synthetic networks respectively so as to compare their performance. We conclude that QD are more effective than QB when the size of communities are heterogeneous while QB is more suitable to detect communities with similar size. Besides, we also make a contrast between MACD-BNs and other community detection method and the results show the effectiveness of MACD-BNs.

P143 *Complex-Valued Feedforward Neural Networks Learning Without Backpropagation [#17871]*

Wei Guo, He Huang and Tingwen Huang, Soochow University, China; Texas AM University at Qatar, Qatar

This paper presents an efficient learning algorithm for complex-valued feedforward neural networks with application to classification problems. It simplifies complex-valued neural networks learning by using the forward-only computation rather than traditional forward and backward computations. By incorporating the forward-only computation, the complex-valued Levenberg- Marquardt algorithm becomes more efficient. Comparison results of computation cost show that the proposed forward-only complex-valued learning algorithm can be faster than the traditional implementation of the Levenberg-Marquardt algorithm.

P144 *Using Word Mover's Distance with Spatial Constraints for Measuring Similarity between Mongolian Word Images [#17322]*

Hongxi Wei, Hui Zhang, Guanglai Gao and Xiangdong Su, Inner Mongolia University, China

In the framework of bag-of-visual-words, visual words are independent each other, which results in discarding spatial relations and lacking semantic information of visual words. To capture semantic information of visual words, a deep learning procedure similar to word embedding technique is used for mapping visual words to embedding vectors in a semantic space. And then, word mover's distance (WMD) is utilized to measure similarity between two word images, which calculates the minimum traveling distance from the visual embeddings of one word image to another one. Moreover, word images are partitioned into several sub-regions with equal sizes along rows and columns in advance. After that, WMDs can be computed from the corresponding sub-regions of the two word images, separately. Thus, the similarity between the two word images is the sum of these WMDs. Experimental results show that the proposed method outperforms various baseline and state-of-the-art methods, including spatial pyramid matching, latent Dirichlet allocation, average visual word embeddings and the original word mover's distance.

P145 *Shape-based Image Retrieval Based on Improved Genetic Programming [#17272]*

Ruochen Liu, Guan Xia and Jianxia Li, Xidian University, China

Two-stage genetic programming algorithm based on a novel coding strategy (NTGP) is proposed in this paper, in which the generation of individual tree is not random but according to a special rule .This rule assigns each function operator a weight and the assignments of these weights based on the frequencies of function operators in good individuals. The greater weight of a function is, the more possibly it will be selected. By using the new coding strategy, the image feature database can be rebuilt. For two-stage genetic programming algorithm, in the first stage, the feature weight vector is obtained, GP is used to construct new features for the next step. While in the second stage, GP is used to induce an image matching function based on the features provided by the first stage. Based on these models, one can retrieve target images from the image database with much better performance. Three benchmark problems are used to validate performance of the proposed algorithm. Experimental results demonstrate that the proposed algorithm can obtain better performance.

P146 *Parameter Identification for a Class of Nonlinear Systems Based on ESN [#17149]*

Xianshuang Yao, Zhanshan Wang and Huaguang Zhang, Northeastern University, China

In this paper, a new identification method based on echo state network (ESN) is proposed to identify the parameters of a class of discrete-time nonlinear systems. Through analyzing the characteristics of output signals, the identification method can determine the maximal delay time of the given nonlinear system. To obtain the better prediction and identification accuracy of this method, an online learning algorithm is proposed to train the output weights of ESN. Simulation examples show the effectiveness of the proposed identification method.

P147 *Adaptive Dynamic Programming for Human Postural Balance Control [#17368]*

Eric Mauro, Tao Bian and Zhong-Ping Jiang, New York University, United States

This paper provides a basis for studying human postural balance control about upright stance using adaptive dynamic programming (ADP) theory. Previous models of human sensorimotor control rely on a priori knowledge of system dynamics. Here, we provide an alternative framework based on the ADP theory. The main advantage of this new framework is that the system model is no longer required, and an adaptive optimal controller is obtained directly from input and state data. We apply this theory to simulate human balance behavior, and the obtained results are consistent with the experiment data presented in the past literature.

P148 *Robot Path Planning Based on A Hybrid Approach [#17193]*

Zhou Jiang and Zhigang Zeng, Huazhong University of Science and Technology, China

In this paper, an optimal method based on combination of improved genetic algorithm(IGA) and improved artificial potential field(IAPF) for path planning of mobile robot is proposed. This method consists of two steps. Firstly, free space model of mobile robot is established by using grid-based method and IGA is employed to find a global optimal collision-free path which is usually the shortest through known static environment. Secondly, according to the path obtained by IGA, IAPF is utilized to generate a real-time path to avoid dynamic obstacles. This ensures that the robot can avoid obstacles as well as move along the optimal path. Simulation experiments are carried out to verify the superiority of the proposed algorithm.

P149 *Scanpath Prediction Based on High-level Features and Memory Bias [#17112]*

Xuan Shao, Ye Luo, Dandan Zhu, Shuqin Li, Laurent Itti and Jianwei Lu, Tongji University, China; University of Southern California, United States

Human scanpath prediction aims to use computational models to mimic human gaze shifts under free view conditions. Previous works utilizing low-level features, hand-crafted high-level features, saccadic amplitude, memory bias cannot fully explain the mechanism of visual attention. In this paper, we propose a comprehensive method to predict scanpath from four aspects: low-level features, saccadic amplitude, semantic features learned via deep convolutional neural network, memory bias including short- term and long-term memory. By calculating the probabilities for all candidate regions in an image, the position of next fixation point can be selected via picking the one with the largest probability product. Moreover, fixation duration as a key factor is first used to model memory effect on scanpath prediction. Experiments on two public datasets demonstrate the effectiveness of the proposed method, and comparisons with state-of-the-art methods further validate the superiority of our method.

P150 *Spatial Quality Aware Network for Video-based Person Re-identication [#17247]*

Yujie Wang, Biao Leng and Guanglu Song, Beihang University, China

Person re-identification in video is challenging in computer vision. Most methods adopt feature aggregation to get a video-level representation. However, almost all of them do it on the final feature embedding, which neglects the spatial difference among feature maps. To address this problem, we proposed an effective approach, named Spatial Quality Aware Network(SQAN) for video-based person re-identification. SQAN distributes a score for each pixel in a feature map. Then scores are normalized across all frames and the weighted sum is used to aggregate them. To deal with overfitting, we also proposed a semantic dropout strategy. Experiments show that our proposed method is competitive with state-of-the-art methods in performance.

P151 *Discriminative Semi-supervised Learning Based on Visual Concept-Like Features [#17533]*

Fang Liu and Xiaofeng Wu, Fudan University, China

A discriminative semi-supervised learning method based on visual concept-like high- level features is proposed in this paper. Previous

semi-supervised learning methods usually use unlabeled data to augment the training set or regularize the decision boundary of classifiers. The classification results rely on the precision on unlabeled data using supervised classifiers trained with limited labeled samples. When a small number of labeled samples are provided, these methods are likely to get bad results. Differently, the proposed method directly uses the distribution information of all available data in the feature space to learn a new representation which is achieved by computing the similarities of a chosen image and some discriminative data exemplars sampled from the feature space. A semi-supervised distance metric learning method by learning a projection matrix under the equivalence constraints of similar pairs and dissimilar pairs is introduced to measure these similarities, and a pseudo-mahalanobis distance is thus obtained to represent the similarities between data samples instead of Euclidean distance. Experiments showed the effectiveness of this learned distance. The new representation can be fed into standard classifiers for image classification task. The training data of our system can either be original image data or handcrafted features or image features learned by deep architectures. Therefore, the proposed method can be applied in both feature extraction and feature enhancement. In the semi-supervised classification task on eight standard datasets, the proposed method achieves improved performance over many of the previous existing methods.

P152 *Pedestrian Counting System Based on Multiple Object Detection and Tracking [#17700]*

Xiang Li, Haohua Zhao and Liqing Zhang, Shanghai Jiao Tong University, China

With the increasing demands on video surveillance and business promotion, effective pedestrian counting in surveillance environments has become a hot research topic in computer vision. In this paper, we implement a pedestrian counting system based on multiple object detection and tracking. Region proposal network (RPN) and Real Adaboost classifier are employed to train a head-shoulder detector with high accuracy. We utilize the DSST algorithm to track the position transformations and the size changes of pedestrians. By combining human detection with object tracking together and using detection results to optimize the tracking algorithm, the pedestrian counting system is developed with high robustness against occlusions. We evaluated the system on the videos recorded in the subway station. The results showed that our system achieves a high accuracy and can be used for pedestrian counting in crowded public places.

P153 *RGB-D Tracking based on Kernelized Correlation Filter with Deep Features [#17715]*

Shuang Gu, Yao Lu, Lin Zhang and Jian Zhang, Beijing Institute of Technology, China; University of Technology Sydney, Australia

This paper proposes a new RGB-D tracker which is upon Kernelized Correlation Filter(KCF) with deep features. KCF is a high-speed target tracker. However, the HOG feature used in KCF shows some weaknesses, such as not robust to noise. Therefore, we consider using RGB-D deep features in KCF, which refer to deep features of RGB and depth images and the deep features contain abundant and discriminated information for tracking. The mixture of deep features highly improves the performance of the tracker. Besides, KCF is sensitive to scale variations while depth images benefit for handling this problem. According to the principle of similar triangle, the ratio of scale variation can be observed simply. Tested over Princeton RGB-D Tracking Benchmark, Our RGB-D tracker achieves the highest accuracy when no occlusion happens. Meanwhile, we keep the high-speed tracking even if deep features are calculated during tracking and the average speed is 10 FPS.

P154 *Convolutional Gated Recurrent Units Fusion for Video Action Recognition [#17855]*

Bo Huang, Hualong Huang and Hongtao Lu, Shanghai Jiao Tong University, China

Two-stream Convolutional Networks (ConvNets) have achieved great success in video action recognition. Research also shows that early fusion of the two-stream ConvNets can further boost the performance. Existing fusion methods focus on short snippets thus fails to learn global representations for videos. We introduce a Convolutional Gated Recurrent Units (ConvGRU) fusion method to model long-term dependency inside actions. This fusion method takes advantage of both Recurrent Neural Networks (RNN) models which have strong capacity to handle long-term dependency for sequence modeling and early fusion architecture which learns the evolution of appearance feature and motion feature. We further propose an end-to-end architecture according to this fusion method and evaluate our approach using a widely used action recognition dataset named UCF101. We investigate different input lengths and fusion layers and find that fusing at the last convolutional layer with an input length of 10 entries yields best performance (93.0%) which is comparable to the state-of-the-art.

P155 *Stereo Matching using Conditional Adversarial Networks [#17859]*

Hualong Huang, Bo Huang, Hongtao Lu and Huiyu Weng, Shanghai Jiao Tong University, China

Recently, adversarial networks have attracted increasing attentions for the promising results of generative tasks. In this paper we present the first application of conditional adversarial networks to stereo matching task. Our approach performs a conditional adversarial training process on two networks: a generator that learns the mapping from a pair of RGB images to a dense disparity map, and a discriminator that distinguishes whether the disparity map comes from the ground truth or from the generator. Here, both the generator and the discriminator take the same RGB image pair as an input condition. During this conditional adversarial training process, our discriminator gradually captures high-level contextual features to detect inconsistencies between the ground truth and the generated disparity maps. These high-level contextual features are incorporated into loss function in order to further help the generator to correct predicted disparity maps. We evaluate our model on the Scene Flow dataset and an improvement is achieved compared with the most related work pix2pix.

P156 *A Point and Line Features Based Method for Disturbed Surface Motion Estimation [#17860]*

Xiang Li and Yue Zhou, Shanghai Jiao Tong University, China

Calculating the motion of disturbed surface such as a reflective monochromatic one is often a difficult part, especially when using single feature based method. The error introduced from the feature extraction and matching will gradually accumulate into a larger final error. For a texture-less surface, the number of features makes the situation even more challenging. In this paper, point and line features from stereo sequences are combined to estimate 3D motion of disturbed surfaces. Taking the advantage of feature combination by two-stage iterative optimization and multiple filtering, the motion of surfaces can be estimated accurately, even under little motion blur. This paper also explored the relationship between measurement accuracy and object motion mode. This may provide a reference for the design of a vision based motion measuring system.

P157 *Improving Object Detection with Convolutional Neural Network via Iterative Mechanism [#17327]*

Xin Qiu and Chun Yuan, Tsinghua University, China

The iterative mechanism is prevalent and widely used in many fields, since iterations of simple functions can make complex behaviors. But this mechanism is often overlooked by the state-of-the-art convolutional neural network (CNN)-based object detection methods. In this paper, we propose to use the iterative mechanism to improve the object detection performance of the CNN algorithms. In order to show the benefits of using the iterative mechanism in object detection from more aspects, the main contributions of our work are two aspects: Firstly, we train an iterative version of Faster RCNN to show the application of the iterative mechanism in improving the localization accuracy; Secondly, we present a prototype CNN model that iteratively searches for objects on a very simple dataset to generate proposals. The thoughtful experiments on object detection benchmark datasets show that the proposed two iterative methods consistently improve the performance of the baseline methods, e.g. in PASCAL VOC2007 test set, our iterative version of Faster RCNN has 0.7115 mAP about 1.5 points higher than the baseline Faster RCNN (0.6959 mAP).

P158 *An Improved Random Walk Algorithm for Interactive Image Segmentation [#17178]*

Peitao Wang, Zhaoshui He and Shifeng Huang, Guangdong University of Technology, China

Interactive image segmentation is an important issue in computer vision. Many algorithms have been proposed for this problem. Among them, random walk based algorithms have been proved to be efficient. However, a large number of seeds (i.e, pixels with user-specified labels) must be given in advance to achieve a desirable segmentation for such algorithms, which makes user interaction inconvenient. To solve this problem, we improve the random walk algorithm in two aspects: 1) label prior is taken into account when computing edge weights between adjacent pixels; 2) each unseeded pixel is assigned with the same label as the seed with maximum first arrival probability to reduce the bias effect of seed size. The improved algorithm can achieve a desirable segmentation with few seeds. Experiment results on natural images illustrate the accuracy of the proposed algorithm.

P159 *Scene Recognition Based on Multi-Feature Fusion for Indoor Robot [#17242]*

Xiaocheng Liu, Wei Hong and HuiQiu Lu, Jilin University, China

In this paper, a method of scene recognition based on multi feature fusion is pro- posed to solve the problems of poor accuracy in scene recognition of intelligent home robot. Firstly, the H/I color model is used to extract the color feature from the scene. Secondly, the characteristics of the uniform background are extracted by the DS descriptors, and the scene of great difference is extracted using the SURF descriptors. The extracted feature descriptors are quantized using the "vis- ual bag of words", and The SURF-DS-BOW model is generated by weighted fusion of the two feature descriptors. Finally, the multi kernel learning support vector machine (MKL-SVM) is used to fuse the color feature and the SURF-DS-BOW model to improve the accuracy of scene recognition. The experimental results show that the recognition rate of the method in indoor scene recognition is 86.4%, which is better than the relevant literature algorithm.

P160 *A Pattern-based Bayesian Classifier for Data Stream [#17071]*

Jidong Yuan, Zhihai Wang, Yange Sun, Wei Zhang and Jingjing Jiang, Beijing Jiaotong University, China

An advanced approach to Bayesian classification is based on exploited patterns.However, traditional pattern-based Bayesian classifiers cannot adapt to the evolving data stream environment. For that, an effective Pattern-based Bayesian classifier for Data Stream (PBDS) is proposed. First, a data-driven lazy learning strategy is employed to discover local frequent patterns for each test record. Furthermore, we propose a summary data structure for compact representation of data, and to find patterns more efficiently for each class. Greedy search and minimum description length combined with Bayesian network are applied to evaluating extracted patterns. Experimental studies on real-world and synthetic data streams show that PBDS outperforms most state-of-the-art data stream classifiers.

P161 *Soccer Video Event Detection using 3D Convolutional Networks and Shot Boundary Detection via Deep Feature Distance [#17711]*

Tingxi Liu, Yao Lu, Xiaoyu Lei, Lijing Zhang, Haoyu Wang, Wei Huang and Zijian Wang, Beijing Institute of Technology, China

In this work, we propose a novel framework combining temporal action localization and play-break(PB) rules for soccer video event detection. Firstly we treat event detection task in action-level, and adopt 3D convolutional networks to perform action localization. Then we employ PB rules to organize actions into events using long view and replay logo detected in the first step. Finally, we determine the semantic classes of events according to principal actions which contain key semantic information of highlights. For long untrimmed videos, we propose a shot boundary detection method using deep feature distance (DFD) to reduce the number of proposals and improve the performance of localization. Experiment results verify the effectiveness of our framework on a new dataset which contains 152 classes of semantic actions and scenes in soccer video.

P162 *An ELU Network with Total Variation for Image Denoising [#17240]*

Tianyang Wang, Zhengrui Qin and Michelle Zhu, Northwest Missouri State University, United States; Montclair State University, United States

In this paper, we propose a novel convolutional neural network (CNN) for image denoising, which uses exponential linear unit (ELU) as the activation function. We investigate the suitability by analyzing ELU's connection with trainable nonlinear reaction diffusion model (TNRD) and residual denoising. On the other hand, batch normalization (BN) is indispensable for residual denoising and convergence purpose. However, direct stacking of BN and ELU degrades the performance of CNN. To mitigate this issue, we design an innovative combination of activation layer and normalization layer to exploit and leverage the ELU network, and discuss the corresponding rationale. Moreover, inspired by the fact that minimizing total variation (TV) can be applied to image denoising, we propose a TV regularized L2 loss to evaluate the training effect during the iterations. Finally, we conduct extensive experiments, showing that our model outperforms some recent and popular approaches on Gaussian denoising with specific or randomized noise levels for both gray and color images.

P163 *Automatic Multi-view Action Recognition with Robust Features [#17640]*

Kuang-Pen Chou, Mukesh Prasad, Dong-Lin Li, Neha Bharill, Yu-Feng Lin, Farookh Hussain, Chin-Teng Lin and Wen-Chieh Lin, National Chiao Tung University, Taiwan; University of Technology Sydney, Australia; Birla Institute of Technology and Science Pilani, India

This paper proposes view-invariant features to address multi-view action recognition for different actions performed in different views. The view-invarient features are obtained from clouds of varying temporal scale by extracting holistic features, which are modeled to explicitly take advantage of the global, spatial and temporal distribution of interest points. The proposed view-invariant features are highly discriminative and robust for recognizing actions as the view changes. This paper proposes a mechanism for real world application which can follow the actions of a person in a video based on image sequences and can separate these actions according to given training data. Using the proposed mechanism, the beginning and ending of an action sequence can be labeled automatically without the need for manual setting. It is not necessary in the proposed approach to re-train the system if there are changes in scenario, which means the trained database can be applied in a wide variety of environments. The experiment results show that the proposed approach outperforms existing methods on KTH and WEIZMANN datasets.

P164 *Hierarchical Parameter Sharing in Recursive Neural Networks with Long Short-Term Memory [#17638]*

Fengyu Li, Mingmin Chi, Dong Wu and Junyu Niu, Fudan University, China

Parameter Sharing (or weight sharing) is widely used in Neural Networks, such as Recursive Neural Networks (RvNNs) and its variants, to control model complexities and extract prior knowledge. The parameter sharing in RvNNs for language model assumes that non-leaf nodes in treebanks are generated by similar semantic compositionality, where hidden units of all the non-leaf nodes in RvNNs share model parameters. However treebanks have several semantic levels with significantly different semantic compositionality. Accordingly, this leads to a poor classification performance if nodes in high semantic levels share the same parameters with those in low levels. In the paper, a novel parameter sharing strategy in a hierarchical manner is proposed over Long Short-Term Memory (LSTM) cells in Recursive Neural Networks, denoted as shLSTM-RvNN, in which weight connections in hidden units are clustered according to hierarchical semantic levels defined in Penn Treebank tagsets. Accordingly, the parameters in the same semantic level can be shared but those in different semantic levels should have different sets of connections weights. The proposed shLSTM-RvNN model is evaluated in benchmark

data sets containing semantic compositionality. Empirical results show that the shLSTM-RvNN model increases classification accuracies but significantly reduces time complexities.

Wednesday, November 15, 4:00PM-6:00PM

Award Session: WedB1 Best student paper award competition session

Wednesday, November 15, 4:00PM-6:00PM, Room: Kaixuan 7, Chairs: Jun Zhang and Haibo He

4:00PM *Improvement of Texture Clustering Performance in Complex-valued SOM by using Complex-valued Auto-encoder for Millimeter-wave Coherent Imaging [#17190]*

Yuya Arima and Akira Hirose, The University of Tokyo, Japan

Interference in millimeter-wave active radar imaging causes harmful effects such as amplitude fluctuation and phase distortion, resulting in deterioration in visualization quality in a radar system employing complex-valued self-organizing map. We show that a complex-valued auto-encoder is capable of extracting features properly even under these influences, resulting in improvement of clustering performance effectively.

4:15PM *Tensorial Neural Networks and Its Application in Longitudinal Network Data Analysis [#17248]*

Mingyuan Bai, Boyan Zhang and Junbin Gao, The University of Sydney, Australia

The traditional neural networks are only able to process vectorial data, resulting in the loss of spatial information in high-dimensional structural data when vectorising data. The matrix neural networks (MatNet), a new approach, is only capable of capturing structural information on the first and the second dimension/mode of matrix data. Although the state-of-the-art method multilinear tensor regression (MLTR) manages to capture the linear relational information in high dimensions, the possible nonlinear relationships within multidimensional data may be ignored. To analyse both linear and nonlinear relationships among each mode of the multidimensional relational data, a new model, named tensorial neural networks, is proposed. Within the tensorial neural networks, the hidden layers are in high-dimensions rather than one dimension or two dimensions. The backpropagation algorithm for tensorial neural networks is derived and provided. The performance of the new approach is assessed in analysing longitudinal network data which contains weekly international relationships among 25 countries from 2004 to mid-2014 from World-Wide Integrated Crisis Early Warning System. In other words, the application of this newly proposed method, tensorial neural networks, is on international relationship study in this paper. The dependencies among the international relationship data are generally reciprocity and transitivity which are also the interests of the research.

4:30PM *Heterogeneous Features Integration in Deep Knowledge Tracing [#17325]*

Lap Pong Cheung and Haiqin Yang, The Chinese University of Hong Kong, Hong Kong; Hang Send Management College, Hong Kong

Knowledge tracing is a significant research topic in educational data mining. The goal is to automatically trace students' knowledge states by analyzing their exercise performance. Recently proposed Deep Knowledge Tracing (DKT) model has shown a significant improvement to solve this task by applying deep recurrent neural networks to learn interaction between knowledge components and exercises. The input of the model is only the one-hot encoding to represent the exercise tags and it excludes all other heterogeneous features, which may degrade the performance. To further improve the model performance, researchers have analyzed the heterogeneous features and provided manual ways to select the features and discretize them appropriately. However, the feature engineering efforts are not feasible for data with a huge number of features. To tackle with them, we propose an automatic and intelligent approach to integrate the heterogeneous features into the DKT model. More specifically, we encode the predicted response and the true response into binary bits and combine them with the original one-hot encoding feature as the input to a Long Short Term Memory (LSTM) model, where the predicted response is learned via Classification And Regression Trees (CART) on the heterogeneous features. The predicted response plays the role of determining whether a student will answer the exercise correctly, which can relieve the effect of exceptional samples. Our empirical evaluation on two educational datasets verifies the effectiveness of our proposal.

4:45PM *Transfer Learning Enhanced Common Spatial Pattern Filtering for Brain Computer Interfaces (BCIs): Overview and a New Approach [#17554]*

He He and Dongrui Wu, Huazhong University of Science and Technology, China

The electroencephalogram (EEG) is the most widely used input for brain computer interface (BCI), and common spatial pattern (CSP) is frequently used to spatially filter it to increase its signal-to-noise ratio. However, CSP is a supervised filter, which needs some subject-specific calibration data to design. This is time-consuming and not user-friendly. A promising approach for shortening or even completely eliminating this calibration session is transfer learning, which leverages relevant data from other subjects or tasks. This paper introduces three existing approaches for incorporating transfer learning into CSP, and also proposes a new transfer learning enhanced CSP approach. Experiments on motor imagery classification demonstrate the effectiveness of these approaches. Particularly, our proposed approach achieves the best performance when the number of target domain calibration samples is small.

5:00PM *Temporal Attention Neural Network for Video Understanding [#17805]*

Jegyung Son, Gil-Jin Jang and Minho Lee, Kyungpook National University, Korea (South)

Deep learning based vision understanding algorithms have recently approached human-level performance in object recognition and image captioning. These performance evaluations are, however, limited to static data and these algorithms are also limited. Few limitations of these methods include their inability to selectively encode human behavior, movement of multiple objects and time-varying variations in the background. To address these limitations and to extend these algorithms for analyzing dynamic videos, we propose a temporal attention CNN-RNN network with motion saliency map. Our proposed model overcome scarcity of usable information in encoded data and efficiently integrate motion features by incorporating dynamic nature of information present in successive frames. We evaluate our proposed model over UCF101 public dataset and our experiments demonstrate that our proposed model successfully extract motion information for video understanding without any computationally intensive preprocessing.

5:15PM *Average Reward Optimization with Multiple Discounting Reinforcement Learners [#17804]*

Chris Reinke, Eiji Uchibe and Kenji Doya, Okinawa Institute of Science and Technology, Japan; ATR Computational Neuroscience Laboratories, Japan

Maximization of average reward is a major goal in reinforcement learning. Existing model-free, value-based algorithms such as R-Learning use average adjusted values. We propose a different framework, the Average Reward Independent Gamma Ensemble (AR-IGE). It is based on an ensemble of discounting Q-learning modules with a different discount factor for each module. Existing algorithms only learn the optimal policy and its average reward. In contrast, the AR-IGE learns different policies

and their resulting average rewards. We prove the optimality of the AR-IGE in episodic and deterministic problems where rewards are given at several goal states. Furthermore, we show that the AR-IGE outperforms existing algorithms in such problems, especially in situations where policies have to be changed due to changes in the task. The AR-IGE represents a new way to optimize average reward that could lead to further improvements in the field.

5:30PM *Multimodal Classification with Deep Convolutional-Recurrent Neural Networks for Electroencephalography [#17477]*

Chuanqi Tan, Fuchun Sun, Wenchang Zhang, Jianhua Chen and Chunfang Liu, Tsinghua University, China; Yanshan University, China

Electroencephalography (EEG) has become the most significant input signal for brain computer interface (BCI) based systems. However, it is very difficult to obtain satisfactory classification accuracy due to traditional methods can not fully exploit multimodal information. Herein, we propose a novel approach to modeling cognitive events from EEG data by reducing it to a video classification problem, which is designed to preserve the multimodal information of EEG. In addition, optical flow is introduced to represent the variant information of EEG. We train a deep neural network (DNN) with convolutional neural network (CNN) and recurrent neural network (RNN) for the EEG classification task by using EEG video and optical flow. The experiments demonstrate that our approach has many advantages, such as more robustness and more accuracy in EEG classification tasks. According to our approach, we designed a mixed BCI-based rehabilitation support system to help stroke patients perform some basic operations.

5:45PM *Sleep apnea event detection from nasal airflow using convolutional neural networks [#17856]*

Rim Haidar, Irena Koprinska and Bryn Jeffries, The university of Sydney, Australia; The University of Sydney, Australia

Obstructive sleep apnea-hypopnea syndrome is a respiratory disorder characterized by abnormal breathing patterns during sleep. It causes problems during sleep, including loud snoring and frequent awaking. This study proposes a new approach for the detection of apnea-hypopnea events from the raw signal data of nasal airflow using convolutional neural networks. Convolutional neural networks are a prominent type of deep neural networks known for their ability to automatically learn features from high dimensional data without manual feature engineering. We demonstrate the applicability of this technique on a dataset of 24,480 samples (30 seconds long) extracted from nasal flow signals of 100 subjects in the MESA sleep study. The performance of the convolutional neural network model is compared with an-other approach that uses a support vector machine model with statistical features generated from the flow signal. Our results show that the convolutional neural network outperformed the support vector machine approach, achieving accuracy and F1-score of 75%.

Invited Session: WedB2 Reservoir computing and its applications, Spiking neural networks

Wednesday, November 15, 4:00PM-6:00PM, Room: Zhujiang 2, Organizers: Daiju Nakano, Gouhei Tanaka, Nikola Kasabov, Maryam G Doborjeh and Josafath I Espinosa-Ramos, Chairs: Daiju Nakano and Nikola Kasabov

4:00PM *Complex-valued neural networks for wave-based realization of reservoir computing [#17187]*

Akira Hirose, Seiji Takeda, Toshiyuki Yamane, Daiju Nakano, Shigeru Nakagawa, Ryosho Nakane and Gouhei Tanaka, The University of Tokyo, Japan; IBM Research - Tokyo, Japan

In this paper, we discuss the significance of complex-valued neural-network (CVNN) framework in energy-efficient neural networks, in particular in wave-based reservoir networks. Physical-wave reservoir networks are highly enhanced by CVNNs. From this viewpoint, we also compare the features of reservoir computing and other architectures.

4:15PM *Waveform Classification by Memristive Reservoir Computing [#17669]*

Gouhei Tanaka, Ryosho Nakane, Toshiyuki Yamane, Seiji Takeda, Daiju Nakano, Shigeru Nakagawa and Akira Hirose, The University of Tokyo, Japan; IBM Research - Tokyo, Japan

Reservoir computing is one of the computational frameworks based on recurrent neural networks for learning sequential data. We study the memristive reservoir computing where a network of memristors, instead of recurrent neural networks, provides a nonlinear mapping from input sequential signals to high- dimensional spatiotemporal dynamics. First we formulate the circuit equations of the memristive networks and describe the simulation methods. Then we use the memristive reservoir computing for solving a waveform classification problem. We demonstrate how the classification ability depends on the number of reservoir outputs and the variability of the memristive elements. Our methods are useful for finding a better architecture of the memristive reservoir under the inevitable element variability when implemented with nano/micro-scale devices.

4:30PM *Simulation Study of Physical Reservoir Computing by Nonlinear Deterministic Time Series Analysis [#17500]*

Toshiyuki Yamane, Seiji Takeda, Daiju Nakano, Gouhei Tanaka, Ryosho Nakane, Akira Hirose and Shigeru Nakagawa, IBM Research - Tokyo, Japan; The University of Tokyo, Japan

We investigate dynamics of physical reservoir computing by numerical simulations. Our approach is based on nonlinear deterministic time series analysis such as Takens' theorem and false nearest neighbor methods. We show that this approach is useful for efficient design and implementation of physical reservoir computing systems where only partial information of the reservoir state is accessible. We take nonlinear laser dynamics subject to time delay as physical reservoir and show that the size of physical reservoir can be estimated by these method.

4:45PM *Polymer Waveguide-Based Reservoir Computing [#17681]*

Jean Benoit Heroux, Hidetoshi Numata and Daiju Nakano, IBM Research - Tokyo, Japan

Polymer waveguide optical interconnect technology, in which VCSEL and photodiode chip arrays are flip-mounted on an organic carrier to fabricate optical multi-chip modules, has been intensively developed over the last 15 years for data transfer applications in high performance computers. In that application, multiple-channel data signals transmitted to and from CPU and memory components in a system are converted into optical signals for short range, high density, high speed, low power and low cost digital communication. In this work we explore how these efforts could be leveraged to fabricate a compact, fully integrated photonic reservoir computing module with several devices potentially operating in parallel. We present experimental results of low optical loss in a crossing structure as well as good performance simulated with realistic parameters of a time-multiplexed reservoir performing a signal recovery task.

5:00PM *A Fast Precise-Spike and Weight-Comparison based Learning Approach for Evolving Spiking Neural Networks [#17134]*

Lin Zuo, Shan Chen, Hong Qu and Malu Zhang, University of Electronic Science and Technology of China, China

Evolving spiking neural networks (ESNNs) evolve the output neurons dynamically based on the information presented in the incoming samples and the information stored in the network. In order to improve the learning efficiency of the existing algorithms for ESNNs, this paper presents a fast precise-spike and weight-comparison based learning algorithm, called PSWC. PSWC can dynamically add a new neuron or update the parameters of existing neurons according to the precise time of the incoming spikes and the similarities of the weights. The proposed algorithm is demonstrated on several standard data sets. The experimental results demonstrate that PSWC has a significant advantage in terms of speed performance and provides competitive results in classification accuracy compared with SpikeTemp and rank-order-based approach.

5:15PM *An Energy-aware Hybrid Particle Swarm Optimization Algorithm for Spiking Neural Network Mapping [#17357]*

Junxiu Liu, Xingyue Huang, Yuling Luo and Yi Cao, Guangxi Normal University, China; University of Surrey, United Kingdom

Recent approaches to improving the scalability of Spiking Neural Networks (SNNs) have looked to use custom architectures to implement and interconnect the neurons in the hardware. The Networks-on-Chip (NoC) interconnection strategy has been used for the hardware SNNs and has achieved a good performance. However, the mapping between a SNN and the NoC system becomes one of the most urgent challenges. In this paper, an energy-aware hybrid Particle Swarm Optimization (PSO) algorithm for SNN mapping is proposed, which combines the basic PSO and Genetic Algorithm (GA). A Star-Subnet-Based-2D Mesh (2D- SSBM) NoC system is used for the testing. Results show that the proposed hybrid PSO algorithm can avoid the premature convergence to local optimum, and effectively reduce the energy consumption of the hardware NoC systems.

5:30PM *A Dynamic Region Generation Algorithm for Image Segmentation Based on Spiking Neural Network [#17457]*

Lin Zuo, Linyao Ma, Yanqing Xiao, Malu Zhang and Hong Qu, University of Electronic Science and Technology of China, China

We propose a dynamic region generation algorithm for image segmentation based on spiking neural network inspired by human visual cortex that shows the tremendous capacity of processing image. The network structure generated by the proposed algorithm is automatically and dynamically. An image can be decomposed into several different shape and size of regions that look like superpixels. Merging these regions based on the color space similarity can extract contour. Dynamic network architecture brings stronger computing power. Dynamic generation method leads to more flexible network. Experimental results on BCDS300 dataset confirm that our approach achieves satisfactory segmentation results for different images compared with SLIC.

5:45PM *Bio-Inspired Multi-Layer Spiking Neural Network Extracts Discriminative Features from Speech Signals [#17160]*

Amirhossein Tavanaei and Anthony Maida, University of Louisiana at Lafayette, United States

Spiking neural networks (SNNs) enable power-efficient implementations due to their sparse, spike-based coding scheme. This paper develops a bio-inspired SNN that uses unsupervised learning to extract discriminative features from speech signals, which can subsequently be used in a classifier. The architecture consists of a spiking convolutional/pooling layer followed by a fully connected spiking layer for feature discovery. The convolutional layer of leaky, integrate-and-fire (LIF) neurons represents primary acoustic features. The fully connected layer is equipped with a probabilistic spike-timing-dependent plasticity learning rule. This layer represents the discriminative features through probabilistic, LIF neurons. To assess the discriminative power of the learned features, they are used in a hidden Markov model (HMM) for spoken digit recognition. The experimental results show performance above 96% that compares favorably with popular statistical feature extraction methods. Our results provide a novel demonstration of unsupervised feature acquisition in an SNN.

Invited Session: WedB3 Intelligent system modeling & control

Wednesday, November 15, 4:00PM-6:00PM, Room: Zhujiang 3, Organizers: Tieshan Li and Yongming Li, Chairs: Tieshan Li and Yongming Li

4:00PM *Partial-Directed-Topology Based Consensus Control for Linear Multi-Agent Systems [#17399]*

Chunping Shi, Qinglai Wei and Derong Liu, University of Science and Technology Beijing, China; Institute of Automation, Chinese Academy of Sciences, China; Guangdong University of Technology, China

This paper focuses on designing an adaptive controller for solving consensus control problem of continues-time linear multi-agent systems over partially directed topology. The main contribution of this paper is that the multi-agent system under partially directed topology is designed. Using the designed controller, the presented system is stable, which is proved in this paper. The convergence is also analysed. Finally, a simulation study is given to show its effectiveness.

4:15PM *Adaptive Neural Network Output-Feedback Control for A Class of Discrete-Time Nonlinear Systems in Presence of Input Saturation [#17622]*

Xin Wang, Tieshan Li and C.L. Philip Chen, Dalian Maritime University, China; University of Macau, Dalian Maritime University, China

In this paper, an adaptive neural network output-feedback control approach is presented for a class of discrete-time nonlinear strict-feedback systems in presence of input saturation. An auxiliary design system is employed to overcome the problem of input saturation constraint, and states of auxiliary design system are utilized to develop the tracking control. The high-order neural network (HONN) is employed to approximate unknown function. It is shown via Lyapunov theory that all the signals in closed-loop system are semi-globally uniformly ultimately bounded (SGUUB) and the tracking error converges to a small neighborhood of zero by choosing the control parameters appropriately. A simulation example is included to illustrate the effectiveness of the proposed approach.

4:30PM *FPGA Implementation of the Projection Based Recurrent Neural Network Approach to Compute the Distance Between a Point and an Ellipsoid [#17683]*

Shenshen Gu and Xiaowen Wang, Shanghai University, China

In this paper, an FPGA hardware implementation based on a recurrent neural network was proposed to compute the distance between a point and an ellipsoid. This implementation takes the 0-1 constraint box into consideration as well, it is also capable to solve the hyperellipsoid problem based on the methodology of an automatic generation of neural hardware tool. The hardware design is based on the Xilinx's System Generator development tool and experimental results show that the proposed hardware implementation method is very efficient with a high degree of parallelism.

4:45PM *Reasoning under Conflicts in Smart Environment Systems [#17726]*

Hela Sfar, Raddaoui Badran and Bouzeghoub Amel, Telecom SudParis, France

This paper addresses the rule conflict within rules-based systems. Nowadays, using logic rules to infer knowledge, express restrictions and so on has shown a great interest in several domains which makes rules-based systems very popular. However, since rules may originate from distinct sources and change over time, methods are required to maintain rule consistency by detecting and resolving the conflict. The method we put forward refines a form of non- monotonic reasoning called argumentation with new definition. Arguments are created to help the user weigh up the evidence in favor of and against the information caused the conflict. In order to evaluate the proposal, we resolve conflicts through the method in an rules-based system. The result proves the efficiency and viability of the proposal.

5:00PM *Adaptive Neural Control for Pure Feedback Nonlinear Systems with Uncertain Actuator Nonlinearity [#17695]*

Maolong Lv, Ying Wang, Simone Baldi, Zongcheng Liu, Chao Shi, Chaoqi Fu, Xiangfei Meng and Yao Qi, Air force engineering university, China; Delft University of Technology, Netherlands

For the pure feedback systems with uncertain actuator nonlinearity and in-differentiate non-affine function, a novel adaptive neural control scheme is proposed. Firstly, the assumption that the non-affine function must be differentiable with respect to control input has been canceled, in addition, the proposed approach can not only be applicable to actuator input dead zone nonlinearity but also suitable for backlash nonlinearity without changing the controller. Secondly, the neural network (NN) is used to approximate unknown nonlinear functions of system generated in the process of control design and a nonlinear robust term is introduced to eliminate the actuator nonlinearity modeling error, NN approximation error and external disturbances. Thirdly, semi- globally uniformly ultimately boundedness of all signals in the closed loop system is analytically proved by utilizing Lyapunov theory. Finally, the effectiveness of the designed method is demonstrated via two examples.

5:15PM *Grammatical Evolution using Tree Representation Learning [#17744]*

Shunya Maruta, Yi Zuo, Masahiro Nagao, Hideyuki Sugiura and Eisuke Kita, Nagoya University, Japan

Grammatical evolution (GE) is one of the evolutionary computations, which evolves genotype to map phenotype by using the Backus-Naur Form (BNF) syntax. GE has been widely employed to represent syntactic structure of a function or a program in order to satisfy the design objective. As the GE decoding process parses the genotype chromosome into array or list structures with left-order traversal, encoding process could change gene codons or orders after genetic operations. For improving this issue, this paper proposes a novel GE algorithm using tree representation learning (GETRL) and presents three contributions to the original GE, genetic algorithm (GA) and genetic programming (GP). Firstly, GETRL uses a tree-based structure to represent the functions and programs for practical problems. To be different from the traditional GA, GETRL adopts a genotype-to-phenotype encoding process, which transform the genes structures for tree traversal. Secondly, a pointer allocation mechanism is introduced in this method, which allows the GETRL to pursue the genetic operations like typical GAs. To compare with the typical GP, however GETRL still generates a tree structure, our method adopts a phenotype-to-genotype decoding process, which allows the genetic operations be able to be applied into tree-based structure. Thirdly, due to each codon in GE has different expression meaning, genetic operations are quite different from GAs, in which all codons have the same meaning. In this study, we also suggest a multi-chromosome system and applied it into GETRL, that can prevent from overriding the codons for different objectives.

5:30PM *Application of Grammatical Swarm to Symbolic Regression Problem [#17851]*

Eisuke Kita, Risako Yamamoto, Hideyuki Sugiura and Zuo Yi, Nagoya University, Japan

Grammatical Swarm (GS), which is one of the evolutionary computations, is designed to find the function, the program or the program segment satisfying the design objective.Since the candidate solutions are defined as the bit-strings,the use of the translation rules translates the bit-strings into the function or the program.The swarm of particles is evolved according to Particle Swarm Optimization (PSO) in order to find the better solution. The aim of this study is to improve the convergence property of GS by changing the traditional PSO in GS with the other PSOs such as Particle Swarm Optimization with constriction factor (PSO-cf), Union of Global and Local Particle Swarm Optimizations (UPSO), Comprehensive Learning Particle Swarm Optimization (CLPSO), Particle Swarm Optimization with Second Global best Particle (SG-PSO) and Particle Swarm Optimization with Second Personal best Particle (SG-PSO). The improved GS algorithms, therefore, are named as Grammatical Swarm with constriction factor (GS-cf), Union of Global and Local Grammatical Swarm (UGS), Comprehensive Learning Grammatical Swarm (CLGS), Grammatical Swarm with Second Global best Particle (SG-GS) and Grammatical Swarm with Second Personal best Particle (SG-GS), respectively. Symbolic regression problem is considered as the numerical example. The original GS is compared with the other algorithms. The effect of the model parameters for the convergence properties of the algorithms are discussed in the preliminary experiments. Then, except for CLGS and UGS, the convergence speeds of the other algorithms are faster than that of the original GS. Especially, the convergence properties of GS-cf and SP-GS are fastest among them.

WedB4 Machine learning 2

Wednesday, November 15, 4:00PM-6:00PM, Room: Zhujiang 5, Chairs: Tingwen Huang and Kok Wai Wong

4:00PM *Learning of Phase-Amplitude-Type Complex-Valued Neural Networks With Application to Signal Coherence [#17624]*

Rongrong Wu, He Huang and Tingwen Huang, Soochow University, China; Texas AM University at Qatar, Qatar

This paper presents a limited-memory BFGS (L-BFGS) based learning algorithm for complex-valued neural networks (CVNNs) with phase-amplitude-type activation functions, which can be applied to deal with coherent signals effectively. The performance of the proposed L-BFGS algorithm is compared with traditional complex-valued stochastic gradient descent method on the tasks of wave-related signal processing with various degrees of coherence. The experimental results demonstrate that both faster convergence speed and smaller training errors are achieved by our algorithm. Furthermore, the phase outputs of the CVNNs trained by this algorithm are more stable when white Gaussian noises are added to the input signals.

4:15PM *Semi-supervised Multi-label Linear Discriminant Analysis [#17213]*

Yanming Yu, Guoxian Yu, Xia Chen and Yazhou Ren, Southwest University, China; University of Electronic Science and Technology of China, China

Multi-label dimensionality reduction methods often ask for sufficient labeled samples and ignore abundant unlabeled samples ones. To leverage abundant unlabeled samples and scarce labeled ones, we introduce a method called Semi-supervised Multi-label Linear Discriminant Analysis (SMLDA). SMLDA measures the dependence between pairwise samples in the original space and in the projected subspace to utilize unlabeled samples. After that, it optimizes the target projective matrix by minimizing the distance of within-class samples, whilst maximizing the distance of between-class samples and the dependence term. Extensive

empirical study on multi-label datasets shows that SMLDA outperforms other related methods across various evaluation metrics, and the dependence term is an effective alternative to the widely-used smoothness term.

4:30PM *Application of Instruction-based Behavior Explanation to a Reinforcement Learning Agent with Changing Policy [#17716]*

Yosuke Fukuchi, Masahiko Osawa, Hiroshi Yamakawa and Michita Imai, Keio University, Japan; Keio University / Research Fellow of Japan Society for the Promotion of Science, Japan; Dwango Artificial Intelligence Laboratory / The Whole Brain Architecture Initiative, Japan

Agents that acquires their own policies autonomously have the risk of accidents caused by the agents' unexpected behavior. Therefore, it is necessary to improve the predictability of the agents' behavior in order to ensure the safety. Instruction-based Behavior Explanation (IBE) is a method for a reinforcement learning agent to announce the agent's future behavior. However, it was not verified that the IBE was applicable to an agent that changes the policy dynamically. In this paper, we consider agents under training and improved the IBE for the application to such agents. We conducted an experiment to verify if the behavior explanation model of an immature agent worked even after the agent's further training. The results indicated the applicability of the improved IBE to agents under training.

4:45PM *Joint Neighborhood Subgraphs Link Prediction [#17813]*

Dinh Tran Van, Alessandro Sperduti and Fabrizio Costa, University of Padova, Italy; University of Exeter, United Kingdom

A crucial computational task for relational and network data is the "link prediction problem" which allows for example to discover unknown interactions between proteins to explain the mechanism of a disease in biological networks, or to suggest novel products for a customer in a e-commerce recommendation system. Most link prediction approaches however do not effectively exploit the contextual information available in the neighborhood of each edge. Here we propose to cast the problem as a binary classification task over the union of the pair of subgraphs located at the endpoints of each edge. We model the classification task using a support vector machine endowed with an efficient graph kernel and achieve state-of-the-art results on several benchmark datasets.

5:00PM *Differential Evolution Memetic Document Clustering Using Chaotic Logistic Local Search [#17286]*

Ibraheem Al-Jadir, Kok Wai Wong, Chun Che Fung and Hong Xie, Murdoch University, Australia

In this paper, we propose a Memetic-based clustering method that improves the partitioning of document clustering. Our proposed method is named as Differential Evolution Memetic Clustering (DEMC). Differential Evolution (DE) is used for the selection of the best set of cluster centres (cen- troids) while the Chaotic Logistic Search (CLS) is used to enhance the best set of solutions found by DE. For the purpose of comparison, the DEMC is com-pared with the basic DE, Differential Evolution Simulated Annealing (DESA) and the Differential Evolution K-Means (DEKM) methods as well as the tradi-tional partitioning clustering using the K-means. The DEMC is also compared with the recently proposed Chaotic Gradient Artificial Bee Colony (CGABC) document clustering method. The reuters-21578, a pair of the 20-news group, classic 3 and TDT benchmark collection (TDT5) along with a real-world six-event-crimes datasets are used in the experiments in this paper. The results showed that the proposed DEMC outperformed the other methods in terms of the convergence rate measured by the fitness function (ADDC) and the com-pactness of the resulted clusters measured by the F-macro and F-micro measures.

5:15PM *Completion of High Order Tensor Data with Missing Entries via Tensor-train Decomposition [#17254]*

Longhao Yuan, Qibin Zhao and Jianting Cao, Saitama Institute of Technology and RIKEN AIP, Japan; RIKEN Center for Advanced Intelligence Project (AIP) and Guangdong University of Technology, Japan; Saitama Institute of Technology, Japan

In this paper, we aim at the completion problem of high order tensor data with missing entries. The existing tensor factorization and completion methods suffer from the curse of dimensionality when the order of tensor N>>3. To overcome this problem, we propose an efficient algorithm called TT-WOPT (Tensor-train Weighted OPTimization) to find the latent core tensors of tensor data and recover the missing entries. Tensor-train decomposition, which has the powerful representation ability with linear scalability to tensor order, is employed in our algorithm. The experimental results on synthetic data and natural image completion demonstrate that our method significantly outperforms the other related methods. Especially when the missing rate of data is very high, e.g., 85% to 99%, our algorithm can achieve much better performance than other state-of-the-art algorithms.

5:30PM *GASOM: Genetic Algorithm assisted Architecture Learning in Self Organizing Maps [#17098]*

Ashutosh Saboo, Anant Sharma and Tirtharaj Dash, Birla Institute of Technology and Science, Pilani - Goa Campus, India

Self Organizing Map (SOM) is a special kind of neuron architecture that partially simulates the visual cortex of the animal brain and has been proven to be exceptionally successful in data visualization and clustering applications. Generally, these applications start with a predefined and fixed representation architecture of SOM without considering the underlying characteristics of the data in the original input space. In such a scenario, the performance so obtained might not be considered to be optimal. In order to enhance the quality and performance of SOM, we propose to use an evolutionary computation approach, the Genetic Algorithm (GA) to learn the optimal architecture of SOM given any data with adverse characteristics and complexity. The developed package named GASOM has been extensively evaluated with 6 synthetic datasets and 6 real-world datasets. The quality of mapping in terms of error measures have been noted carefully for each evaluation. The recorded quantitative outcomes of GASOM for each dataset demonstrate promising performance with regard to quality of mapping from the input space to the representation space.

5:45PM *Educational and Non-educational Text Classification Based on Deep Gaussian Processes [#17583]*

Huijuan Wang, Jing Zhao, Zeheng Tang and Shiliang Sun, East China Normal University, China

With the development of the society, more and more people are concerned about education, such as preschool education, primary and secondary education and adult education. These people want to retrieve educational contents from large amount of information through the Internet. From the technical view, this requires identifying educational and non-educational data. This paper focuses on solving the educational and non-educational text classification problem based on deep Gaussian processes (DGPs). Before training the DGP, word2vec is adopted to construct the vector representation of text data. Then we use the DGP regression model to model the processed data. Experiments on real-world text data are conducted to demonstrate the feasibility of the DGP for the text classification problem. The promising results show the validity and superiority of the proposed method over other related methods, such as GP and Sparse GP.

WedB5 Deep learning 2

Wednesday, November 15, 4:00PM-6:00PM, Room: Zhujiang 7, Chairs: Yoshihiro Ohama and Long Cheng

4:00PM *A Parallel Forward-Backward Propagation Learning Scheme for Auto-Encoders [#17151]*

Yoshihiro Ohama and Takayoshi Yoshimura, Toyota Central Research and Development Laboratories, Inc., Japan

Auto-encoders constitute one popular deep learning architecture for feature extraction. Since an auto-encoder has at least one bottle neck layer for feature representation and at least five layers for fitting nonlinear transformations, back-propagation learning (BPL) algorithms with saturated activation functions sometimes face the vanishing gradient problem, which slows convergence. Thus, several modified methods have been proposed to mitigate this problem. In this work, we propose the calculation of forward-propagated errors in parallel with back-propagated errors in the network, without modification of the activation functions or the network structure. Although this scheme for auto-encoder learning has a larger computational cost than that of BPL, processing time until convergence could be reduced by implementing parallel computing. In order to confirm the feasibility of this scheme, two simple problems were examined by training auto-encoders to acquire (1) identity mappings of two-dimensional points along the arc of a half-circle to extract the central angle and (2) hand-writing images to extract labeled digits. Both results indicate that the proposed scheme requires only about half of the iterations to reduce the cost value enough, compared to BPL.

4:15PM *Hierarchical Attention BLSTM for Modeling Sentences and Documents [#17673]*

Xiaolei Niu and Yuexian Hou, Tianjin University, China

Recently, neural network based methods have made remarkable progresses on various Natural Language Processing (NLP) tasks. However, it is still a challenge to model both short and long texts, e.g. sentences and documents. In this paper, we propose a Hierarchical Attention Bidirectional LSTM (HA-BLSTM) to model both sentences and documents. HA-BLSTM effectively obtains a hierarchy of representations from words to phrases through the hierarchical structure. We design two attention mechanisms: local and global attention mechanisms. The local attention mechanism learns which components of a text are more important for modeling the whole text, while the global attention mechanism learns which representations of the same text are crucial. Thus, HA-BLSTM can model long documents along with short sentences. Experiments on four benchmark datasets show that our model yields a superior classification performance over a number of strong baselines.

4:30PM *Bi-directional LSTM with Quantum Attention Mechanism for Sentence Modeling [#17682]*

Xiaolei Niu, Yuexian Hou and Panpan Wang, Tianjin University, China

Bi-directional LSTM (BLSTM) often utilizes Attention Mechanism (AM) to improve the ability of modeling sentences. But additional parameters within AM may lead to difficulties of model selection and BLSTM training. To solve the problem, this paper redefines AM from a novel perspective of the quantum cognition and proposes a parameter-free Quantum AM (QAM). Furthermore, we make a quantum interpretation for BLSTM with Two-State Vector Formalism (TSVF) and find the similarity between sentence understanding and quantum Weak Measurement (WM) under TSVF. Weak value derived from WM is employed to represent the attention for words in a sentence. Experiments show that QAM based BLSTM outperforms common AM (CAM) [1] based BLSTM on most classification tasks discussed in this paper.

4:45PM *An Effcient Binary Search Based Neuron Pruning Method for ConvNet Condensation [#17748]*

Boyu Zhang, A. K. Qin and Jeffrey Chan, Royal Melbourne Institute of Technology, Australia; Swinburne University of Technology, Australia

Convolutional neural networks (CNNs) have been widely applied in the field of computer vision. Nowadays, the architecture of CNNs is becoming more and more complex, involving more layers and more neurons per layer. The augmented depth and width of CNNs will lead to greatly increased computational and memory costs, which may limit CNN's practical utility. However, as demonstrated in previous research, CNNs of complex architecture may contain considerable redundancy in terms of hidden neurons. In this work, we propose a magnitude based binary neuron pruning method which can selectively prune neurons to shrink the network size while keeping the performance of the original model without pruning. Compared to some existing neuron pruning methods, the proposed method can achieve higher compression rate while automatically determining the number of neurons to be pruned per hidden layer in an efficient way.

5:00PM *Generative Moment Matching Autoencoder with Perceptual Loss [#17797]*

Mohammad Ahangar Kiasari, Dennis Singh Moirangthem and Minho Lee, Kyungpook National University, Korea (South)

In deep generative networks, one of the major challenges is to generate non- blurry, clearer images. Unlike the generative adversarial networks, generative models such as variational autoencoders, generative moment matching networks etc. use pixel-wise loss which leads to the generation of blurry images. In this paper, we propose an improved generative model called Generative Moment Matching Autoencoder (GMMA) with a feature-wise loss mechanism. We use a pre- trained VGGNet convolutional neural network to compute the loss at the various feature extraction layers. We evaluate the performance of our model on the MNIST and the Large-scale CelebFaces Attributes (CelebA) dataset. Our generative model outperforms the existing models on the log-likelihood estimation test. We also illustrate the effectiveness of our mechanism and the improved generation and reconstruction capabilities. The proposed GMMA with perceptual loss successfully alleviates the problem of blurry image generation.

5:15PM *Will Outlier Tasks Deteriorate Multitask Deep Learning? [#17516]*

Sirui Cai, Yuchun Fang and Zhengyan Ma, Shanghai University, China

Most of the multitask deep learning today use different but correlated tasks to improve their performances by sharing the common features of the tasks. What will happen if we use outlier tasks instead of related tasks? Will they deteriorate the performance? In this paper, we explore the influence of outlier tasks to the multitask deep learning through carefully designed experiments. We compare the accuracies and the convergence rates between the single task convolutional neural network (STCNN) and outlier multitask convolutional neural network (OMTCNN) on facial attribute recognition and hand-written digit recognition. By doing that, we prove that outlier tasks will constrain each other in a multitask network without parameter redundancy and cause a worse performance. We also discover that outlier tasks related to image recognition, like facial attribute recognition and hand-written digit recognition, may not be outlier tasks and have some common features in the bottom layers for the fact that they can use the other one's first convolutional layer to replace theirs without any accuracy losses.

5:30PM *The Effect of Task similarity on Deep Transfer Learning [#17534]*

Wei Zhang, Yuchun Fang and Zhengyan Ma, Shanghai University, China

In recent years, with deep learning achieving a great success, deep transfer learning gradually becomes a new issue. Fine-tuning as a simple transfer learning method can be used to help train deep network and improve the performance of network. In our paper, we use two fine-tuning strategies on deep convolutional neural network and compare their results. There are many influencing factors, such as the depth and width of the network, the amount of data, the similarity of the source and target domain, and so on. Then we keep the network structure and other related factors consistent and use the fine fine-tuning strategy to find the effect of cross-domain factor and similarity of task. Specifically, we use source network and target test data to calculate the similarity. The results of experiments show that when we use fine-tune strategy, using different dataset in source and target domain would affects the target task a lot. Besides the similarity of tasks has direction, and to some extent the similarity would reflect the increment of performance of target task when the source and target task use the same dataset.

5:45PM *Exploiting the Tibetan Radicals in Recurrent Neural Network for Low-resource Language Models [#17334]*

Tongtong Shen, Longbiao Wang, Xie Chen, Kuntharrgyal Khysru and Jianwu Dang, Tianjin University, China; University of Cambridge, England

In virtue of the superiority of handling the sequence data and the effectiveness of preserving long-distance information, recurrent neural network language model (RNNLM) has prevailed in a range of tasks in recent years. However, a large quantities of data are required for language modelling with good performance, which poses the difficulties of modeling for low-resource languages. To address this issue, Tibetan as one of minority languages is instantiated, and its radicals (components of Tibetan characters) are explored for constructing language model. Motivated by the inherent structure of Tibetan, a novel construction of Tibetan character embedding is exploited to RNNLM. The fusion of individual radical embedding is enhanced by three ways, including using uniform weight (TRU), different weight (TRD) and radical combination (TRC). This structure, especially combining with the radicals, can extend the capability to capture long-term con-text dependencies and solve the low-resource problem to some extent. The experimental results suggest that this proposed structure obtained a better performance than standard RNNLM, yielding 7.4%, 12.7% and 13.5% relative perplexity reduction by using TRU, TRD and TRC respectively. And RNNLMs were also combined with n-gram LM by using a fixed weight by linear interpolation, which further improved the performance of the language model.

WedB6 Biomedical engineering

Wednesday, November 15, 4:00PM-6:00PM, Room: Kaixuan 3, Chairs: Yoshiki Kashimori and Huajin Tang

4:00PM *A Haptics Feedback Based-LSTM Predictive Model for Pericardiocentesis Therapy Using Public Introperative Data [#17858]*

Amin Khatami, Yonghang Tai, Abbas Khosravi, Lei Wei, Mohsen Moradi Dalvand, Jun Peng and Saeid Nahavandi, Deakin University, Australia; Yunnan First People's Hospital, China

Proposing a robust and fast real-time medical procedure, operating remotely is always a challenging task, due mainly to the effect of delay and dropping of the speed of networks, on operations. If a further stage of prediction is properly designed on remotely operated systems, many difficulties could be tackled. Hence, in this paper, an accurate predictive model, calculating haptics feedback in percutaneous heart biopsy is investigated. A one-layer Long Short-Term Memory based (LSTM-based) Recurrent Neural Network, which is a natural fit for understanding haptics time series data, is utilised. An offline learning procedure is proposed to build the model, followed by an online procedure to operate on new experiments, remotely fed to the system. Statistical analyses prove that the error variation of the model is significantly narrow, showing the robustness of the model. Moreover, regarding computational costs, it takes 0.7 millisecond to predict a time step further online, which is quick enough for real-time haptic interaction.

4:15PM *Tinnitus EEG Classification Based on Multi-frequency Bands [#17249]*

Shao-Ju Wang, Yue-Xin Cai, Zhi-Ran Sun, Chang-Dong Wang and Yi-Qing Zheng, Sun Yat-sen University, China

Tinnitus is an auditory phantom percept of chronic high-pitched sound, ringing, or noise. Since the underlying physiological mechanisms of tinnitus are still under study, there is no universally effective treatment to cure tinnitus so far. There is even no method for objectively classifying tinnitus patients from normal people. In this paper, we utilize a Multi-view Intact Space Learning (MISL) method for the analysis and classification of electroencephalogram (EEG) signals using power value of frequency bands. At first, the power values of seven frequency bands are calculated by using Fast Fourier Transform (FFT) so as to obtain seven single views of features. Next, Multi-view Intact Space Learning is applied to integrate the seven single views together to get better classification results. Compared with the single view classification, the Multi- view Intact Space Learning method has achieved significant accuracy improvements by 6.32%-23.25%. That is, the best accuracy, precision, recall and F1 of classification performance reach 0.828, 0.811, 0.857 and 0.833 respectively. The proposed method can be applied for auxiliary therapy of tinnitus as well as be extended to assist with the treatment of other diseases.

4:30PM *fNIRS Approach to Pain Assessment for Non-verbal Patients [#17432]*

Raul Fernandez Rojas, Xu Huang, Julio Romero and Keng-Liang Ou, University of Canberra, Australia; Taipei Medical University Hospital, Taiwan

The absence of verbal communication in some patients (e.g., critically ill, suffering from advanced dementia) difficult their pain assessment due to the impossibility to self-report pain. Functional near-infrared spectroscopy (fNIRS) is a non-invasive technology that has showed promising results in assessing cortical activity in response to painful stimulation. In this study, we aim to use fNIRS signals to predict the state of pain in humans using machine learning methods. Eighteen healthy subjects were stimulated using thermal stimuli with a thermode while their cortical activity was recorded using fNIRS. Bag-of-words (BoW) model was used to represent each fNIRS time series, the effect of different step size, window length and codebook size was investigated to improve computational cost and generalization. In addition, we explored the effect of choosing different features as neurological biomarkers in three different domains: time, frequency, and time-frequency (wavelet). Classification on the histogram representation was performed using K-nearest neighbour (K-NN). The performance is evaluated by using leave-one-out cross validation and with different nearest neighbours. The results showed that wavelet-based features produced the highest results (88.33%) to distinguish between heat and cold pain while discriminate between low and high pain. It is possible to use fNIRS to assess pain in response to four types of thermal pain. However, future research is needed for the assessment of pain in clinical settings.

4:45PM *Computational efficacy of GPGPU-accelerated simulation for various neuron models [#17466]*

Shun Okuno, Kazuhisa Fujita and Yoshiki Kashimori, Univ. of Electro-Communications, Japan; Tsuyama National College of Technology, Japan

To understand the processing mechanisms of sensory information in the brain, it is necessary to simulate a huge size of network that consists of complicated neuron model imitating the actual neurons. However, such a simulation requires a very long computation time, failing to perform computer simulation with a realistic time scale. In order to solve the problem of computation time, we focus on the reduction of computation time by GPGPU, providing an efficient method for simulation of huge number of neurons. In this paper, we develop a computational architecture of GPGPU, by which computation of neurons is performed in parallel. Using this architecture, we show that the GPGPU method significantly reduces the computation time of neural network simulation. We also show that the simulations with single and double float precision give little significant difference in the results, independently of the neuron models used. These results suggest that the GPGPU computation with single float precision could be a most efficient method for simulation of a huge size of neural network.

5:00PM *Using Transfer Learning with Convolutional Neural Networks to Diagnose Breast Cancer from Histopathological Images [#17371]*

Weiming Zhi, Henry Wing Fung Yueng, Zhenghao Chen, Seid Miad Zandavi, Zhicheng Lu and Yuk Ying Chung, University of Auckland, New Zealand; University of Sydney, Australia

Diagnosis from histopathological images is the gold standard in diagnosing breast cancer. This paper investigates using transfer learning with convolutional neural networks to automatically diagnose breast cancer from patches of histopathological images. We compare the performance of using transfer learning with an off-the-shelf deep convolutional neural network architecture, VGGNet, and a shallower custom architecture. Our proposed final ensemble model, which contains three custom convolutional neural network classifiers trained using transfer learning, achieves a significantly higher image classification accuracy on the large public benchmark dataset than the current best results, for all image resolution levels.

5:15PM *Real-time prediction of the unobserved states in Dopamine neurons on a reconfigurable FPGA platform [#17671]*

Shuangming Yang, Jiang Wang, Bin Deng, Xile Wei, Lihui Cai, Huiyan Li and Ruofan Wang, Tianjin University, China; Tianjin University of Technology and Educations, China

Real-time prediction of dynamical characteristics of Dopamine (DA) neurons, including properties in ion channels and membrane potentials, is meaningful and critical for the investigation of the dynamical mechanisms of DA cells and the related psychiatric disorders. However, obtaining the unobserved states of DA neurons is significantly challenging. In this paper, we present a real-time prediction system for DA unobserved states on a reconfigurable field- programmable gate array (FPGA). In the presented system, the unscented Kalman filter (UKF) is implemented into a DA neuron model for dynamics prediction. We present a modular structure to implement the prediction algorithm and a digital topology to compute the roots of matrices in the UKF im-plementation. Implementation results show that the proposed system provides the real-time computational ability to predict the DA unobserved states with high precision. Although the presented system is aimed at the state prediction of DA cells, it can also be applied into the dynamic-clamping technique in the electrophysiological experiments, the brain-machine interfaces and the neural control engineering works.

5:30PM *A Subject-Specific EMG-driven Musculoskeletal Model for the Estimation of Moments in Ankle Plantar-Dorsiflexion Movement [#17706]*

Congsheng Zhang, Qingsong Ai, Wei Meng and Jiwei Hu, Wuhan University of Technology, China

In traditional rehabilitation process, ankle movement ability is only qualitatively evaluated by its motion performance, however, its movement is actually achieved by the forces acting on the joints produced by muscles contraction. In this paper, the musculoskeletal model is introduced to provide a more physiologic method for quantitative muscle forces and muscle moments assessment during rehabilitation. This paper focuses on the modeling method of musculoskeletal model using EMG and angle signals for ankle plantar-dorsiflexion (P-DF) which is very important in gait rehabilitation and foot prosthesis control. Due to the skeletal morphology differences among people, a subject-specific geometry model is proposed to realize the evaluation of muscle length and muscle contraction force arm. Based on the principle of forward and inverse dynamics, difference evolutionary (DE) algorithm is used to adjust individual parameters of the whole model, realizing subject-specific parameters optimization. Results from five healthy subjects show the inverse dynamics joint moments are well predicted with an average correlation coefficient of 94.21% and the normalized RMSE of 12.17%. The proposed model provides a good way to estimate muscle moments during movement tasks.

5:45PM *Real-Time Scalp-Hemodynamics Artifact Reduction Using Sliding-Window General Linear Model: A Functional Near-Infrared Spectroscopy Study [#17761]*

Yuta Oda, Takanori Sato, Isao Nambu and Yasuhiro Wada, Nagaoka University of Technology, Japan

Functional near-infrared spectroscopy (fNIRS) measures temporal hemoglobin changes in gray matter, reflecting brain activity. The primary advantage of fNIRS is real-time estimation of brain activity, with applications such as neurofeedback training. However, task-related scalp-hemodynamics distributed across the whole head are superimposed onto cerebral activity, leading to false estimation of brain activity. To prevent this, we propose a real-time artifact rejection method using a short distance probe, by applying a sliding-window general linear model (GLM) with a real-time updated design matrix via a global scalp-hemodynamics model (GSHM). To assess the performance of our proposed method, we performed simulation, assuming that fNIRS signals, consisting of local cerebral blood flow (CBF) and scalp-hemodynamics, had a spatially common pattern. Simulation results were compared with off-line analysis and previous on-line methods, with scalp-hemodynamics excluded from the design matrices. The proposed method showed significantly higher performance for estimating CBF.

WedB7 Computational intelligence 2

Wednesday, November 15, 4:00PM-6:00PM, Room: Kaixuan 5, Chairs: Min Han and Fuxiao Tan

4:00PM *New Decrease-and-Conquer Strategies for the Dynamic Genetic Algorithm for Server Consolidation [#17738]*

Chanipa Sonklin, Maolin Tang and Yu-Chu Tian, Queensland University of Technology, Australia

The energy consumption in a data center is a big issue as it is responsible for about half of the operational cost of the data centre. Thus, it is desirable to reduce the energy consumption in data centre. One of the most effective ways of cutting the energy consumption in a data centre is through server consolidation, which can be modelled as a virtual machine placement problem. Since virtual machines in a data centre may come and go at any time, the virtual machine placement problem is a dynamic one. As a result, a decrease-and- conquer dynamic genetic algorithm has been proposed for the dynamic virtual machine placement problem. The decrease-and-conquer strategy plays a very important role in the dynamic genetic algorithm as it directly affects the performance of the dynamic genetic algorithm. In this paper we propose three new decrease-and-conquer strategies and conduct an empirical study of the

three new decrease-and-conquer strategies as well as the existing one being used in the decrease-and-conquer genetic algorithm. Through the empirical study we find one of the decrease-and-conquer strategy, namely new first-fit decreasing, is significantly better than the existing decrease-and-conquer strategy.

4:15PM *Online Chaotic Time Series Prediction based on Square Root Kalman Filter Extreme Learning Machine [#17424]*

Shoubo Feng, Meiling Xu and Min Han, Dalian University of Technology, China

In this paper, we proposed a novel neural network prediction model based on extreme learning machine for online chaotic time series prediction problems. The model is characterized by robustness and generalization. The initial weights are initialized by orthogonal matrix to improve the generalization performance and the output weights are updated by square root Kalman filter. The convergence of the algorithm is proved by Lyapunov stability theorem. Simulations based on artificial and real-life data sets demonstrate the effectiveness of the proposed model.

4:30PM *Automatic Detection of Epileptic Seizures based on Entropies and Extreme Learning Machine [#17428]*

Xiaolin Cheng, Meiling Xu and Min Han, Dalian University of Technology, China

Epilepsy is a common neurological disease, and it is usually judged based on EEG signals. Automatic detection and classification of epileptic EEG gradually get more and more attention. In this work, we adopt two-step program to implement the automatic classification. Three entropies (approximate entropy, sample entropy, permutation entropy) are extracted as features to prepare for classifying. Then extreme learning machine is utilized to realize feature classification. Experimental results on Bonn epilepsy EEG dataset indicate that the proposed method is capable of recognizing normal, pre-ictal and ictal EEG with an accuracy of 99.31%, which is helpful for doctors to diagnose epilepsy disease.

4:45PM *Improving Shape Retrieval by Fusing Generalized Mean First-passage Time [#17578]*

Danchen Zheng, Wangshu Liu and Hanxing Wang, Dalian University of Technology, China

In recent years, many efforts have been made to fuse different similarity measures for robust shape retrieval. In this paper, we firstly propose generalized mean first- passage time (GMFPT) that extends the mean first-passage time (MFPT) to the general form. Instead of focusing on the propagation of similarity information, GMFPT is introduced to improve pairwise shape distances, which denotes the mean time-steps for the transition from one state to a set of states. Through a semi-supervised learning framework, an iterative approach with a time-invariant state space is further proposed to fusing multiple distance measures, and the relative objects on the the geodesic paths can be gradually and explicitly retrieved. The experimental results on different databases demonstrate that shape retrieval results can be effectively improved by the proposed method.

5:00PM *Deep Reinforcement Learning: From Q-learning to Deep Q-learning [#17880]*

Fuxiao Tan, Pengfei Yan and Xinping Guan, Fuyang Normal University, China; University of Science and Technology Beijing, China; Shanghai Jiao Tong University, China

As the two hottest branches of machine learning, deep learning and einforcement learning both play a vital role in the field of artificial intelligence. Combining deep learning with reinforcement learning, deep reinforcement learning is a method of artificial intelligence that is much closer to human learning. As one of the most basic algorithms for reinforcement learning, Q-learning is a discrete strategic learning algorithm that uses a reasonable strategy to generate an action. According to the rewards and the next state generated by the interaction of the action and the environment, optimal Q-function can be obtained. Furthermore, based on Q-learning and convolutional neural networks, the deep Q-learning with experience replay is developed in this paper. To ensure the convergence of value function, a discount factor is involved in the value function. The temporal difference method is introduced to training the Q-function or value function. At last, a detailed procedure is proposed to implement deep reinforcement learning.

5:15PM *Multi-population Based Search Strategy Ensemble Artificial Bee Colony Algorithm with A Novel Resource Allocation Mechanism [#17257]*

Liu Wu, Zhiwei Sun, Kai Zhang, Genghui Li and Ping Wang, Shenzhen University, China; Shenzhen Polytechnic, China

Artificial bee colony algorithm (ABC) is a simple yet effective biologically-inspired optimization method for global numerical optimization problems. However, ABC often suffers from slow convergence due to its solution search equation performs well in exploration but badly in exploitation. Moreover, all food sources are assigned with almost equal computing resources so that good solutions are not being fully exploited. In order to address these issues, we propose a multi-population based search strategy ensemble ABC algorithm with a novel resource allocation mechanism (called MPABC_RA). Specifically, in employed bee phase, all food sources are divided into three subgroups according to their quality. Then each subgroup uses different search equations to find better solutions. By this way, better tradeoff between exploitation and exploration can be obtained. In addition, the superior solutions in onlooker bee phase are allocated with more resources to evolve. And onlooker bees fully exploit the area between the locations of the selected superior solutions and the current best solution by a novel search equation. We compare MPABC_RA with four state- of-the-art ABC variants on 22 benchmark functions, the experimental results show that MPABC_RA is significantly better than the compared algorithms on most test functions in terms of solution accuracy, convergence rate and robustness.

5:30PM *Personalized Web Search Based on Ontological User Profile in Transportation Domain [#17446]*

Omar Elhaweesh, Farookh Khadeer Hussain, Haiyan Lu, Malak Al-hassan and Sadegh Kharazmi, University of Technology, Australia; The University of Jordan, Jordan; Redbubble.com, Australia

Current conventional search engines deliver similar results to all users for the same query. Because of the variety of user interests and preferences, personalized search engines, based on semantics, hold the promise of providing more efficient information that better reflects users' needs. The main feature of building a personalized web search is to represent user interests in terms of user profiles. This paper proposes a personalized search approach using an ontology-based user profile. The aim of this approach is to build user profiles based on user browsing behavior and semantic knowledge of specific domain ontology to enhance the quality of the search results. The proposed approach utilizes a re-ranked algorithm to sort the results returned by the search engine to provide a search result that best relates to the user query. This algorithm evaluates the similarity between a user query, the retrieved search results and the ontological concepts. This similarity is computed by taking into account a user's explicit browsing behavior, semantic knowledge of concepts, and synonyms of term-based vectors extracted from the WordNet API. A set of experiments using a case study from a transport service domain validates the effectiveness of the proposed approach and demonstrates promising results.

5:45PM *A preliminary approach to semi-supervised learning in convolutional neural networks applying "sleep-wake" cycles [#17598]*

Mikel Elkano, Humberto Bustince and Andrew Paplinski, Public University of Navarre, Spain; Monash University, Australia

The scarcity of labeled data has limited the capacity of convolutional neural networks (CNNs) until not long ago and still represents a serious problem in a number of image processing applications. Unsupervised methods have been shown to perform well in feature extraction and clustering tasks, but further investigation on unsupervised solutions for CNNs is needed. In this work, we propose a bio-inspired methodology that applies a deep generative model to help the CNN take advantage of

unlabeled data and improve its classification performance. Inspired by the human "sleep-wake cycles", the proposed method divides the learning process into sleep and waking periods. During the waking period, both the generative model and the CNN learn from real training data simultaneously. When sleep begins, none of the networks receive real data and the generative model creates a synthetic dataset from which the CNN learns. The experimental results showed that the generative model was able to teach the CNN and improve its classification performance.

WedB8 Computer vision 2

Wednesday, November 15, 4:00PM-6:00PM, Room: Kaixuan 6, Chairs: Haiyan Lu and Hongyi Li

4:00PM *Towards Simulating Foggy and Hazy Images and Evaluating their Authenticity [#17145]*

Ning Zhang, Lin Zhang and Zaixi Cheng, Tongji University, China

To train and evaluate fog/haze removal models, it is highly desired but burdensome to collect a large-scale dataset comprising wellaligned foggy/hazy images with their fog-free/haze-free versions. In this paper, we propose a framework, namely Foggy and Hazy Images Simulator (FoHIS for short), to simulate more realistic fog and haze effects at any elevation in images. What's more, no former studies have introduced objective methods to evaluate the authenticity of synthetic foggy/hazyimages.We innovatively design an Authenticity Evaluator for Synthetic foggy/hazy Images (AuthESI for short) to objectively measure which simulation algorithm could achieve more natural- looking results. We compare FoHIS with another two state-of-the-art methods, and the subjective results show that it outperforms those competitors. Besides, the prediction on simulated image's authenticity made by AuthESI is highly consistent with subjective judgements.

4:15PM *Learning Spatiotemporal and Geometric Features with ISA for Video-based Facial Expression Recognition [#17355]*

Chenhan Lin, Fei Long, Junfeng Yao, Ming-Ting Sun and Jinsong Su, Xiamen University, China; University of Washington, United States

Many appearance-based and geometry-based approaches have been proposed in facial expression recognition. In this paper, we propose a method of learning and combining spatiotemporal features and geometric features for video-based expression recognition. Specifically, we first adopt a multi-layer independent subspace analysis (ISA) network to learn spatiotemporal features directly from videos, and then use another single layer ISA network to learn geometric features from the trajectories of the facial landmark points. The learned spatiotemporal features and geometric features are concatenated to be the final representation for the input video. We use a linear SVM in classification. Experiments on CK+ and MMI facial expression databases show that recognition performance can be improved effectively by incorporating geometric features into spatiotemporal features. Furthermore, comparison results with other related methods demonstrate that the overall accuracy of our method is comparable to some deep learning based methods and the learned features outperform popular hand- crafted features.

4:30PM *Robust edge-based model with sparsity representation for object segmentation [#17381]*

Guoqi Liu, Haifeng Li and Chenjing Li, Henan Normal University, China

Active contour models (ACM) based on level set method (LSM) are widely used in image segmentation. However, the classical edge-based models always extract some unnecessary objects or noise, and they lack robustness in segmenting weak boundary. In this paper, a method to constrain the evolution of contour is proposed. Firstly, extracting objects with a known topology (such as k connected objects) is viewed a sparse representation problem under a set of basis functions. According to sparse representation, a set of basis function is obtained with label operator to represent every connected region. Then, the corresponding energy functional model which views noise and non-objects as redundancy is defined based on basis functions. Furthermore, through the defined basis functions, a novel edge-stop term is designed and integrated into geometric active contour models. Experiments demonstrate that the proposed method improves the robust performances of ACM. On the other hand, the proposed method does not introduce any extra parameter.

4:45PM *Salient Object Detection Based on Amplitude Spectrum Optimization [#17474]*

Ce Li, Yuqi Wan and Hao Liu, Lanzhou University of Technology, China

Saliency detection is prerequisite for many computer vision tasks. The existing frequency domain models can't always detect a complete object. We propose a novel salient object detection model based on an optimized am-plitude spectrum. This model computes saliency map in two steps. Firstly, we optimize amplitude spectrum by smoothing the peaks in log amplitude spec-trum. The raw saliency maps are computed by combining the optimized ampli-tude spectrum and the original phase spectrum according to different thresholds. Secondly, we compute the entropy of raw saliency maps and select the raw sali-ency map with the smallest value of entropy as the final saliency map. Our model detects more complete object region. By testing on the databases ASD, MSRA10k, DUT-OMRON and SED2, experiments demonstrate that the pro-posed model outperforms the state-of-the-art models.

5:00PM *Optimized image up-scaling from learning selective similarity [#17493]*

He Jiang and Jie Yang, Institute of pattern recognition and image processing, China

Remarkable up-scaling results are obtained from local self-examples (LSE) at low cost. However, fine-detailed and cluttered regions are not reproduced realistically due to inappropriate addition of high frequency, and thus appear somewhat faceted and slightly distorted at edges. In this paper, an optimized algorithm that reduces these artifacts is proposed. A selective search is applied in the original restricted searching area. Mismatches can be avoided when patches are with extremely random details. Meanwhile we extend the local self-similarity on natural images to sub-pixel level which makes the assumption of local self- similarity more suitable especially for fine edge areas. It corrects the slightly misalignments when scaled with small factor. The proposed algorithm remains simple, and generates clear and believable textures compared with the original LSE and other mainstream methods.

5:15PM *Action Prediction using Unsupervised Semantic Reasoning [#17832]*

Cuiwei Liu, Yaguang Lu, Xiangbin Shi, Zhaokui Li and Liang Zhao, Shenyang Aerospace University, China; Liaoning University, China

This paper aims to address the problem of predicting the category of an ongoing action in a video, which enables us to react as quickly as possible. Action prediction is a challenge problem since neither the complete semantic information nor the definite temporal progress can be obtained from a partially observed video. In this paper, we propose to predict action categories of unfinished videos by using semantic reasoning. For the purpose of exploiting mid-level semantics from videos, we present an unsupervised semantic mining approach which expresses an observed video as a sequence of semantic concepts and learns the context relationship of various concepts by using a General Mixture Transform Distribution model (GMTD). Then the invisible future semantic concepts can be automatically estimated from the observed semantic concept sequence. Finally, we develop a discriminative structural model that integrates video observations, observed semantic concepts, and inferred semantic concepts for early recognition of incomplete videos. Experimental results on the UT- Interaction dataset show that the proposed method is able to effectively predict the action category of an unfinished video.

5:30PM *Evaluation of Deep Models for Real-time Small Object Detection [#17473]*

Phuoc Pham, Duy Nguyen, Tien Do, Thanh Duc Ngo and Duy-Dinh Le, Vietnam National University - Ho Chi Minh City, Viet Nam

Real-time object detection is crucial for many applications. Approaches based on Deep Learning have achieved state-of-the-art performance on challenging datasets. Although several evaluations of the models have been conducted, there is no extensive evaluation with specific focuses on real-time small object detection. In this work, we present an in-depth evaluation of existing deep learning models in detecting small objects. We evaluate three state-of- the-art models including You Only Look Once (YOLO), Single Shot MultiBox Detector (SSD), and Faster R-CNN with related trade-off factors i.e. accuracy, execution time and resource constraints. Experiments were conducted on benchmark datasets and a newly generated dataset for small object detection. All analyses and findings are then presented.

5:45PM *Graph Embedding Learning for Cross-modal Information Retrieval [#17065]*

Youcai Zhang and Xiaodong Gu, Fudan University, China

The aim of cross-modal retrieval is to learn mappings that project samples from different modalities into a common space where the similarity among instances can be measured. To pursuit common subspace, traditional approaches tend to solve the exact projection matrices while it is unrealistic to fully model multimod-al data only by linear projection. In this paper, we propose a novel graph embed-ding learning framework that directly approximates the projected manifold and utilizes both the labeled information and local geometric structures. It avoids ex-plicit eigenvector decomposition by iterating random walk on graph. Sampling strategies are adopted to generate training pairs to fully explore inter and intra modality among the data cloud. Moreover, graph embedding is learned in a semi-supervised learning manner which helps to discriminate the underlying represen-tation over different classes. Experimental results on Wikipedia datasets show that the proposed framework is effective and outperforms other state-of-the-art methods on cross-modal retrieval.

Thursday, November 16, 1:30PM-3:30PM

Invited Session: ThuA1 Deep learning for computer vision: theory and applications

Thursday, November 16, 1:30PM-3:30PM, Room: Kaixuan 7, Organizers: Chin-Teng Lin, Michael Blumenstein, Nabin Sharma and Mukesh Prasad, Chairs: Mukesh Prasad and Michael Blumenstein

1:30PM *Generic Pixel Level Object Tracker Using Bi-channel Fully Convolutional Network [#17346]*

Zijing Chen, Jun Li, Zhe Chen and Xinge You, University of Technology Sydney, Australia; University of Sydney, Australia; Huazhong University of Science and Technology, China

As most of the object tracking algorithms predict bounding boxes to cover the target, pixel-level tracking methods provide a better description of the target. However, it remains challenging for a tracker to precisely identify detailed foreground areas of the target. In this work, we propose a novel bi-channel fully convolutional neural network to tackle the generic pixel-level object tracking problem. By capturing and fusing both low-level and high-level temporal information, our network is able to produce pixel-level foreground mask of the target accurately. In particular, our model neither updates parameters to fit the tracked target nor requires prior knowledge about the category of the target. Experimental results show that the proposed network achieves compelling performance on challenging videos in comparison with competitive tracking algorithms.

1:45PM *RBNet: A Deep Neural Network for Unified Road and Road Boundary Detection [#17665]*

Zhe Chen and Zijing Chen, University of Sydney, Australia; University of Technology Sydney, Australia

Accurately detecting road and its boundary on the images is an essential task for vision-based autonomous driving systems. However, prevailing methods either only detect road or add an extra processing stage to detect road boundary. In this work, we introduce a deep neural network, called Road and road Boundary detection Network (RBNet), that can detect both road and road boundary in a single process. In specific, we first investigate the contextual relationship between the road structure and its boundary arrangement and then model them with a Bayesian network. By implementing the Bayesian model, the RBNet can learn to simultaneously estimate the probabilities of a pixel on the image belonging to the road and road boundary. Comprehensive evaluations are carried out based on the well-known road benchmark, which can demonstrate the compelling performance of the proposed method.

2:00PM *Analysis of Gradient Degradation and Feature Map Quality in Deep All-Convolutional Neural Networks Compared to Deep Residual Networks [#17542]*

Wei Gao and Mark McDonnell, University of South Australia, Australia

The introduction of skip connections used for summing feature maps in deep residual networks (ResNets) were crucially important for overcoming gradient degradation in verydeep convolutional neural networks (CNNs). Due to the strong results of ResNets, it is a natural choice to use features that it produces at various layers in transfer learning or from other feature extraction tasks. In order to analyse how the gradient degradation problem is solved by ResNets, we empirically investigate how discriminability changes as inputs propagate through the intermediate layers of two CNN variants: all-convolutional CNNs and ResNets. We found that the feature maps produced by residual-sum layers exhibit increasing discriminability with layer-distance from the input, but that feature maps produced by convolutional layers do not. We also studied how discriminability varies with training duration and the placement of convolutional layers. Our method suggests a way to determine whether adding extra layers will improve performance and show how gradient degradation impacts on which layers contribute increased discriminability.

2:15PM *EPI-Patch Based Convolutional Neural Network for Depth Estimation on 4D Light Field [#17827]*

Yaoxiang Luo, Wenhui Zhou, Junpeng Fang, Linkai Liang, Hua Zhang and Guojun Dai, Hangzhou Dianzi University, China

Depth recovery from light field is an essential part of many light field applications.However, conventional methods usually suffers from two challenges: sub- pixel displacements and occlusions. In this paper, we propose an effective convolutional neural network (CNN) framework to perform the depth estimation on 4- dimensional(4D) light field. Based on the orientation-depth relationship of epipolar images (EPIs), we firstly build a training set by extracting a group of valid EPI-patch pairs with balanced depth distribution, and then an EPI-patch based CNN architecture is designed and trained to estimate the disparity of each pixel. Finally, a post-processing with global constrains is applied to the whole images torefine the output of CNN. Experimental results demonstrate the effectiveness and robustness of our method.

2:30PM *Deep Metric Learning with False Positive Probability: Trade off Hard Levels in a Weighted Way [#17313]*

Jiaxing Zhong, Ge Li and Nannan Li, Peking University, China

In recent years, deep metric learning has been an end-to-end fashion in computer vision community due to the great success of deep learning. However, existing deep metric learning frameworks are faced with a dilemma about the hard level trade-off for training examples. Namely, the "harder" examples we feed to neural networks, the more likely we attain highly discriminative models, but the more easily neural networks get stuck into poor local minimal in practice. To fight against this dilemma, we propose a deep metric learning method with FAlse Positive ProbabilitY (FAPPY) to gradually incorporate different hard levels. Unlike mainstream deep metric learning schemes, the presented approach optimizes similarity probability distribution among training samples, instead of the similarity itself. Experimental results on CUB-200-2011, Stanford Online Products and VehicleID datasets show that our FAPPY method achieves or outperforms state- of-the-art metric learning methods on fine-grained image retrieval and vehicle re-identification tasks. Besides, the presented method has relatively low sensitivity of hyper-parameters and it requires minor changes on traditional classification networks.

2:45PM *Deep Learning based Face Recognition with Sparse Representation Classification [#17675]*

Eric-Juwei Cheng, Mukesh Prasad, Deepak Puthal, Nabin Sharma, Om Kumar Prasad, Po-Hao Chin, Chin-Teng Lin and Michael Blumenstein, National Chiao Tung University, Taiwan; University of Technology Sydney, Australia

Feature extraction is an essentialstep in solving real-world pattern recognition and classification problems. The accuracy of face recognition highly depends on the extracted features to represent a face. The traditional algorithms uses geometric techniques, comprising feature values including distance and angle between geometric points (eyes corners, mouth extremities, and nostrils). These features are sensitive to the elements such as illumination, variation of poses, various expressions, to mention a few. Recently, deep learning techniques have been very effective for feature extraction, and deep features have considerable tolerance for various conditions and unconstrained environment. This paper proposes a two layer deep convolutional neural network (CNN) for face feature extraction and applied sparse representation for face identification. The sparsity and selectivity of deep features can strengthen sparseness for the solution of sparse representation, which generally improves the recognition rate. The proposed method outperforms other feature extraction and classification methods in terms of recognition accuracy.

3:00PM *License Plate Detection using Deep Cascaded Convolutional Networks in Complex Scenes [#17152]*

Qiang Fu, Yuan Shen and Zhenhua Guo, Tsinghua University, China

License plate detection plays an important role in intelligent transportation system. However, it is still a challenging task due to plenty of complex scenes. Recent studies show that deep learning approaches achieve prominent results on general object detection. Therefore, in this paper, we propose a deep cascaded convolutional neural network for improving license plate detection in complex scenes. Firstly, we utilize convolutional features to generate candidate vehicles proposals. Then a network is used to detect a license from each vehicle proposal by analyzing the correlation between vehicles and licenses. Finally, we enhance detection performance by processing license boundary. Experimental results on a large dataset demonstrate that our method works effectively in a variety of complex scenes.

3:15PM *Deep Neural Network with l2-norm Unit for Brain Lesions Detection [#17362]*

Mina Rezaei, Haojin Yang and Christoph Meinel, Hasso Plattner Institute, Germany

Automated brain lesions detection is an important and very challenging clinical diagnostic task, because the lesions have different sizes, shapes, contrasts and locations. Deep Learning recently shown promising progresses in many application fields, which motivates us to apply this technology for such important problem. In this paper we propose a novel and end-to-end trainable approach for brain lesions classification and detection by using deep Convolutional Neural Network (CNN). In order to investigate the applicability, we applied our approach on several brain diseases including high and low grade glioma tumor, ischemic stroke, Alzheimer diseases, by which the brain Magnetic Resonance Images (MRI) have been applied as input for the analysis. We proposed a new operation unit which receives features from several projections of a subset units of the bottom layer and computes a normalized l2-norm for next layer. We evaluated the proposed approach on two different CNN architectures and number of popular benchmark datasets. The experimental results demonstrate the superior ability of the proposed approach.

Workshop: ThuA2 Data mining and cybersecurity workshop

Thursday, November 16, 1:30PM-3:30PM, Room: Zhujiang 2, Organizers: Kaizhu Huang, Paul Pang, Tao Ban, Youki Kadobayashi, Jungsuk Song, Geong Sen Poh, Iqbal Gondal

2:15PM *Deep Mixtures of Factor Analyzers with Common Loadings: A Novel Deep Generative Approach to Clustering [#17734]*

Xi Yang, Kaizhu Huang and Rui Zhang, Xi'an Jiaotong-Liverpool University, China

In this paper, we propose a novel deep density model, called Deep Mixtures of Factor Analyzers with Common Loadings (DMCFA). Employing a mixture of factor analyzers sharing common component loadings, this novel model is more physically meaningful, since the common loadings can be regarded as feature selection or reduction matrices. Importantly, the novel DMCFA model is able to remarkably reduce the number of free parameters, making the involved inferences and learning problem dramatically easier. Despite its simplicity, by engaging learnable Gaussian distributions as the priors, DMCFA does not sacrifice its flexibility in estimating the data density. This is particularly the case when compared with the existing model Deep Mixtures of Factor Analyzers (DMFA), exploiting different loading matrices but simple standard Gaussian distributions for each component prior. We evaluate the performance of the proposed DMCFA in comparison with three other competitive models including Mixtures of Factor Analyzers (MFA), MCFA, and DMFA and their shallow counterparts. Results on four real data sets show that the novel model demonstrates significantly better performance in both density estimation and clustering.

2:30PM *Improve Deep Learning with Unsupervised Objective [#17798]*

Shufei Zhang, Kaizhu Huang, Rui Zhang and Amir Hussain, Xi'an Jiaotong- Liverpool University, China; University of Stirling, United Kingdom

We propose a novel approach capable of embedding the unsupervised objective into hidden layers of the deep neural network (DNN) for preserving important unsupervised information. To this end, we exploit a very simple yet effective unsupervised method, i.e. principal component analysis (PCA), to generate the unsupervised "label" for the latent layers of DNN. Each latent layer of DNN can then be supervised not just by the class label, but also by the unsupervised "label" so that the intrinsic structure information of data can be learned and embedded. Compared with traditional methods which combine supervised and unsupervised learning, our proposed model avoids the needs for layer-wise pre-training and complicated model learning e.g. in deep autoencoder. We show that the resulting model achieves state-of-the-art performance in both face and handwriting data simply with learning of unsupervised "labels".

2:45PM *Class-wised Image Enhancement for Moving Object Detection at Maritime Boat Ramps [#17762]*

Jing Zhao, Shaoning Pang, Bruce Hartill and Sarrafzadeh Hossein, Unitec Institute of Technology, New Zealand; Unitec instiute of Technology, New Zealand; National Institute of Water and Atmospheric Research, New Zealand

In the context of marine boat ramps traffic surveillance, we propose in this paper a novel image enhancement method for interpreting the traffic of boats passing across the boat ramps. As the background dynamics of land and water scenes differ markedly, this new approach classifies areas in each image as either land or water, so that different strategies can be adopted to enhance image on land and on the water, respectively. In particular, the use of the dynamic sharpening size and adaptive sharpening strength significantly increases the robustness of this enhancement method. Experimental results demonstrate that our method is much more able to cope with the highly dynamic land and water composition scenes compared with the state-of-the-art methods.

3:00PM *AI Web-Contents Analyzer for Monitoring Underground Marketplace [#17829]*

Yuki Kawaguchi, Akira Yamada and Seiichi Ozawa, Kobe University, Japan; KDDI Research, Inc., Japan

Recently, it become a serious problem that products for cyberattacks such as exploits and malwares are illegally traded on a hidden web services called ``Dark Web'' where normal web browsers cannot access. In general, it is difficult to capture the whole picture of trades at the marketplaces on the dark web because traded products are very wide-ranging. In this paper, to understand the sales trends of underground business on cyberattacks, we focus on the largest marketplace ``AlphaBay'' and develop an AI web-contents analyzer to monitor business trades on dark web. The proposed system consists of a Tor crawler to collect the product information at AlphaBay automatically and a topic analyzer to know the trends of peoples' interests and popular products of cyberattacks. We use a topic model called Latent Dirichlet Allocation (LDA) as a topic analyzer and we show that the topic analysis would be helpful for predicting new cyberattacks.

3:15PM *Detecting Black IP using for Classification and Analysis through Source IP of Daily Darknet Traffic [#17701]*

Jinhak Park, Jangwon Choi and Jungsuk Song, Korea Institute of Science and Technology Information, Korea (South)

Recently, the community is recognizing to an importance of network vulnerability. Also, the using this vulnerability, attackers can acquire the information of vulnerable users. Therefore, many researchers have been studying about a countermeasure of network vulnerabillty. In recent, the darknet is a received attention to research for detecting action of attackers. The means of darknet are formed a set of unused IP addresses and no real systems of connect to the darknet. In this paper, we proposed an using darknet for the detecting black IPs. So, it was choosen to classification and analysis through source IP of daily darknet traffic. The proposed method prepared 8,192 darknet space and collected the darknet traffic during 1 months. It collected total 277,002,257 in 2016, August. An applied results of the proposed process were seen for an effectiveness of pre-detection for real attacks.

Invited Session: ThuA3 Neuro-inspired learning and adaptation for optimization and control

Thursday, November 16, 1:30PM-3:30PM, Room: Zhujiang 3, Organizers: Jing Na, Chenguang Yang, Wei He and Qiang Chen, Chairs: Wei He and Jing Na

1:30PM *A PD Controller of Flexible Joint Manipulator based on Neuro-Adaptive Observer [#17045]*

Xin Liu, Chenguang Yang, Min Wang and Wei He, South China University of Technology, China; University of Science and Technology Beijing, China

Due to inevitable uncertainties associated with the dynamics and kinematics of flexible joint manipulators, accurate models would not be available for control design. Furthermore, practically we may face the problem that state variables required by the controller are not measurable. In this paper, we focus on the study of control system design using a neural network observer to solve the aforementioned unmeasurable problem. A state observer of a general multivariable nonlinear systems based on neural network is proposed. It can be applied to systems without any priori knowledge about system dynamics. To test the effectiveness of the proposed observer we design a PD controller combining with the observer proposed for the flexible joint manipulator whose model is unknown. The stability of the controller and observer is shown by Lyapunov method. To test and verify the effectiveness of the proposed controller simulation studies are performed.

1:45PM *Transient Tracking Performance Guaranteed Neural Control of Robotic Manipulators with Finite-time Learning Convergence [#17046]*

Tao Teng, Chenguang Yang, Wei He, Jing Na and Zhijun Li, South China University of Technology, China; University of Science and Technology Beijing, China; Kunming University of Science and Technology, China

An adaptive finite-time (FT) neural control scheme is proposed for robotic manipulators, which could guarantee transient tracking performances in the presence of model uncertainties. With the introduction of an error transformation mechanism, the original constrained manipulator system can be transformed into an unrestricted system. Moreover, the FT neural learning algorithm motivated by the estimated weights error, under persistent excitation (PE) condition, can guarantee the estimated neural weights converge to a small neighborhoods around the optimal values in finite time. Subsequently, the adaptive FT neural controller could ensure uniformly ultimate boundedness of all the signals in the closed-loop system and guarantee prescribed tracking and neural learning performances. The simulation results are given to illustrate the feasibility of the algorithm and correctness of theoretical analysis.

2:00PM *Guaranteeing Predefined Full State Constraints for Non-affine Nonlinear Systems Using Neural Networks [#17089]*

Min Wang and Yanwen Zhang, South China University of Technology, China

This paper presents adaptive neural control (ANC) design for a class of nonaffine nonlinear systems with full state constraints. A novel transformed function is presented to convert the origin system into an equivalent nonaffine systems with new unconstrained states. By combining dynamic surface control, the explosion of complexity is avoided in the backstepping design. Subsequently, a novel ANC control scheme is proposed by Lyapunov synthesis. The proposed adaptive control guarantees that all closed-loop signals are uniformly ultimately bounded and all system states do not violate the predefined constraints. Simulation studies are performed to show the effectiveness of the proposed control scheme.

2:15PM *Self-Repairing Learning Rule for Spiking Astrocyte-Neuron Networks [#17353]*

Junxiu Liu, Liam McDaid, Jim Harkin, John Wade, Shvan Karim, Anju Johnson, Alan Millard, David Halliday, Andy Tyrrell and Jon Timmis, Ulster University, United Kingdom; University of York, United Kingdom

In this paper a novel self-repairing learning rule is proposed which is a combination of the spike-timing-dependent plasticity (STDP) and

Bienenstock, Cooper, and Munro (BCM) learning rules: in the derivation of this rule account is taken of the coupling of GABA interneurons to the tripartite synapse. The rule modulates the plasticity level by shifting the plasticity window, associated with STDP, up and down the vertical axis as a function of postsynaptic neural activity. Specifically when neurons are inactive, the window is shifted up the vertical axis (open) and as the postsynaptic neuron activity increases and, as learning progresses, the plasticity window moves down the vertical axis until learning ceases. Simulation results are presented which show that the proposed approach can still maintain the network performance even with a fault density approaching 80% and because the rule is implemented using a minimal computational overhead it has potential for large scale spiking neural networks in hardware.

2:30PM *Finite-Time Adaptive Attitude Stabilization for Spacecraft Based on Modified Power Reaching Law [#17608]*

Meiling Tao, Qiang Chen, Xiongxiong He and Hualiang Zhuang, Zhejiang University of Technology, China

In this paper, a finite-time adaptive sliding mode control scheme is proposed for the attitude stabilization of spacecrafts with lumped uncertainties. By introducing an exponential function in the reaching law design, an improved reaching law is developed such that the faster convergence of sliding manifold can be achieved. Then, an adaptive controller is proposed based on the modified reaching law to guarantee the finite time attitude stabilization of spacecrafts by adaptive estimating the bounds of uncertainties. Besides, the chattering problem is reduced by using a power rate term in the controller design. Simulations are given to illustrate the effectiveness and superior performance of the proposed method.

2:45PM *Neural Network Based Finite-Time Adaptive Backstepping Control of Flexible Joint Manipulators [#17633]*

Qiang Chen, Huihui Shi and Mingxuan Sun, Zhejiang University of Technology, China

This paper proposes a finite-time adaptive backstepping control for an n-link flexible joint manipulator based on neural network approximation. In each recursive step, an adaptive virtual controller or practical controller is designed to guarantee that all the state errors can converge into a small region within a finite time. Besides, two simple neural networks are employed to approximate and compensate for the lumped uncertainties, and the finite time stability analysis is provided based on Lyapunov synthesis. Finally, simulation results show the effectiveness of the proposed method.

3:00PM *Robust Control of Uncertain Nonlinear Systems Based on Adaptive Dynamic Programming [#17834]*

Jing Na, Jun Zhao, Guanbin Gao and Ding Wang, Kunming University of Science and Technology, China; Chinese Academy of Sciences, China

In this paper, we propose a new approach to address robust control problem of nonlinear systems with uncertainties based on an adaptive dynamic programming (ADP) algorithm. After reformulating the robust control problem as an optimal control problem, we propose an modified ADP method to solve the derived Hamilton- Jacobi-Bellman (HJB) equation, where the optimal cost function is approximated by online training a critic neural network (NN). Then the approximated optimal control action can be derived to guarantee the stability of the controlled system with uncertainties. The closed-loop system stability and convergence have been proved. A simulation example is provided to illustrate the effectiveness of the method.

3:15PM *Co-evolutionary multi-task learning for modular pattern classification [#17429]*

Rohitash Chandra, University of Sydney, Australia

Modularity in the learning process is a means by which effective decision making can be maintained when some of the input features are missing. In this paper, co-evolutionary multi-task learning algorithm is used for pattern classification which is robust to situations when some input features are unavailable during the deployment stage of decision support or control systems. The main feature of the algorithm is the ability to make decisions with some degree of error given misinformation in input. The results show that the method produces results comparable to non-modular methods while having modular features for dynamic and robust pattern classification.

ThuA4 Neural data analysis

Thursday, November 16, 1:30PM-3:30PM, Room: Zhujiang 5, Chairs: El-Sayed El-Alfy and Bao-Liang Lu

1:30PM *Hybrid Deep Learning for Sentiment Polarity Determination of Arabic Microblogs [#17204]*

Sadam Al-Azani and El-Sayed El-Alfy, King Fahd University of Petroleum and Minerals, Saudi Arabia

In this study, we investigate various deep learning models based on convolutional neural networks (CNNs) and Long Short Term Memory (LSTM) recurrent neural networks for sentiment analysis of Arabic microblogs. Unlike English language, Arabic language has several specifics which complicate the process of feature extraction by traditional methods. We adopted a neural language model created at Google, known as word2vec, for vectorizing text. We then designed and evaluated several deep learning architectures using CNN and LSTM. The experiments were run on two publicly available Arabic tweets datasets. Promising results have been attained when combining LSTMs and compared favorably with most related work.

1:45PM *A graph theory analysis on distinguishing EEG-based brain death and coma [#17564]*

Gaochao Cui, Li Zhu, Qibin Zhao, Jianting Cao and Andrzej Cichocki, Saitama Institute of Technology, Japan; Xiamen University, China; Brain Science Institute, RIKEN, Japan

Electroencephalogram (EEG) is always used to diagnosis the patients consciousness clinically because it is safe and easy to be record from patients. The aim of this paper is to analysis the relations between each channel in order to find out the brain network of brain death and coma patients particularity. In this paper, we use 10 adult patients EEG data to calculate the partial directed coherence (PDC) and build the average brain network for the two groups' data after t-test based on the PDC results. Results showed that, these two clinical data are at most difference in the network parameters of degree, centrality and cluster coefficient as the threshold of PDC is set of 0.3. The time-varying connectivity could lead to better understanding of non- symmetric relations between different EEG channels and application in prediction of patients in brain death or coma state.

2:00PM *Emotion Annotation Using Hierarchical Aligned Cluster Analysis [#17816]*

Weiye Zhao, Sheng Fang, Ting Ji, Qian Ji, Weilong Zheng and Baoliang Lu, Shanghai Jiao Tong University, China

The correctness of annotation is quite important in supervised learning, especially in electroencephalography(EEG)-based emotion recognition. The conventional EEG annotations for emotion recognition are based on the feedback like questionnaires about emotion elicitation from subjects. However, these methods are subjective and divorced from experiment data, which lead to inaccurate annotations. In this paper, we pose the problem of annotation optimization as temporal clustering one. We mainly explore two types of clustering algorithms: aligned clustering analysis (ACA) and hierarchical aligned clustering analysis (HACA). We compare the performance of questionnaire-based, ACA-based, HACA-based

annotation on a public EEG dataset called SEED. The experimental results demonstrate that our proposed ACA-based and HACA-based annotation achieve an accuracy improvement of 2.59% and 4.53% in average, respectively, which shows their effectiveness for emotion recognition.

2:15PM *Functional Connectivity Analysis of EEG in AD Patients with Normalized Permutation Index [#17658]*

Lihui Cai, Jiang Wang, Ruofan Wang, Bin Deng, Haitao Yu and Xile Wei, Tianjin University, China; Tianjin University of Technology and Education, China

In this work, we proposed Normalized Permutation Index (NPI) to analysis the functional connectivity of EEG from human brain with Alzheimer's disease. NPI is modified method of permutation disalignment index based on permutation entropy, and can be used for the functional network analysis. The simulation analysis of NPI is first performed and the results show that NPI could effectively estimate the coupling strength with high sensitivity. Then NPI is applied to the syn- chronization and network analysis of AD brain. It can be observed that the func- tional connectivity in AD brain is weakened in most channel pairs, and the net- work properties are also altered with decreased global and local efficiency. These preliminary results demonstrate that NPI could be used to provide a new bi-omarker for AD pathology.

2:30PM *EEG-Based Sleep Quality Evaluation with Deep Transfer Learning [#17815]*

Xingzan Zhang, Weilong Zheng and Baoliang Lu, Shanghai Jiao Tong University, China

In this paper, we propose a subject-independent approach with deep transfer learning to evaluate the last-night sleep quality using EEG data. To reduce the intrinsic cross-subject differences of EEG data and background noise variations during signal acquisition, we adopt two classes of transfer learning methods to build subject- independent classifiers. One is to find a subspace by matrix decomposition and regularization theory, and the other is to learn the common shared structure with the deep autoencoder. The experimental results demonstrate that deep transfer learning model achieves the mean classification accuracy of 82.16% in comparison with the baseline SVM (65.74%) and outperforms other transfer learning methods. Our experimental results also indicate that the neural patterns of different sleep quality are discriminative and stable: the delta responses increase, the alpha responses decrease when sleep is partially deprived, and the neural patterns of 4-hour sleep and 6-hour sleep are more similar compared with 8-hour sleep.

2:45PM *A Stochastic Neural Firing Generated at A Hopf Bifurcation and Its Biological Relevance [#17795]*

Huijie Shang, Rongbin Xu, Dong Wang, Jin Zhou and Shiyuan Han, University of Jinan, China

The integer multiple firing patterns, generated in the rabbit depressor baroreceptors under the different static blood pressure, were observed between the resting state and the periodic firing and were characterized to be stochastic but not chaotic by a series of nonlinear time series estimations. These patterns exhibited very similar characteristics to those observed in the experimental neural pacemaker. Using Ina,p+IK models with dynamics of a supercritical Hopf bifurcation, we successfully simulated the bifurcation process of firing patterns and observed the induction of the integer multiple firing patterns by adding noise. The results strongly suggest that the integer multiple firing rhythms generated by rabbit baroreceptors result from the interplay between noise and the system's dynamics. Because of the important normal physiological function ofbaroreceptors, the biological significance of noise and the noise-induced firing rhythms at a Hopf bifurcation is interesting to be addressed.

3:00PM *Evolutionary Modularity Optimization Clustering of Neuronal Spike Trains [#17306]*

Chaojie Yu, Yuquan Zhu, Yuqing Song and Hu Lu, Jiangsu University, China; fudan University, China

We propose a method for automatic evolutionary clustering of multi neuronal spike trains on the basis of community detection in complex networks. We use a genetic algorithm for optimization to maximize the modularity for community partitioning and then automatically determine the number of clusters hidden in the multi neuronal spike trains. The number of clusters does not need to be specified in advance. Compared with the traditional graph partitioning method, the genetic evolutionary modularity optimization clustering algorithm can obtain the maximum value of modularity and, determine the number of communities. We evaluate the performance of this method on surrogate spike train datasets with ground truth and compare the results with that of the existing spike firing pattern detection algorithm based on a clustering algorithm. The results obtained showed improvement. We then apply this proposed method to raw real spike trains recorded from multiple arrays and compared them with the existing spike firing pattern detection algorithm based on community modularity partitioning. We obtain a larger value for modularity and the results. The proposed method is a completely unsupervised clustering method that requires no prior knowledge. This finding suggests that the proposed method can be used to detect the hidden firing pattern from multi-electrode recording spike trains and to identify the optimal population of unknown neurons in the brain.

3:15PM *Identifying Gender Differences in Multimodal Emotion Recognition Using Bimodal Deep AutoEncoder [#17819]*

Xue Yan, Weilong Zheng, Wei Liu and Baoliang Lu, Shanghai Jiao Tong University, China

This paper mainly focuses on investigating the differences between males and females in emotion recognition using electroencephalography (EEG) and eye movement data. Four basic emotions are considered, namely happy, sad, fearful and neutral. The Bimodal Deep AutoEncoder (BDAE) and the fuzzy-integral-based method are applied to fuse EEG and eye movement data. Our experimental results indicate that gender differences do exist in neural patterns for emotion recognition; eye movement data is not as good as EEG data for examining gender differences in emotion recognition; the activation of the brains for females is generally lower than that for males in most bands and brain areas especially for fearful emotions. According to the confusion matrix, we observe that the fearful emotion is more diverse among women compared with men, and men behave more diversely on the sad emotion compared with women. Additionally, individual differences in fear are more pronounced than other three emotions for females.

ThuA5 Data mining 1

Thursday, November 16, 1:30PM-3:30PM, Room: Zhujiang 7, Chairs: Paul Watters and Cesare Alippi

1:30PM *Low-rank and Sparse Matrix Completion for Recommendation [#17101]*

Zhi-Lin Zhao, Ling Huang, Chang-Dong Wang, Jian-Huang Lai and Philip S. Yu, Sun Yat-sen University, China; University of Illinois at Chicago, United States

Recently, recommendation algorithms have been widely used to improve the benefit of businesses and the satisfaction of users in many online platforms. However, most of the existing algorithms generate intermediate output when predicting ratings and the error of intermediate output will be propagated to the final results. Besides, since most algorithms predict all the unrated items, some predicted ratings may be unreliable and useless which will lower the efficiency and effectiveness of recommendation. To this end, we propose a Low-rank and Sparse Matrix Completion (LSMC) method which recovers rating matrix directly to improve the quality of rating prediction. Following the common methodology, we assume the structure of the predicted rating matrix is low-rank since rating is just connected with some factors of user and item. However, different from the existing methods, we assume the matrix is sparse so some unreliable predictions will be removed and important results will be retained. Besides, a slack variable will be used to prevent overfitting and weaken the influence of noisy data. Extensive experiments on four real-world datasets have been conducted to verify that the proposed method outperforms the state-of-the-art recommendation algorithms.

1:45PM *Social and Content based Collaborative Filtering for Point-of-Interest Recommendations [#17308]*

Yi-Ning Xu, Lei Xu, Ling Huang and Chang-Dong Wang, Sun Yat-sen University, China

The rapid development of Location-based Social Networks (LBSNs) has led to the great demand of personalized Point-of-interests (POIs) recommendation. Although previous researches have presented a variety of methods to recommend POIs by utilizing social relation, geographical mobility data and user content profile, they fail to address user/location's cold-start problem with high-dimensional sparse data, and overlook the compatibility of social relation, content based methodology and collaborative filtering. To cope with these challenges, we analyze user's check-in preference and find that it may be influenced in two spaces, namely Social Propagation Influence Space and Individual Attribute Influence Space. To this end, we propose a Social and Content based Collaborative Filtering Model (SCCF), which consists of a Social Relation Preference based Model (SRPB) considering social friends' preference and a User Location Content-based Model (ULCB) matching the user attributes with location features. Extensive experiments on real-world datasets firmly demonstrate that the proposed SCCF model outperforms the state-of-the-art approaches while addressing cold-start problems in POI recommendation.

2:00PM *Multiclass Imbalanced Classification using Fuzzy C-Mean and SMOTE with Fuzzy Support Vector Machine [#17422]*

Ratchakoon Pruengkarn, Kok Wai Wong and Chun Che Fung, Murdoch University, Australia

A hybrid sampling technique is proposed by combining Fuzzy C-Mean Clustering and Synthetic Minority Oversampling Technique (FCMSMT) for tackling the imbalanced multiclass classification problem. The mean number of classes is used as the number of instances for applying undersampling and oversampling. Using the mean as the fixed number of the required instances for each class can prevent the within-class imbalance data from being eliminated erroneously during undersampling. This technique can decrease both within-class and between-class errors, and thus can increase the classification performance. The study was conducted using eight benchmark datasets from KEEL and UCI repositories and the results were compared against three major classifiers based on G-mean and AUC measurements. The results reveal that the proposed technique could handle most of the multiclass imbalanced datasets used in the experiments for all classifiers and retain the integrity of the original data.

2:15PM *Incremental Matrix Reordering for Similarity-Based Dynamic Data Sets [#17485]*

Parisa Rastin and Basarab Matei, University Paris 13, France

Visualization methods are important to describe the underlying structure of a data set. When the data is not described as a vector of numerical values, a visualization can be obtained through the reordering of the corresponding similarity matrix. Although several methods of reordering exist, they all need the complete similarity matrix in memory. However, this is not possible for the analysis of dynamic data sets. The goal of this paper is to propose an original algorithm for the incremental reordering of a similarity matrix adapted to dynamic data sets. The proposed method is compared with state-of-the-art algorithms for static data-sets and applied to a dynamic data-set in order to demonstrate its efficiency.

2:30PM *Learning with Partially Shared Features for Multi-Task Learning [#17653]*

Cheng Liu, Wen-Ming Cao, Chu-Tao Zheng and Hau-San Wong, City University of Hong Kong, Hong Kong

The objective of Multi-Task Learning (MTL) is to boost learning performance by simultaneously learning multiple relevant tasks. Identifying and modeling the task relationship is essential for multi-task learning. Most previous works assume that related tasks have common shared structure. However, this assumption is too restrictive. In some real-world applications, relevant tasks are partially sharing knowledge at the feature level. In other words, the relevant features of related tasks can partially overlap. In this paper, we propose a new MTL approach to exploit this partial relationship of tasks, which is able to selectively exploit shared information across the tasks while produce a task-specific sparse pattern for each task. Therefore, this increased flexibility is able to model the complex structure among tasks. An efficient alternating optimization has been developed to optimize the model. We perform experimental studies on real world data and the results demonstrate that the proposed method significantly improves learning performance by simultaneously exploiting the partial relationship across tasks at the feature level.

2:45PM *Strength Analysis on Safety-Belt ISOFIX Anchorage for Vehicles Based on HyperWorks and Ls-Dyna [#17172]*

Peicheng Shi, Suo Wang and Ping Xiao, Anhui Polytechnic University, China

We, per the national standard GB14167-2013 of the People's Republic of China about strength test for ISOFIX anchorage on vehicle seats and taking a new vehicle seat product as research object with the finite element analysis theory, established the finite element model for ISOFIX anchorage on vehicle seats; obtained the stress and strain nephogram of vehicle seats based on HyperWorks software for forward force test and oblique force test; thus provided reference for structural optimization design by analyzing and forecasting the weak parts of vehicle seats.

3:00PM *Evaluating Accuracy in Prudence Analysis for Cyber Security [#17053]*

Omaru Maruatona, Peter Vamplew, Richard Dazeley and Paul Watters, PwC, Australia; Federation University, Australia; La Trobe University, Australia

Conventional Knowledge-Based Systems (KBS) have no way of detecting or signalling when their knowledge is insufficient to handle a case. Consequently, these systems may produce an uninformed conclusion when presented with a case beyond their current knowledge (brittleness) which results in the KBS giving incorrect conclusions due to insufficient knowledge or ignorance on a specific case. Prudence Analysis (PA) has been shown to be a viable alternative to brittleness in Ripple Down Rules (RDR) knowledge bases. To date, there have been two approaches to Prudence; attribute-based and structural-based pru-dence. This paper introduces Integrated Prudence Analysis (IPA), a novel Prudence method formed by combining these methods.

3:15PM *A Method to Improve Accuracy of Velocity Prediction Using Markov Model [#17230]*

Ya-dan Liu, Liang Chu, Nan Xu, Yi-fan Jia and Zhe Xu, Jilin University, China; China FAW Group Corporation, China

In order to predict the velocity in driving cycle, first-stage Markov chain (MC) predictor method is adopted. In the traditional Markov prediction model, only one state transition matrix was used to predict the speed. However it will produce a larger error to use the same matrix for predicting speed in different categories of driving cycles. Random Markov-Chain (RMC) model is adopted to improve the accuracy, but the accuracy is still not enough. In this paper, we propose that the state transition matrices in RMC model are divided into two categories: city and highway. Before the prediction, we use the neural network to choose state transition matrix by judging the kinematic parameters of velocity in driving cycles. The simulation results show that the effect of prediction using the state transition matrix after neural network classification is more accurate than no classification. Therefore, the improved RMC model can increase the accuracy of velocity prediction effectively.

ThuA6 Machine learning 3

Thursday, November 16, 1:30PM-3:30PM, Room: Kaixuan 3, Chairs: Jeremiah D. Deng and Zhigang Zeng

1:30PM *Incremental Self-Organizing Maps for Collaborative Clustering [#17329]*

Denis Maurel, Jeremie Sublime and Sylvain Lefebvre, ISEP, France

Collaborative clustering aims at revealing the common structures of data distributed on different sites using local clustering methods such as Self-Organizing Maps (SOM). To face the ever growing quantity of data available, incremental clustering methods are needed. This paper presents an algorithm to perform incremental SOM-based collaborative clustering without topological modifications of the map. The experiments conducted on several datasets demonstrate the validity of the method and present the influence of the batch size on the learning.

1:45PM *Efficient Neighborhood Covering Reduction with Submodular Function Optimization [#17497]*

Qiang Chen, Xiaodong Yue, Jie Zhou and Yufei Chen, Shanghai University, China; Shenzhen University, China; Tongji University, China

Neighborhood Covering Reduction (NCR) methods learn rules for classification through formulating the covering of data space with neighborhoods. NCR method transforms original data into neighborhood systems and facilitates the data generalization. However, the computational complexity of extant NCR methods is O(n^2) which impedes the application of NCR on massive data and the error bound analysis is insufficient. In this paper, we remodel the objective of NCR from the view of Submodular Function Optimization and thereby improve the efficiency of NCR based on submodular optimization strategies. We first optimize the reduction process of neighborhoods with Lazy-Greedy strategy and further extend the serial algorithm to a parallel version according to the parallel optimization strategy of submodular functions. The error bounds of the proposed NCR algorithms are also analyzed. Experimental results validate the efficiency of the proposed NCR algorithms.

2:00PM *Atomic Distance Kernel for Material Property Prediction [#17754]*

Hirotaka Akita, Yukino Baba, Hisashi Kashima and Atsuto Seko, Kyoto University, Japan

A comprehensive search of various candidate materials is an important step in discovering novel materials with desirable physical properties. However, the search space is quite vast, so that it is not practical to perform exhaustive experiments to check all the candidates. Even if the chemical composition is the same, the properties of materials may differ significantly depending on the crystal structure, and therefore, the number of possible combinations increases considerably. Recently, machine learning methods have been successfully applied to material search to estimate prediction models using existing databases and predict the physical properties of unknown substances. In this research, we propose a novel kernel function between compounds, which directly uses crystal structure information for the prediction of physical properties of inorganic crystalline compounds based on the crystal structures. We conduct evaluation experiments and show that the structure information improves the prediction accuracy.

2:15PM *Large Scale Image Classification Based on CNN and Parallel SVM [#17704]*

Zhanquan Sun, Feng Li and Huifen Huang, Shandong Computer Science Center, China; Shanghai University, China; Shandong Yingcai University, China

Image classification is one of the most important problems for computer vision and machine learning. Many image classification methods have been proposed and applied to many application areas. But how to improve the performance of image classification is still an important research issue to be resolved. Feature ex- traction is the most important task of image classification, which affects the clas-sification performance directly. Classical features extraction methods are designed manually according to color, shape or texture etc.. They can only display the im-age characters partially and can't be extracted objectively. Convolutional Neural Network (CNN), which is one kind of artificial neural networks, has already be-come current research focuses for image classification. Deep learning based on CNN can extract image features automatically. For improving image classification performance, a novel image classification method that combines CNN and paral-lel SVM is proposed. In the method, deep neural network based on CNN is used to extract image features. Extracted features are input to a parallel SVM based on MapReduce for image classification. It can improve the classification accuracy and efficiency markedly. The efficiency of the proposed method is illustrated through examples analysis.

2:30PM *Accumulator Based Arbitration Model for both Supervised and Reinforcement Learning Inspired by Prefrontal Cortex [#17372]*

Masahiko Osawa, Yuta Ashihara, Takuma Seno, Michita Imai and Satoshi Kurihara, Keio University, Japan; The University of Electro-Communications, Japan

A method that provides an excellent performance by arbitrating multiple modules is important. There are variety of multi-module arbitration methods proposed in various contexts. However, there is yet to be a multi-module arbitration method proposed in reference to structure of animals' brains. Considering that the animals' brains achieve general-purpose multi-module arbitration, such function may be achieved by referring to the actual brain. In this paper, with reference to the knowledge of accumulator neurons hypothesized to exist in the prefrontal cortex, we propose an Accumulator Based Arbitration Model (ABAM). By arbitrating multiple modules, ABAM exerts a superior performance in both supervised learning and reinforcement learning task.

2:45PM *Malware Detection Using Deep Transferred Generative Adversarial Networks [#17537]*

Jin-Young Kim, Seok-Jun Bu and Sung-Bae Cho, Yonsei University, Korea (South)

Malicious software is generated with more and more modified features of which the methods to detect malicious software use characteristics. Automatic classification of malicious software is efficient because it does not need to store all characteristic. In this paper, we propose a transferred generative adversarial network (tGAN) for automatic classification and detection of the zero- day attack. Since the GAN is unstable in training

process, often resulting in generator that produces nonsensical outputs, a method to pre-train GAN with autoencoder structure is proposed. We analyze the detector, and the performance of the detector is visualized by observing the clustering pattern of malicious software using t-SNE algorithm. The proposed model gets the best performance compared with the conventional machine learning algorithms.

3:00PM *A Grassmannian Approach to Zero-Shot Learning for Network Intrusion Detection [#17232]*

Jorge Rivero, Bernardete Ribeiro, Ning Chen and Fatima Silva Leite, Centre of Informatics and Systems of the University of Coimbra, Portugal; University of Coimbra, Portugal; Henan Polytechnic University, China

One of the main problems in Network Intrusion Detection comes from constant rise of new attacks, so that not enough labeled examples are available for the new classes of attacks. Traditional Machine Learning approaches hardly address such problem. This can be overcome with Zero-Shot Learning, a new approach in the field of Computer Vision, which can be described in two stages: the Attribute Learning and the Inference Stage. The goal of this paper is to propose a new Inference Stage algorithm for Network Intrusion Detection. In order to attain this objective, we firstly put forward an experimental setup for the evaluation of the Zero-Shot Learning in Network Intrusion Detection related tasks. Secondly, a decision tree based algorithm is applied to extract rules for generating the attributes in the AL stage. Finally, using a representation of a Zero-Shot Class as a point in the Grassmann manifold, an explicit formula for the shortest distance between points in that manifold can be used to compute the geodesic distance between the Zero-Shot Classes which represent the new attacks and the Known Classes corresponding to the attack categories. The experimental results in the datasets KDD Cup 99 and NSL-KDD show that our approach with Zero- Shot Learning successfully addresses the Network Intrusion Detection problem.

3:15PM *Reinforced Memory Network for Question Answering [#17455]*

Anupiya Nugaliyadde, Kok Wai Wong, Ferdous Sohel and Hong Xie, Murdoch University, Australia

Deep learning techniques have shown to perform well in Question Answering (QA) tasks. We present a framework that combines Memory Network (MN) and Reinforcement Learning (Q-learning) to perform QA, termed Rein-forced MN (R- MN). We investigate the proposed framework by the use of Long Short Term Memory Network (LSTM) and Dynamic Memory Network (DMN). We call them Reinforced LSTM (R-LSTM) and Reinforced DMN (R-DMN), respectively. The input text sequence and question are passed to both MN and Q-Learning. The output of the MN is then fed to Q-Learning as a second input for refinement. The R- MN is trained end-to-end. We evaluated R-MNs on the bAbI 1K QA dataset for all of the 20 tasks. We achieve superior performance when compared to conventional method of RL, LSTM and the state of the art technique, DMN. Using only half of the training data, both R-LSTM and R-DMN achieved all of the bAbI tasks with high accuracies. The experimental results demonstrated that the proposed framework of combining MN and Q-learning enhances the QA tasks while using less training data.

ThuA7 Deep learning 3

Thursday, November 16, 1:30PM-3:30PM, Room: Kaixuan 5, Chairs: Ikuro Sato and Tingwen Huang

1:30PM *Asynchronous, Data-Parallel Deep Convolutional Neural Network Training with Linear Prediction Model for Parameter Transition [#17185]*

Ikuro Sato, Ryo Fujisaki, Yosuke Oyama, Akihiro Nomura and Satoshi Matsuoka, Denso IT Laboratory, Inc., Japan; Tokyo Institute of Technology, Japan

Recent studies have revealed that Convolutional Neural Networks requiring vastly many sum-of-product operations with relatively small numbers of parameters tend to exhibit great model performances. Asynchronous Stochastic Gradient Descent provides a possibility of large-scale distributed computation for training such networks. However, asynchrony introduces stale gradients, which are considered to have negative effects on training speed. In this work, we propose a method to predict future parameters during the training to mitigate the drawback of staleness. We show that the proposed method gives good parameter prediction accuracies that can improve speed of asynchronous training. The experimental results on ImageNet demonstrates that the proposed asynchronous training method, compared to a synchronous training method, reduces the training time to reach a certain model accuracy by a factor of 1.9 with 256 GPUs used in parallel.

1:45PM *Efficient Learning Algorithm using Compact Data Representation in Neural Networks [#17406]*

Masaya Kibune and Michael Lee, Fujitsu Laboratories of America, Inc., United States

Convolutional neural networks have dramatically improved the prediction accuracy in a wide range of applications, such as vision recognition and natural language processing. However the recent neural networks often require several hundred megabytes of memory for the network parameters, which in turn consume a large amount of energy during computation. In order to achieve better energy efficiency, this work investigates the effects of compact data rep- resentation on memory saving for network parameters in artificial neural net- works while maintaining comparable accuracy in both training and inference phases. We have studied the dependence of prediction accuracy on the total number of bits for fixed point data representation, using a proper range for syn-aptic weights. We have also proposed a dictionary based architecture that utilizes a limited number of floating-point entries for all the synaptic weights, with proper initialization and scaling factors to minimize the approximation error. Our experiments using a 5-layer convolutional neural network on Cifar-10 dataset have shown that 8 bits are enough for bit width reduction and dictionary based architecture to achieve 96.0% and 96.5% relative accuracy respectively, compared to the conventional 32-bit floating point.

2:00PM *Regularizing CNN via Feature Augmentation [#17481]*

Liechuan Ou, Zheng Chen, Jianwei Lu and Ye Luo, Tongji University, China

Very deep convolutional neural network has a strong representation power and becomes the dominant model to tackle very complex image classification problems. Due to the huge number of parameters, overfitting is always a primary problem in training a network without enough data. Data augmentation at input layer is a commonly used regularization method to make the trained model generalize better. In this paper, we propose that feature augmentation at intermediate layers can be also used to regularize the network. We implement a modified residual network by adding augmentation layers and train the model on CIFAR10. Experimental results demonstrate our method can successfully regularize the model. It significantly decreases the cross- entropy loss on test set although the training loss is higher than the original network. The final recognition accuracy on test set is also improved. In comparison with Dropout, our method can cooperate better with batch normalization to produce performance gain.

2:15PM *Effectiveness of adversarial attacks on class-imbalanced convolutional neural networks [#17482]*

Rafael Possas and Ying Zhou, University of Sydney, Australia

Convolutional neural networks (CNNs) performance has increased considerably in the last couple of years. However, as with most machine learning methods, these networks suffer from the data imbalance problem - when the underlying training dataset is comprised of an unequal number of samples for each label/class. Such imbalance enforces a phenomena known as domain shift that causes the model to have poor generalisation when presented with previously unseen data. Recent research has focused on a technique called gradient sign that intensifies domain shift in CNNs by modifying inputs to deliberately yield erroneous model outputs,

while appearing unmodified to human observers. Several commercial systems rely on image recognition techniques to perform well. Therefore, adversarial attacks poses serious threats to their integrity. In this work we present an experimental study that sheds light on the link between adversarial attacks, imbalanced learning and transfer learning. Through a series of experiments we evaluate the fast gradient sign method on class imbalanced CNNs, linking model vulnerabilities to the characteristics of its underlying training set and internal model knowledge.

2:30PM *Sharing ConvNet Across Heterogeneous Tasks [#17742]*

Takumi Kobayashi, National Institute of Advanced Science and Technology, Japan

Deepconvolutionalneuralnetwork(ConvNet)isoneofthemostpromis- ing approaches to produce state-of-the-art performance on image recognition. The ConvNet exhibits excellent performance on the task of the training target as well as favorable transferability to the other datasets/tasks. It, however, is still de- pendent on the characteristics of the training dataset and thus deteriorates perfor- mance on the other types of task, such as by transferring the ConvNet pre-trained on ImageNet from object classification to scene classification. In this paper, we propose a method to improve generalization performance of ConvNets. In the proposed method, the ConvNet layers are partially shared across heterogeneous tasks (datasets) in end-to-end learning, while the remaining layers are tailored to respective datasets. The method provides models of various generality and spe- cialty by controlling the degree of shared layers, which are effectively trained by introducing the diversity into mini- batches. It is also applicable to fine-tuning the ConvNet especially on a smaller-scale dataset. The experimental results on image classification using ImageNet and Places-365 datasets show that our method im- proves performance on those datasets as well as provides the pre- trained ConvNet of higher generalization power with favorable transferability.

2:45PM *Training Deep Neural Networks for Detecting Drinking Glasses using Synthetic Images [#17774]*

Abdul Jabbar, Luke Farrawell, Jake Fountain and Stephan Chalup, The University of Newcastle, Australia

This study presents an approach of using synthetically rendered images for training deep neural networks on object detection. A new plug-in for the computer graphics modelling software Blender was developed that can generate large numbers of photo-realistic raytraced images and include meta information as training labels. The performance of the deep neural network DetectNet is evaluated using training data comprising synthetically rendered images and digital photos of drinking glasses. The detection accuracy is determined by comparing bounding boxes using intersection over union technique. The detection experiments using real-world and synthetic image data resulted in comparable results and the performance increased when using a pre-trained GoogLeNet model. The experiments demonstrated that training deep neural networks for object detection on synthetic data is effective and the proposed approach can be useful for generating large labelled image data sets to enhance the performance of deep neural networks on specific object detection tasks.

3:00PM *Deep Clustering with Convolutional Autoencoders [#17439]*

Xifeng Guo, Xinwang Liu, En Zhu and Jianping Yin, National University of Defense Technology, China

Deep clustering utilizes deep neural networks to learn feature representation that is suitable for clustering tasks. Though demonstrating promising performance in various applications, we observe that existing deep clustering algorithms either do not well take advantage of convolutional neural networks or do not considerably preserve the local structure of data generating distribution in the learned feature space. To address this issue, we propose a deep convolutional embedded clustering algorithm in this paper. Specifically, we develop a convolutional autoencoders structure to learn embedded features in an end-to-end way. Then, a clustering oriented loss is directly built on embedded features to jointly perform feature refinement and cluster assignment. To avoid feature space being distorted by the clustering loss, we keep the decoder remained which can preserve local structure of data in feature space. In sum, we simultaneously minimize the reconstruction loss of convolutional autoencoders and the clustering loss. The resultant optimization problem can be effectively solved by mini-batch stochastic gradient descent and back-propagation. Experiments on benchmark datasets empirically validate the power of convolutional autoencoders for feature learning and the effectiveness of local structure preservation.

3:15PM *An Incremental Deep Learning Network for On-line Unsupervised Feature Extraction [#17491]*

Yu Liang, Yi Yang, Furao Shen, Jinxi Zhao and Tao Zhu, Nanjing University, China

In this paper, we propose an incremental deep learning network for on-line unsupervised feature extraction. This deep learning network is based on 3 data processing components: 1) cascaded incremental orthogonal component analysis network(IOCANet); 2) binary hashing; and 3) blockwise histograms. In this architecture, IOCANet can process online data and get filters to do convolutions. Binary hashing is used to enhance the nonlinearity of IOCANet and reduce the quantity of the data. Eventually, the data is encoded by blockwise histograms. Experiments demonstrate that the proposed architecture has potential results for on-line unsupervised feature extraction.

ThuA8 Time series analysis

Thursday, November 16, 1:30PM-3:30PM, Room: Kaixuan 6, Chairs: Rohitash Chandra and Dong Yue

1:30PM *Arterial Coordination for Dedicated Bus Priority Based on a Spectral Clustering Algorithm [#17221]*

Shuhui Zheng, Xiaoming Liu, Chunlin Shang, Guorong Zheng and Guifang Zheng, Beijing Information Technology College, China; Beijing Key Lab of Urban Road Traffic Intelligent Tech, China

The current method of dedicated bus arterial coordination priority is mostly based on the arterial coordination control scheme of social vehicle, which makes the dedicated bus arterial coordination priority have many limitations. This paper compare social vehicle traffic flow data with bus traffic flow data which obtained from survey to determine the weighted proportion between them by using spectral clustering (SC) method. And then design multi-period division program for intersection by using Piecewise Aggregate Approximation (PAA). At last we get new arterial coordination control scheme by using graphic method. This paper selects per capita delay as efficiency indicator to measure intersection traffic efficiency. After VISSIM simulation we find out that the new-control-method's outstanding performance on bus traffic efficiency which can decrease the per capita delay and achieve public transit-oriented purpose.

1:45PM *Multi-Resolution Selective Ensemble Extreme Learning Machine for Electricity Consumption Prediction [#17636]*

Hui Song, Kai Qin and Flora Salim, Royal Melbourne Institute of Technology, Australia; Swinburne University of Technology, Australia

We propose a multi-resolution selective ensemble extreme learning machine (MRSE-ELM) method for time-series prediction with the application to the next- step and next-day electricity consumption prediction. Specifically, at the current time stamp, the preceding time-series data is sampled at different time intervals (i.e. resolutions) to constitute the time windows used for the prediction. The value at each sampled point can be certain statistics calculated from its associated time interval. At each resolution, multiple extreme learning machines (ELMs) with different numbers of hidden neurons are first trained. Then, sequential forward selection and least square regression are used to select an

optimal set of trained ELMs to constitute the final ensemble model. The experimental results demonstrate that the proposed MRSE- ELM outperforms the best single ELM model across all resolutions. Compared to three state-of-the-art prediction models, MRSE-ELM shows its superiority on the next-step and next-day electricity consumption prediction tasks.

2:00PM *Fix-Budget and Recurrent Data Mining for Online Haptic Perception [#17528]*

Lele Cao, Fuchun Sun, Xiaolong Liu, Wenbing Huang, Weihao Cheng and Ramamohanarao Kotagiri, Tsinghua University, China; The University of Melbourne, Australia

Haptic perception is to identify different targets from haptic input. Haptic data have two prominent features: sequentially real-time and temporally correlated, which calls for a fixed-budget and recurrent perception procedure. Based on an efficient-robust spatio-temporal feature representation, we handle the problem with a bounded online- sequential learning framework (MBS-ESN), and incorporates the strength of batch-regularization bootstrapping, bounded recursive reservoir, and momentum-based estimation. Experimental evaluations show that it outperforms the state-of-the-art methods by a large margin on test accuracy; and its training performance is superior to most compared models from aspects of computational complexity and storage efficiency.

2:15PM *Bayesian neural learning via Langevin dynamics for chaotic time series prediction [#17514]*

Rohitash Chandra, Lamiae Azizi and Sally Cripps, University of Sydney, Australia

Although neural networks have been very promising tools for chaotic time series prediction, they lack methodology for uncertainty quantification. Bayesian inference using Markov Chain Mont-Carlo (MCMC) algorithms have been popular for uncertainty quantification for linear and non-linear models. Langevin dynamics refer to a class of MCMC algorithms that incorporate gradients with Gaussian noise in parameter updates. In the case of neural networks, the parameter updates refer to the weights of the network. We apply Langevin dynamics in neural networks for chaotic time series prediction. The results show that the proposed method improves the MCMC random-walk algorithm for the majority of the problems considered. In particular, it gave much better performance for the real-world problems that featured noise.

2:30PM *Spatio-Temporal Wind Power Prediction using Recurrent Neural Networks [#17056]*

Wei Lee Woon, Stefan Oehmcke and Oliver Kramer, Masdar Institute of Science and Technology, United Arab Emirates; University of Oldenburg, Germany

While wind is an abundant source of energy, integrating wind power into existing electricity grids is a major challenge due to its inherent variability. The ability to accurately predict future generation output would greatly mitigate this problem and is thus extremely valuable. Numerical Weather Prediction (NWP) techniques have been the basis of many wind prediction approaches, but the use of machine learning techniques is steadily gaining ground. Deep Learning (DL) is a sub-class of machine learning which has been particularly successful and is now the state of the art for a variety of classification and regression problems, notably image processing and natural language processing. In this paper, we demonstrate the use of Recurrent Neural Networks, a type of DL architecture, to extract patterns from the spatio- temporal information collected from neighboring turbines. These are used to generate short term wind energy forecasts which are then benchmarked against various prediction algorithms. The results show significant improvements over forecasts produced using state of the art algorithms.

2:45PM *TMRCP: A Trend-Matching Resources Coupled Prediction Method over Data Stream [#17297]*

Runfan Wu, Yijie Wang, Xingkong Ma and Li Cheng, National University of Defense Technology, China

Resource prediction promotes dynamic scheduling and energy saving in cloud computing. However, resource prediction becomes a challenge with the diversity and dynamicity of the cloud environment. Existing methods merely focus on single specific resource and ignore the correlation among resources, resulting in inaccurate predictions. Therefore, we propose a trend-matching resources coupled prediction method (TMRCP) based on incremental learning over data stream, which consists of three algorithms. First, to cope with the diversity of the cloud environment, we propose a Resources Utilization Trend Matching algorithm (RUTM), which defines a new similarity measure for multi-dimensional sequences and takes the correlation among resources into consideration. Second, we propose a dynamic prediction window adjustment algorithm that selects appropriate prediction length for different resource utilization trends to overcome the disadvantage of fixed window. Third, in response to the sudden changes, we put forward a mixed synthesis algorithm to improve the robustness of the method. Experiments on Google's cluster usage trace show that the Mean Absolute Percentage Error of TMRCP is 4.7%, 20% better than the state-of-the-art. In addition, the TMRCP is still accurate in multi-step-ahead prediction.

3:00PM *App Uninstalls Prediction: A Machine Learning and Time Series Mining Approach [#17605]*

Jiaxing Shang, Jinghao Wang, Ge Liu, Hongchun Wu, Shangbo Zhou and Yong Feng, Chongqing University, China

Nowadays mobile applications (a.k.a. app) are playing unprecedented important roles in our daily life and their research has attracted many scholars. However, traditional research mainly focuses on mining app usage patterns or making app recommendations, little attention is paid to the study of app uninstall behaviors. In this paper, we study the problem of app uninstalls prediction based on a machine learning and time series mining approach. Our approach consists of two steps: (1) feature construction and (2) model training. In the first step we extract features from the dynamic app usage data with a time series mining algorithm. In the second step we train classifiers with the extracted features and use them to predict whether a user will uninstall an app in the near future. We conduct experiments on the data collected from AppChina, a leading Android app marketplace in China. Results show that the features mined from time series data can significantly improve the prediction performance.

3:15PM *Decouple Adversarial Capacities with Dual-Reservoir Network [#17575]*

Qianli Ma, Lifeng Shen, Wanqing Zhuang and Jieyu Chen, South China University of Technology, China; University of California, United States

Reservoir computing such as Echo State Network (ESN) and Liquid State Machine (LSM) has been successfully applied in dynamical system modeling. However, there is an antagonistic trade-off between the non-linear mapping capacity and the short-term memory capacity in single-reservoir networks, especially when the input signals contain high non-linearity and short-term dependencies. To address this problem, we propose a novel reservoir computing model called Dual-Reservoir Network (DRN), which connects two reservoirs with an unsupervised en- coder such as PCA. Specifically, we allow these two adversarial capacities to be decoupled and enhanced in the dual reservoirs respectively. In our experiments, we first verify DRN's feasibility on an extended polynomial system, which allows us to control the non-linearity and short- term dependencies of data. In addition, we demonstrate the e effectiveness of DRN on the synthesis and real-world time series predictions.

Thursday, November 16, 1:30PM-6:00PM

Plenary Poster Session: P2 Poster Session 2

Thursday, November 16, 1:30PM-6:00PM, Room: Poster Area, Chairs: Yifei Pu and Sung Bae Cho

P301 *End-to-End Chinese Image Text Recognition with Attention Model [#17507]*

Fenfen Sheng, Chuanlei Zhai, Zhineng Chen and Bo Xu, Institute of Automation, Chinese Academy of Sciences, China

This paper presents an attention-based model for end-to-end Chinese image text recognition. The proposed model includes an encoder and a decoder. For each input text image, the encoder part firstly combines deep convolutional layers with bidirectional Recurrent Neural Network to generate an ordered, high-level feature sequence, which could avoid the complicated text segmentation pre- processing. Then in the decoder, a recurrent network with attention mechanism is developed to generate text line output, enabling the model to selectively exploit image features from the encoder correspondingly. The whole segmentation-free model allows end-to-end training within a standard backpropagation algorithm. Extensive experiments demonstrate significant performance improvements comparing to baseline systems. Furthermore, qualitative analysis reveals that the proposed model could learn the alignment between input and output in accordance with the intuition.

P302 *Application of Data Augmentation Methods to Unmanned Aerial Vehicle Monitoring System for Facial Camouflage Recognition [#17655]*

Yanyang Li, Sanqing Hu, Wenhao Huang and Jianhai Zhang, Hangzhou Dianzi University, China

Recently, the Unmanned Aerial Vehicle(UAV) monitoring system based on face recognition technology has attracted much attention. However, partly because of human hair changes, glasses wearing and other camouflage behavior, the accuracy of UAV face recognition system is still not high enough. In this paper, two kinds of data augmentation methods (the hairstyle hypothesis and eyeglass hypothesis) are used to expand the face dataset to make up the shortage of the original face data. In addition, the UAV locates human's face in the air from special distance and elevation, the collected face characteristics are vastly different from those in the public face library. Considering the peculiarity of UAV face localization, the data augmentation program is implemented to improve the accuracy of UAV identification of camouflage face to be 97.5%. The results show that our approach is effective and feasible.

P303 *3D Reconstruction with Multi-View Texture Mapping [#17849]*

Xiaodan Ye, Lianghao Wang, Dongxiao Li and Ming Zhang, Zhejiang University, China

In this paper, a novel 3D reconstruction with multi-view texture mapping method based on Kinect 2 is proposed. Camera poses of all chosen key frames are optimized according to photometric consistency. Optimized camera poses can make the projected point from vertices to different views get closer. A small range of translations with limited calculation is added in this method. A new form of data term and smoothness term in Markov Random Field (MRF) objective function is presented. The outlier images are rejected before view selection and Poisson blending are applied in the end. Experimental results show that our method achieves a high-quality 3D model with high fidelity texture.

P304 *Online Tracking with Convolutional Neural Networks [#17468]*

Xiaodong Liu and Yue Zhou, Shanghai Jiao Tong University, China

Convolutional neural networks (CNNs) have recently been widely applied to visual applications, but there are still not much attempts to employ CNNs for object tracking. In this paper, we propose a novel visual tracking method which utilizes the powerful representations of CNNs. We regard the visual tracking as a traditional binary classification task along with an online model update. The binary classification network is pre-trained on ImageNet dataset and fine-tuned on visual tracking benchmark dataset by sequentially training to avoid overfitting. In the tracking process, we conduct a short-term and long-term model update mechanism for adaptiveness and robustness, respectively. Extensive experiments on two visual tracking datasets demonstrate that our algorithm is comparable to state-of-art methods in terms of accuracy and robustness.

P305 *MC-DCNN: Dilated Convolutional Neural Network for Computing Stereo Matching Cost [#17530]*

Xiao Liu, Ye Luo, Yu Ye and Jianwei Lu, Tongji University, China

Designing a model for computing better matching cost is a fundamental problem in stereo method. In this paper, we propose a novel convolutional neural network (CNN) architecture, which is called MC-DCNN, for computing matching cost of two image patches. By adding dilated convolution, our model gains a larger receptive field without adding parameters and losing resolution. We also concatenate the features of last three convolutional layers as a better descriptor that contains information of different image levels. The experimental results on Middlebury datasets validate that the proposed method outperforms the baseline CNN network on stereo matching problem, and especially performs well on weakly-textured areas, which is a shortcoming of traditional methods.

P306 *Improving Deep Crowd Density Estimation via Pre-Classification of Density [#17567]*

Shunzhou Wang, Huailin Zhao, Weiren Wang, Huijun Di and Xueming Shu, Shanghai Institute of Technology, China; Tsinghua University, China; Beijing Institute of Technology, China

Previous works about deep crowd density estimation usually chose one unified neural network to learn different densities. However, it is hard to train a compact neural network when the crowd density distribution is not uniform in the image. In order to get a compact network, a new method of pre-classification of density to improve the compactness of counting network is proposed in this paper. The method includes two networks: classification neural network and counting neural network. The classification neural network is used to classify crowd density into different classes and each class is fed to its corresponding counting neural networks for training and estimating. To evaluate our method effectively, the experiments are conducted on UCF_CC_50 dataset and Shanghaitech dataset. Comparing with other works, our method achieves a good performance.

P307 *Level Set Based Online Visual Tracking via Convolutional Neural Network [#17639]*

Xiaodong Ning and Lixiong Liu, Beijing Institute of Technology, China

Current researches in visual tracking usually uses hand-crafted features to locate the object, or discard some low-level features while using learning models. As a result, they suffer the disadvantages of inaccurate details of the object. Moreover, conventional segmentation methods fail to obtain the object contour effectively in a video. In this paper, we propose a novel level set tracking algorithm, which integrates the information of the original frame and the confidence predicted by the deep feature based detector. First, we extract features from convolutional neural network in the detector and select part of them to avoid redundancy. The features are used to generate a confidence map of the tracked object. The confidence and original image frame are applied in level set model to acquire the segmentation result. And then we introduce an outlier rejection scheme to further improve the result. Finally, updating is employed to the AdaBoost

model to adapt to the changes in the video. One important contribution of our work is to use the deep features in confidence prediction, particularly the usage of low-level features in the neural network. Experimental results show that our model delivers a better performance than the state-of-the-art on a series of challenging videos.

P308 *Deep Salient Object Detection via Hierarchical Network Learning [#17332]*

Dandan Zhu, Ye Luo, Lei Dai, Xuan Shao, Laurent Itti and Jianwei Lu, Tongji University, China; Jiangsu University, China; University of Southern California, United States

Salient object detection is a fundamental problem in both pattern recognition and image processing tasks. Previous salient object detection algorithms usually involve various features based on priors/assumptions about the properties of the objects. Inspired by the effectiveness of recently developed feature learning, we propose a novel deep salient object detection (DSOD) model using the deep residual network (ResNet 152-layers) for saliency computation. In particular, we model the image saliency from both local and global perspectives. In the local feature estimation stage, we detect local saliency by using a deep residual network (ResNet-L) which learns local region features to determine the saliency value of each pixel. In the global feature extraction stage, another deep residual network (ResNet-G) is trained to predict the saliency score of each image based on the global features. The final saliency map is generated by a conditional random field (CRF) to combining the local and global-level saliency map. Our DSOD model is capable of uniformly highlighting the objects-of-interest from complex background while well preserving object details. Quantitative and qualitative experiments on three benchmark datasets demonstrate that our DSOD method outperforms state-of-the-art methods in the salient object detection.

P309 *A Spatio-Temporal Convolutional Neural Network for Skeletal Action Recognition [#17278]*

Lizhang Hu and Jinhua Xu, East China Normal University, China

Human action recognition based on 3D skeleton data is a rapidly growing research area in computer vision. Convolutional Neural Networks (CNNs) have been proved to be the most effective representation learning in many vision tasks, but there is little work of CNNs for skeletal action recognition due to the variable-length of time sequences and lack of big skeleton datasets. In this paper, we propose a Spatio-Temporal CNN for skeleton based action recognition. A CNN architecture with two convolutional layers is used, in which the first layer is used to capture the spatial patterns and second layer for spatio-temporal patterns. Some techniques including data augmentation and segment pooling strategy are employed for long sequences. Experimental results on MSR Action3D, MSR DailyActivity3D and UT-Kinect show that our approach achieves comparable results with those of the state-of-the-art models.

P310 *Autonomous Perceptual Projection Correction Technique of Deep Heterogeneous Surface [#17307]*

Fan Yang, Baoxing Bai, Cheng Han, Chao Zhang and Yuying Du, Changchun University of Science and Technology, China

This paper proposes a projection correction method which to improve the adaptive percep-tion projection of the projection equipment in different environments. Firstly, in the process of photon signal transmission, projector- camera can cause the loss of photon signal due to the coupling of system channel. Therefore, this paper proposes a system coupling correction scheme, which effectively reduces the system coupling crosstalk. Secondly, in order to establish the feature mapping relationship between the projection image and the deep heter-ogeneous surface quickly, a projection feature image of color structured light mesh fringe is designed. Finally, due to the feature point of the heterogeneous surface is quite different in topological structure, it will lead to the problem of inconsistent geometric mapping relation. For this reason, a projective geometric correction algorithm for topological analysis is pro-posed, analyzing the spatial topological distribution of the depth heterogeneous surface and solving the homography matrix of each region in the heterogeneous surface, then the geo-metric correction of the projected distortion image is solved by using the homography ma-trix set. From the experimental analysis we can see that, in the deep heterogeneous surface environment, the average error, the maximum error and the root-mean-square error of the correction image respectively are 0.424pixels, 0.862 pixels and 0.216 pixels. At the same time, the parallelism of the distortion correction image is kept 90 degrees substantially. It can be seen that the geometric distortion correction accuracy of this method has reached the sub-pixel level and the imaging screen consistency level.

P311 *Multi-Camera Tracking Exploiting Person Re-ID Technique [#17126]*

Yiming Liang and Yue Zhou, Shanghai Jiao Tong University, China

Multi-target multi-camera tracking is an important issue in image processing. It is meaningful to improve matching performance across cameras with high computational efficiency. In this paper, we apply high performance feature representation LOMO and metric learning XQDA in person re-identification across cameras to improve tracking performance. We also exploit direction information of trajectories to handle viewpoint variation. Experiments on DukeMTMCT dataset show that the proposed method improves tracking performance and is also competitive in running time.

P312 *Active Contours Driven by Saliency Detection for Image Segmentation [#17315]*

Guoqi Liu and Chenjing Li, Henan Normal University, China

Aming at the over-segmentation problem of the active contour models, a new model based on the LBF(Local Binary Fitting) model driven by saliency detection is proposed.The proposed method consists of two main innovations: 1)The target object is located quickly and the initial contour is generated automatically by saliency detection method,which solves the problem that the LBF model is sensitive to the initial position,and the different targets can be segmented by selecting different initial contours. 2) The saliency detection results are transformed into priori energy functions, which are added to the energy model to prevent over-segmentation during the iterative process.We applied the proposed method to some gray images and real images, the simulation results show better segmentation accuracy.

P313 *Robust Visual Tracking by Hierarchical Convolutional Features and Historical Context [#17348]*

Zexi Hu, Xuhong Tian and Yuefang Gao, South China Agricultural University, China

In this paper, we present a visual tracking method to address the problem of model drift, which usually occurs because of drastic change on tar-get appearance, such as motion blur, illumination, out-of-view and rotation. It has been proved that the hierarchical convolutional features of deep neural net-works learned by huge classification datasets are generic for other task and can aid the tracker's power of discrimination. Ensemble based tracker has been studied also to offer historical context for drift correction. We combine these two advantages into our proposed tracker, in which correlation filters are learned by hierarchical convolutional features and preserved as snapshots in an ensemble in certain occasion. Such an ensemble is capable to encode the target appearance as well as provide historical context to prevent drift. Such context is considered to be complementary to correlation filters and convolutional fea-tures. The experimental results demonstrate the competitive performance against state-of-the-art trackers.

P314 *The Camouflage Color Target Detection with Deep Networks [#17648]*

Ce Li, Xiyu Zhao and Yuqi Wan, Lanzhou University of Technology, China

The camouflage color target is similar to the background,so the detection is very difficult. How to identify the camouflage color target is still a challenging visual task. In order to solve the problem,we proposes a camouage color target detection algorithm based on image enhancement. Firstly, the image enhancement algorithm is used to realize the difference between the target and the background feature. Secondly, the region proposal network is used to realize the accurate positioning of the specific

target, and the extraction area ROI is identified by the classification layer in the depth neural network. The final realization of the detection with a camouflage color target. In this paper, the detection algorithm received a better detection results in the leaves of butterfly and chameleon data collection.

P315 *Automatic Leaf Recognition Based on Deep Convolutional Networks [#17323]*

Huisi Wu, Yongkui Xiang, Jingjing Liu and Zhenkun Wen, Shenzhen University, China

Leaf recognition remains a hot research topic receiving intensive attention in computer vision. In this paper, we propose deep convolu-tional networks with deep learning framework on the large scale of leaf data-bases. Different from the existing leaf recognition algorithms that mainly depend on traditional feature extractions and pattern matching operations, our method can achieve automatic leaf recognition based on deep convolutional networks without any explicit feature extraction or matching. Because it does not require any feature detection and selection, the advantages of our frame-work are obvious, especially for the large scale leaf databases. Specifically, we design deep convolutional networks structure and adopt fine-tuning strategy for our network initialization. In addition, we also develop a visualization-guided parameter tuning scheme to guarantee the accuracy of our deep learning frame-work. Our method is evaluated on several different databases with different scales. Comparison experiments are performed and demonstrate that the accu-racy of our method outperforms traditional methods.

P316 *Learning Discriminative Convolutional Features for Skeletal Action Recognition [#17208]*

Jinhua Xu, Yang Xiang and Lizhang Hu, East China Normal University, China

Human action recognition is an important yet challenging computer vision task. With the introduction of RGB-D sensors, human body joints can be extracted with high accuracy, and skeleton-based action recognition has been investigated and gained some success. Convolutional Neural Networks (ConvNets) have been proved to be the most effective representation learning method for visual recognition tasks, but have not been applied to skeletal action recognition due to the lack of a big dataset. In this paper, we propose a convolutional network for skeletal action recognition. Different from the supervised training of ConvNets ConvNets using backpropagation, we learn the convolutional features using projective dictionary pair learning. The advantages of our model include: First, the learned convolutional features are discriminative; Second, no big dataset is needed for training the ConvNets. Experimental results on three benchmark datasets demonstrate the effectiveness of our approach.

P317 *Algorithm of Multi-Camera Object Handoff Based on Object Mapping [#17612]*

Jianrong Cao and Xuemei Sun, Shandong Jianzhu University, China

Aiming at the problem of multi-camera tracking and object matching in overlapped regions,an algorithm of multi-camera moving object handover based on object mapping is proposed in this paper. At First, the video image of the ground in the corridor is mapped to a building floor plan chart, and then the center point of the bottom line of minimum external object rectangle is defined as the foothold of moving object. The position of foothold is used to represent the moving object in order to achieve the mapping of moving object in the building floor plan. When the moving object is tracked and matched in the overlapping field of multi-camera, it is judged whether it is the same moving object according to the mapping position in the building floor plan, the moving direction and the color histogram of moving object. So an accurate tracking object handover matching can be obtained. The continuous tracking of the same moving object can be achieved between different cameras. The experimental results show that the proposed algorithm can accurately obtain the real time position of moving object and realize the continuous tracking of the same moving object by the multi-camera.

P318 *Illumination Quality Assessment for Face Images: A Benchmark and A Convolutional Neural Networks Based Model [#17063]*

Lijun Zhang, Lin Zhang and Lida Li, Tongji University, China; The Hong Kong Polytechnic University, Hong Kong

Many institutions, such as banks, usually require their customers to provide face images under proper illumination conditions. For some remote systems, a method that can automatically and objectively evaluate the "illumination quality" of a face image in a human-like manner is highly desired. However, few studies have been conducted in this area. To fill this research gap to some extent, we make two contributions in this paper. Firstly, in order to facilitate the study of illumination quality prediction for face images, a large-scale database, namely, Face Image Illumination Quality Database (FIIQD), is established. FIIQD contains 224,733 face images with various illumination patterns and for each image there is an associated illumination quality score. Secondly, based on deep convolutional neural networks (DCNN), a novel highly accurate model for predicting the illumination quality of face images is proposed. To make our results reproducible, the database and the source codes have been made publicly available at https://github.com/zhanglijun95/FIIQA.

P319 *An Approach to Pulse Coupled Neural Network Based Vein Recognition [#17219]*

Ting Yu and Xiaodong Gu, Fudan University, China

Hand vein recognition has received increasing attention in biometric identification for the uniqueness, stability, and easiness of collection of the vein image. Local Binary Pattern (LBP) has been a widely used texture descriptor, being well developed invein recognition. However, the use of histogram in LBP as the feature of the vein image leads to the loss of global spatial information. That loss results in final accuracy reduction for absence of geometry structure, being essential to vein representation .In this paper we use Pulse Coupled Neural Network (PCNN) to process original LBP feature map as a solution to spatial information loss, because in PCNN pulse emitting and spreading reflects the intensity distribution pattern related to the vein geometry. The image time signature (image icon) produced by pulse emitting and spreading in PCNN is used as the vein feature. Using PCNN to extract time signature, we adopt a multi-valued linking channel in each neuron of the network to control the neighboring influence more precisely, and we introduce an adaptive linking strength to address the less information on vein pattern of the dark region in the vein image. As for the vein binary representation, Unit-linking PCNN is employed. It uses pulse spreading to perform eroding operation on the K-clustering binarization result of the vein image. After computing the time signature and the binary representation, Support Vector Machine (SVM) fusion strategy is used to fuse them. The EER (Equal Error Rate) of our approach is 0.03% on the CASIA Multi-spectral Palmprint Image Database, which is better than four other ap-proaches, including the multi-sampling method, mutual foreground LBP (MF_LBP) method, and so on.

P320 *A Regularized Margin Fisher Analysis Method for Face Recognition [#17260]*

Xiaoyu Xue, Xiaohu Ma, Yuxin Gu, Xiao Sun and Zhiwen Ni, Soochow University, China

Margin Fisher Analysis is a typical graph-based dimensionality reduction technique and has been successfully applied to face recognition. However, it always suffers from the over-fitting, noise, and singular matrix problems. Common preprocessing methods such as PCA lose certain discriminant information in data, which leads the poor classification rate. We propose a novel method called Regularized Margin Fisher Analysis, which decomposes the inter-class similarity matrix into three subspace: principal space, noise space and null space. Then, we regularize the three subspaces in different ways to deal with the noise and over-fitting problems. Moreover, we use twice standard eigendecompositions instead of single generalized eigendecomposition which avoids the singular matrix problem. The experiments on Extended YaleB, CMU PIE and FERET face databases demonstrates that the proposed method is effective and can improve the classification ability.

P321 *A Deep Orthogonal Non-negative Matrix Factorization Method for Learning Attribute Representations [#17498]*

Bensheng Lyu, Kan Xie and Weijun Sun, Guangdong University of Technology, China

Orthogonal non-negative matrix factorization (ONMF) is a powerful unsupervised learning method because it is equivalent to the K-means method and can be more robust and flexible for clustering analysis. Arguing that ONMF with a single layer implementation often fails to capture the potential hierarchical features of complex objects, a deep orthogonal NMF (deep ONMF) model with cascaded multiple ONMF layers was proposed in this paper. We demonstrated how deep ONMF is able to reveal the hierarchy information of data and hence lead to improved clustering performance by both theoretical analysis and experiments on real-world data.

P322 *Subspace Clustering via Adaptive Low-rank Model [#17657]*

Mingbo Zhao, Donghua University, China

Subspace Clustering has been a major issue in many real-world task and sparse and low-rank representation based methods have received considerable attention during the past decades. However, both above methods need huge computation in order to solve sparse or trace-norm minimization problem, which may not be scalable to large-scale data. In this paper, we develop an efficient and effective sparse and low-rank model for subspace clustering. Starting from the basic idea of Robust Principal Component Analysis (RPCA), we observe that the optimal solution of RPCA can be equivalently solved by an iterative procedure, where the low-rank matrix is reformulated by two factorizations. We thereby further impose the group sparse constraint on such factorizations and additionally non-negative constraint on all variable matrix. As a result, the coefficient matrix S can both achieve sparcity and capture the global structure of whole data, which can be utilized to construct the graph for subspace clustering. Extensive simulations have verified the effectiveness of the proposed methods.

P323 *Affine-Constrained Group Sparse Coding Based on Mixed Norm [#17666]*

Jianshu Zhang, Zhongyu Chen, Changbin Tang, Feilong Lin, Jie Yang and Zhonglong Zheng, Zhejiang Normal University, China; Shanghai Jiaotong University, China

Recently, sparse coding has received an increasing amount of interests. In this paper, a new algorithm named affine-constrained group sparse coding based on mixed norm (MNACGSC) is presented, which further extends the framework of sparse representation-based classification (SRC). From the perspective of geometry, affine-constrained group sparse coding based on mixed norm (MNACGSC) not only finds out the vector that can be best encoded according to the given dictionary in the convex hull spanned by input samples, but also establishes on multiple regularization terms which can leverage the collaborative effects of those regularization terms to strength the robustness. This paper mainly discusses $ L_1 $-norm and $ L_2 $-norm. The experimental results have demonstrated that the proposed model is effective, robust to noise and outperforms some representative methods.

P324 *Elastic Net Based Weighted Iterative Method for Image Classification [#17785]*

Bingrong Xu and Qingshan Liu, Huazhong University of Science and Technology, China

This paper presents a weighted elastic net constrained sparse coding method for solving the sparse representation (SR) based image classification problem. First, the original model is transformed into the unconstrained basis pursuit denoising (BPDN) problem under the assumption that the residual error of the SR follows Gaussian distribution. The probability density function (PDF) of the residual error is approximated by the first order Taylor expansion and a weighted diagonal matrix is calculated according to the Taylor expansion formulation, which aims to eliminate the sparse representation error. Second, the weighted BPDN problem is solved by dual augmented Lagrangian method (DALM). The consistency and convergence of the proposed method are analysed. Finally, experiments conducted on three well-known face data sets present the effectiveness of the proposed method compared with some other algorithms for face recognition, especially with noisy and disguise situations.

P325 *ELM-Based Signal Detection Scheme of MIMO System Using Auto Encoder [#17441]*

Fei Long and Xin Yan, Guizhou Institute of Technology, China; Guizhou University, China

Signal detection scheme is the key technology to the implementation of multiple- input multiple-output (MIMO) wireless communication system, while the spatial- multiplexing coded MIMO systems cause a severe design challenge for signal detection algorithms. Existing researches are focusing on searching the solution space for optimal solution with more efficient searching algorithm but did not regard the signal detection of MIMO system as a classification problem. In this paper, the detection problem is considered as a feature classification issue, and a novel signal detection scheme of MIMO system based on extreme learning machine auto encoder (ELM-AE) is proposed. The proposed algorithm can efficiently extract the features of input data through ELM-AE and classify these representations to corresponding groups rapidly via extreme learning machine (ELM). This paper has constructed a theoretical model of the proposed signal detector for MIMO system and carried out simulations to evaluating its performance. Simulation results indicate that the proposed detector outperforms many traditional schemes and state-of-the-art algorithms.

P326 *Low-frequency Representation for Face Recognition [#17529]*

Bangjun Wang, Li Zhang and Fanzhang Li, Soochow University, China

This paper proposes a low-frequency representation (LFR) method for face images based on support value transform. LFR works directly on 2D image matrices rather than 1D vectors, thus the image matrix does not need to be transformed into a vector prior to feature extraction. In LFR, the simple and slowly variational features for face images are remained. To demonstrate the effectiveness of LFR, a series of experiments are performed on two face image databases: ORL and UMIST face databases. Experimental results indicate that LFR provides a better representation for face images with multi-view and slightly various illumination.

P327 *Multi-Features Fusion Based Face Recognition [#17073]*

Xianzhong Long and Songcan Chen, Nanjing University of Aeronautics and Astronautics, China

In order to accelerate data processing and improve classification accuracy, some classic dimension reduction techniques have been proposed in the past few decades, such as Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Non-negative Matrix Factorization (NMF), etc. However, these methods only use single feature and do not consider multi-features. In this paper, for the sake of exploiting the complementarity between multiple features, we put forward an efficient data dimensionality reduction scheme based on multi-features fusion. Specifically, gray value and local binary pattern features of all images are first extracted, and then some representative dimension reduction methods are applied. A series of experimental results are carried out over two benchmark face data sets to demonstrate the effectiveness of our proposed scheme.

P328 *Visual Saliency Based Blind Image Quality Assessment via Convolutional Neural Network [#17138]*

Jie Li and Yue Zhou, Shanghai Jiao Tong University, China

Image quality assessment (IQA), as one of the fundamental techniques in image processing, is widely used in many computer vision and image processing applications. In this paper, we propose a novel visual saliency based blind IQA model, which combines the property of human visual system (HVS) with features extracted by deep convolutional neural network (CNN). The proposed model is totally data-driven thus using no hand-crafted features. Instead of feeding the model with patches selected randomly from images, we introduce a salient object detection algorithm to calculate regions of interest which are acted as training data. Experimental

results on the LIVE and CSIQ database demonstrate that our approach outperforms the state-of-art methods compared.

P329 *Supervised Deep Canonical Correlation Analysis for Multiview Feature Learning [#17586]*

Yan Liu, Yun Li, Yunhao Yuan, Jipeng Qiang, Min Ruan and Zhao Zhang, Yangzhou University, China

Recently, a new feature representation method called deep canonical correlation analysis (DCCA) has been proposed with high learning performance for multiview feature extraction of high dimensional data. DCCA is an effective approach to learn the nonlinear mappings of two sets of random variables that make the resulting DNN representations highly correlated. However, the DCCA learning process is unsupervised and thus lacks the class label information of training samples on the two views. In order to take full advantage of the class information of training samples, we propose a discriminative version of DCCA referred to as supervised DCCA (SDCCA) for feature learning, which explicitly considers the class information of samples. Compared with DCCA, the SDCCA method can not only guarantee the nonlinear maximal correlation between two views, but also minimize within-class scatter of the samples. With supervision, SDCCA can extract more discriminative features for pattern classification tasks. We test SDCCA on the Handwriting recognition and XRMB speech recognition using two popular MNIST and XRMB datasets. Experimental results show that SDCCA gets higher performance than several related algorithms.

P330 *Highly Occluded Face Detection: An improved R-FCN Approach [#17846]*

Lin Liu, Fei Jiang and Ruimin Shen, Shanghai Jiao University, China

For highly occluded faces, only few features exist, which makes such face detection more challenging. In this paper, we propose a novel algorithm to make full use of the facial features. The proposed algorithm is based on Region-based Fully Convolutional Network (R-FCN) with two improved parts for robust face detection, including multi- scale training and a new feature-fusion scheme. Firstly, instead of utilizing fixed scales for all faces, we adopt multi-scale inputs to strengthen the features of the partial faces and increase the training set diversity. Up-sampling the training images can efficiently enlarge the features of the occluded faces. Secondly, we make a feature fusion by combining layers with different sizes of receptive fields, which can preserve the details of the faces with only partial faces available. Our method achieves superior accuracy over the stat-of-the-art techniques on massively- benchmarked face dataset (WIDER FACE), and shows great improvements for highly occluded face detection.

P331 *Partial Fingerprint Matching via Phase-only Correlation and Deep Convolutional Neural Network [#17161]*

Jin Qin, Siqi Tang, Congying Han and Tiande Guo, University of Chinese Academy of Sciences, China

A major approach for fingerprint matching today is based on minutiae. However, due to the lack of minutiae, their accuracy de- grades significantly for partial-to-partial matching. We propose a novel matching algorithm that makes full use of the distinguishing information in partial fingerprint images. Our model employs the Phase-Only Corre- lation (POC) function to coarsely assign two fingerprints. Then we use a deep convolutional neural network (CNN) with spatial pyramid pooling to measure the similarity of the overlap areas. Experiments indicate that our algorithm has an excellent performance.

P332 *RGB-D object recognition using the knowledge transferred from relevant RGB images [#17179]*

Depeng Gao, Rui Wu, Jiafeng Liu, Qingcheng Huang, Xianglong Tang and Peng Liu, Harbin Institute of Technology, China

The availability of depth images provides a new possibility to solve the challenging object recognition problem. However, when there is not enough labeled data, we cannot learn a discriminative classifier even using depth information. To solve this problem, we extend LCCRRD method by kernel trick. First, we construct two RGB classifiers with all labeled RGB images from source and target domain. The significant samples for both classifier are boosted and the non-significant ones are inhibited by exploiting the relationship between two domains. In this process, the knowledge of source RGB classifier can be transferred to target RGB classifier effectively. Then to improve the performance of RGB-D classifier by applying the knowledge from source domain, the predicted results of RGB-D classifier are made consistent to target RGB classifier. Furthermore all the parameters are optimized in a unified objective function. Experiments on four cross-domain dataset pairs shows that our approach is indeed effective and promising.

P333 *Image Inpainting by Recursive Estimation using Neural Network and Wavelet Transformation [#17384]*

Hiromu Fujishige, Junichi Miyao and Takio Kurita, Hiroshima University, Japan

This paper proposes image inpainting algorithms in which the pixel values of the regions to be inpainting are recursively estimated by using multi-layered Perceptron from the original input image and its wavelet transformation. Instead of forward estimation by using the deep neural network such as convolutional neural network (CNN), we use shallow neural network and the pixel values are recursively estimated. To improve the estimation quality, wavelet transformation is also used as the input of the neural network. The effectiveness of the proposed approach was experimentally confirmed by using the face databases.

P334 *A Genetic Programming Based ECOC Algorithm for Microarray Data Classification [#17104]*

HanRui Wang, KeSen Li and KunHong Liu, Xiamen University, China

Microarray technology aims to discover the relationship between genes and cancers. But the analysis of multiclass microarray datasets is a difficult problem in considering the small sample size along with the class imbalance problem. In this paper, we propose a Genetic Programing (GP) based Error Correcting Output Codes (ECOC) algorithm to tackle this problem. In our GP framework, each individual represents a codematrix, and a legality checking mechanism is applied to avoid the production of illegal codematrices. So the algorithm evolves towards optimum ECOC codematrices. In experiments, our algorithm is compared with other methods based on four famous microarray datasets. Experimental results prove that our algorithm can achieve better results in most cases.

P335 *Word-Level Permutation and Improved Lower Frame Rate for RNN-Based Acoustic Modeling [#17296]*

Yuanyuan Zhao, Shiyu Zhou, Shuang Xu and Bo Xu, Institute of Automation, Chinese Academy of Sciences, China

Recently, the RNN-based acoustic model has shown promising performance. However, its generalization ability to multiple scenarios is not powerful enough for two reasons. Firstly, it encodes inter-word dependency, which conflicts with the nature that an acoustic model should model the pronunciation of words only. Secondly, the RNN-based acoustic model depicting the inner-word acoustic trajectory frame-by-frame is too precise to tolerate small distortions. In this work, we propose two variants to address aforementioned two problems. One is the word-level permutation, i.e. the order of input features and corresponding labels is shuffled with a proper probability according to word boundaries. It aims to eliminate inter-word dependencies. The other one is the improved LFR (iLFR) model, which equidistantly splits the original sentence into N utterances to overcome the discarding data in LFR model. Results based on LSTM RNN demonstrate 7% relative performance improvement by jointing the word-level permutation and iLFR.

P336 *Phonemic Restoration Based on the Movement Continuity of Articulation [#17382]*

Cenxi Zhao, Longbiao Wang and Jianwu Dang, Tianjin University, China

Phonemic restoration describes one of human capabilities that can retrieve the defect speech signal after adding a certain noise. It is believed that the movement continuity in articulation is one of main factors for realizing the phonemic restoration. This paper proposes an effective

method based on this consideration to retrieve missing speech signal and makes the relevant hypothesis verified to some degree. For the proposed method, the mapping relationship between acoustic and articulatory features is established based on deep neural network (DNN), where a hierarchical DNN architecture with bottleneck feature is realized to improve the performance for acoustic-to- articulatory inversion, then missing articulatory feature obtained from missing speech signal is restored with cubic spline function. 25 sentences are selected from the database MNGU0 and short durations of the sentences are replaced by zeros and/or noise for evaluating. Experimental results show that the proposed method can effectively improve perceptual evaluation of speech quality (PESQ) of the speech with missing signal. And these experiment results provide preliminary experimental clues for verifying the first hypothesis of phonemic restoration--coarticulation, which mean that when the human being producing speech signal, the articulation organs such as lips, a tongue, and a jaw, cannot move freely and abruptly, instead, these organs move smoothly in a highly cooperative manner, resulting in the articulation of adjacent phonetic segments interacting with each other.

P337 *Underdetermined Mixture Matrix Estimation Based on Neural Network and Genetic Algorithm [#17560]*

Shuang Wei, Jian Peng, Feng Wang, Chungui Tao and Defu Jiang, Shanghai Normal University, China; Hohai University, China

This paper proposes an improved approach to estimate the underdetermined mixture matrix to improve the performance of underdetermined blind source separation (UBSS) for speech sources. This approach only use two observed signals and consider a tangent value instead of each vector of the mixture matrix for estimation. An improved clustering method based on competitive neural network and genetic algorithm is then designed to estimate these tangent values. In the proposed method, those tangent values are designed as clustering centers. The competitive neural network is used first to obtain the initial clustering centers, and genetic algorithm is applied to search for the global optimum around the initial clustering centers. Experimental results show that the tangent values of the observed vectors have better clustering characteristics, which could reduce the computational complexity for mixture matrix estimation. The improved clustering algorithm based on neural network and genetic algorithm can estimate a better mixture matrix with high precision than the general neural network clustering algorithm, and it can improve the performance of underdetermined blind signal separation.

P338 *An Altered Kernel Transformation for Time Series Classification [#17137]*

Yangtao Xue, Li Zhang, ZhiWei Tao, Bangjun Wang and Fanzhang Li, Soochow University, China

Motivated by the great efficiency of dynamic time warping (DTW) for time series similarity measure, a Gaussian DTW (GDTW) kernel has been developed for time series classification. This paper proposes an altered Gaussian DTW (AGDTW) kernel function, which takes into consideration each of warping path between time series. Time series can be mapped into a special kernel space where the homogeneous data gather together and the heterogeneous data separate from each other. Classification results on transformed time series combined with dif- ferent classifiers demonstrate that the AGDTW kernel is more powerful to repre- sent and classify time series than the Gaussian radius basis function (RBF) and GDTW kernels.

P339 *An Interweaved Time Series Locally Connected Recurrent Neural Network Model on Crime Forecasting [#17238]*

Ke Wang, Peidong Zhu, Haoyang Zhu, Pengshuai Cui and Zhenyu Zhang, National University of Defense Technology, China

Forecasting events like crimes and terrorist activities is a vital important and challenging problem. Researches in recent years focused on qualitative forecasting of a single type event, such as protests or gun crimes. However, events like crimes usually have complicated correlations with each other, and a single type event forecasting cannot meet actual demands. In reality, a quantitative forecasting is more practical for policy making, decision making and police resources allocating. In this paper, we propose an interweaved time series and an interpretative locally connected Recurrent Neural Network(RNN) model, which forecasts not only whether an event would happen but also how many it would be by each type. The interweaved time series in our paper is used to preprocess the data and for explanation, in which series with different time intervals need not to be resampled. From the perspective of nonlinear fitting and time series forecasting, RNN is an effective architecture. And the interpretative locally connected RNN models is based on LSTM and GRU cells, which are popular RNN structures in recent years. Using open source data from Crimes in Chicago provided by Chicago Police Department, we demonstrate our approach more accurately in forecasting the crime events than the existing methods.

P340 *Tree Factored Conditional Restricted Boltzmann Machines for Mixed Motion Style [#17218]*

Chunzhi Xie, Jiancheng Lv, Bijue Jia and Lei Xia, Sichuan University, China

A factored conditional restricted Boltzmann machine (FCRBM) is an efficient, compact model for multi-class temporal data (e.g. multi-label human motion data). However, since all factors in FCRBM are linked to the labels directly, data generated by the model is heavily dependent on the learned tags. In this paper, we propose a tree-based FCRBM model in which the factors are tree-like connected and only part of the factors are directly connected to the labels. The proposed model can make the newly generated data have a variety of sports styles and achieve a smooth transition between the styles using little or even no labeled data.

P341 *A Piecewise Hybrid of ARIMA and SVMs for Short-Term Traffic Flow Prediction [#17200]*

Yong Wang, Li Li and Xiaofei Xu, South-west University, China

Short-term traffic flow is a variable affected by many factors. Thus, it is quite difficult to forecast accurately with only one model. The ARIMA model and the SVMs model have their own advantages in terms of linearity and nonlinearity. Therefore, making full use of the advantages of ARIMA model and SVMs model to predict traffic flow can significantly improve the overall effect. The current hybrid approach does not take full account of the characteristics of the data, which cause the effect of hybrid model is not always good. In this paper, First of all, we will use time series analysis and feature analysis to find the characteristics of data. Then, based on the analysis results, we decided to use the method of piecewise to fit the data and make the final prediction. The experiment shows that the piecewise hybrid model can give better play to the advantages of the two models.

P342 *Causality Analysis between Soil of Different Depth Moisture and Precipitation in the United States [#17623]*

Hui Su, Sanqing Hu, Tong Cao, Jianhai Zhang, Yuying Zhu, Bocheng Wang and Lan Jiang, Hangzhou Dianzi University, China; Zhejiang University of Media and Communications, China; Zhejiang Environmental Monitoring Center, China

Previously the stronger coupling between soil moisture and precipitation in the land-atmosphere interaction have widely been studied. However, few work discusses the causality between them. In this paper, we use Granger causality (GC) and New causality (NC) to detect the causality between soil of different depth moisture and precipitation. Our results demonstrate that the causality between shallow soil moisture and precipitation is greater than that between deep soil moisture and precipitation. And the results also demonstrate that the NC method is much clearer to reveal the causal influence between soil moisture and precipitation than GC method in the time domain.

P343 *Dow Jones Index is Driven periodically by the Unemployment Rate during Economic Crisis and Non-economic Crisis Periods [#17621]*

Tong Cao, Sanqing Hu, Yuying Zhu, Jianhai Zhang, Hui Su and Bocheng Wang, Hangzhou Dianzi University, China; Zhejiang University of Media and Communications, China

Previous researchers have made some causality hypotheses: the change of stock index causing volatility of economic data or short-run impact of anticipated unemployment rate on stock price. However, they have not reached a consensus. In this article we apply New Causality (NC) method to investigate the causality between Dow Jones Index and the unemployment rate. The results demonstrate stock market is periodically driven by the unemployment rate during all periods, and the causal direction during one ECP and on-going NECP together is uncertain because there may exist two different causal mechanisms in two periods. In this point of view, we conclude that anticipated unemployment rate change results in Dow Jones Index fluctuation in each period. Our conclusion is consistent with the phenomenon that Dow Jones Index was pushed to historical high level after Donald Trump came into power.

P344 *Finite Horizon Optimal Tracking Control for Nonlinear Discrete-time Switched Systems [#17845]*

Chunbin Qin, Xianxing Liu, Guoquan Liu, Jun Wang and Dehua Zhang, Henan University, China; East China University of Technology, China

In this paper, a finite-horizon optimal tracking control scheme is proposed for a class of nonlinear discrete-time switched systems. First, via system transformation, the optimal tracking problem is converted into designing an optimal regulator for the tracking error dynamics. Then, with convergence analysis in terms of value function and control policy, the iterative adaptive dynamic programming algorithm is introduced to obtain the finite-horizon optimal tracking controller which makes the value function close to its optimal value function. Finally, the effectiveness of the proposed control method is demonstrated using a simulation example.

P345 *A Hierarchical Mixture Density Network [#17759]*

Fan Yang, Jaymar Soriano, Takatomi Kubo and Kazushi Ikeda, Nara Institute of Science and Technology, Japan

The relationship among three correlated variables could be very sophisticated, as a result, we may not be able to find their hidden causality and model their relationship explicitly. However, we still can make our best guess for possible mappings among these variables, based on the observed relationship. One of the complicated relationships among three correlated variables could be a two-layer hierarchical many-to-many mapping. In this paper, we proposed a Hierarchical Mixture Density Network (HMDN) to model the two-layer hierarchical many-to-many mapping. We apply HMDN on an indoor positioning problem and show its benefit.

P346 *A New Bayesian Method For Jointly Sparse Signal Recovery [#17454]*

Haiyan Yang, Xiaolin Huang, Cheng Peng, Jie Yang and Li Li, Shanghai Jiao Tong University, China; Tsinghua University, China

In this paper, we address the recovery of a set of jointly sparse vectors from incomplete measurements. We provide a Bayesian inference scheme for the multiple measurement vector model and develop a novel method to carry out maximum a posteriori estimation for the Bayesian inference based on the prior information on the sparsity structure. Instead of implementing Bayesian variables estimation, we establish the corresponding minimization algorithms for all of the sparse vectors by applying block coordinate descent techniques, and then solve them iteratively and sequently through a re-weighted method. Numerical experiments demonstrate the enhancement of joint sparsity via the new method and its robust recovery performance in the case of a low sampling ratio.

P347 *Neural Representation of Object's Shape at the electroreceptor afferents on Electrolocation [#17585]*

Kazuhisa Fujita and Yoshiki Kashimori, University of Electro-Communications, Japan

A weakly electric fish can recognize object's shape in the complete darkness. The ability to recognize object's shape is provided by the electrosensory system of the fish. The fish generates an electric field using its electric organs (EOD: electric organ discharge). An object around the fish modulates the self-generated EOD. Electroreceptor afferents on the fish's body surface convert the EOD amplitude modulation into firings. The fish can extract information about object's shape from the EOD amplitude modulation using its electrosensory system. In the present study, we calculated the EOD amplitude modulation evoked by objects that were various shapes and firing patterns of the electroreceptor afferents evoked by the EOD amplitude modulation using computer simulation. We found that the EOD amplitude modulation can be represented by firing patterns of the electroreceptor afferents. Furthermore, we demonstrated that the feature of object's shape appears in the variation of the peak of firing rate with the rotation of the object.

P348 *Electromyogram Activation Reflects Property of Isochrony Phenomenon during Cyclic Human Arm Movement [#17376]*

Hiroshi Yokoyama, Rie Kurai, Isao Nambu and Yasuhiro Wada, Nagaoka University of Technology, Japan

The isochrony principle is a well-known phenomenon, whereby the speed of human arm movement is regulated to increase as its planned trajectory distance increases. The isochrony principle is observed in many studies, but its relationship with the motor planning process has never been explained. To address this issue, we attempt to explain the relationship between the isochrony principle and trajectory planning based on observable physiological information. Assuming that electromyography (EMG) reflects the temporal aspect of motor commanded signals, we directly evaluated the EMG changes during cyclic arm movement to consider the physiological mechanism underlying the isochrony phenomenon. Our presented results suggested the tendency that duration-average of the EMG change is equal, regardless of the differences in the movement distance. Its tendency suggest experimental evidence that human arm trajectory is planned to ensure constant EMG changes, rather than for equalization of movement duration.

P349 *Next Generation Hybrid Intelligent Medical Diagnosis Systems [#17222]*

Sabri Arik and Laszlo-Barna Iantovics, Istanbul University, Turkey; Petru Maior University, Romania

Many medical diagnosis problems (MDPs) are difficult to be solved by physicians. Frequently, the difficult MDPs solving by physicians require the assistance of the medical computing systems, which many times should be intelligent. Many papers presented in the specialized literature prove, that the intelligence of a system (frequently agent-based) can offer advantages in the MDPs solving versus a system that does not have such intelligence. Cooperative hybrid (human-machine) medical diagnosis systems seem to be well suited for the solving of many difficult MDPs. A difficult aspect in the design of such systems consists in the establishment of how to combine in an optimal way the humans and intelligent systems interoperation in order to solve the undertaken problems in the most efficient way. With this purpose, a novel hybrid medical system, called Intelligent Medical Hybrid System (IntHybMediSys) is proposed in this paper, a system which combines efficiently the humans and computing systems advantages in the problem-solving. We give a definition to the Difficult Medical Diagnosis Problem Solving Intelligence. IntHybMediSys is a highly complex hybrid system composed of physicians and intelligent agents that can interoperate intelligently in different points of decision in order to solve efficiently very difficult medical diagnosis problems. IntHybMediSys is able to handle emergent information that rise during the medical problems solving that allows the precise establishment of the most efficient contributor (a physician or an artificial agent) at each contribution during a problem-solving. This kind of problem-solving has as an effect the increase of accuracy of the elaborated diagnostic.

P350 *2-Tuple Prioritized Weighted Harmonic Operator and its Use in Group Decision Making [#17618]*

Jin Han Park, Seung Bin Lee, Ja Hong Koo and Young Chel Kwun, Pukyong National University, Korea (South); Dong-A University, Korea (South)

In this paper, we develop a 2-tuple prioritized weighted harmonic (2TPWH) operator and discuss its desirable properties such as idemtopency, boundedness and monotonicity. Then, we apply the 2TPWH operator to propose an approach to multiple attribute group decision making, with 2-tuple linguistic information, in which the decision makers and attributes are in different priority levels. Finally, an example is used to illustrate the applicability of the proposed approach.

P351 *Brain Effective Connectivity Analysis from EEG for Positive and Negative Emotion [#17536]*

Jianhai Zhang, Shaokai Zhao, Wenhao Huang and Sanqing Hu, Hangzhou Dianzi University, China

Recently, more and more evidence supports that multiple brain regions are involved in emotion processing. Therefore, research on emotion from the perspective of brain network is becoming popular. In this study, based on the Granger causal analysis method, we constructed brain effective connectivity network from DEAP emotional EEG data to investigate how emotion affects the patterns of effective connectivity. According to our results, prefrontal region plays the most important role in emotion processing with interactions to almost all other regions. More interactions are found under negative emotion. Parietal region is more active under negative emotions because it controls the human's alert mechanism. These results are consistent with the previous findings obtained in neuroscience, which illustrate the effectiveness of our methods. Because the brain effective connectivity network demonstrates significant differences under different emotional states, it also can be used to recognize different emotion states using EEG

P352 *Task-Free Brainprint Recognition Based on Degree of Brain Networks [#17710]*

Wanzeng Kong, Qiaonan Fan, Luyun Wang, Bei Jiang, Yong Peng and Yanbin Zhang, Hangzhou Dianzi University, China

Personal identification plays an important role in the information society. However, the traditional methods of identification cannot fully guarantee security. As a new type of biometrics, brainprint has remarkable advantages of non-stealing and unforgeability. It is a more secure biometrics for personal identification. In this paper, we propose a new method for brainprint recognition based on brain networks of electroencephalogram (EEG) signals. Firstly, we construct the brain functional networks upon the phase synchronization of EEG channels. Then, the degree of brain networks is computed to form a novel feature vector. Lastly, we utilize linear discriminant analysis (LDA) to classify extracted features. Experiments are conducted on four data sets. The average recognition accuracy of each data set is over 0.937 and the best one reaches 0.993.

P353 *An algorithm combining spatial filtering and temporal down-sampling with applications to ERP feature extraction [#17223]*

Feifei Qi, Yuanqing Li, Zhenfu Wen and Wei Wu, South China University of Technology, China

Event-related potentials (ERP) based brain-computer interfaces (BCI) is a promising technology for decoding mental states. Due to the high trail-to-trial variability and low signal-to-noise ratio caused by volume conduction, analyzing brain states corresponding to ERP on a single trial is a challenging task. In this paper, we propose a computationally efficient method for ERP feature extraction, termed spatial filtering and temporal down-sampling (SFTDS). The spatial filters and the temporal down-sampling weight vectors can be optimized under a single objective function by SFTDS. Experiments on real P300 data from 10 subjects show the superiority of SFTDS over other algorithms.

P354 *Recognition of Voluntary Blink and Bite Base on Single Forehead EMG [#17668]*

Jianhai Zhang, Wenhao Huang, Shaokai Zhao, Yanyang Li and Sanqing Hu, Hangzhou Dianzi University, China

With the development of intelligent wearable technology, the need for a more effective and practical means of human-computer interaction is becoming increasingly urgent. In this paper, we used only one forehead Electromyogram (EMG) channel to accurately recognize at least 6 different voluntary blink and bite patterns as output interactive commands. Differential square moving average (DSMA) and square moving average (SMA) were used to distinguish blink and bite, voluntary blink and natural blink, respectively. Then, random forests classifier was employed to classify the 6 blink and bite patterns with extracted time-domain features. The accuracy of 92.60 was obtained for the dataset of 10 subjects. It provides an effective human-computer interaction method with the advantages of rich commands, good real-time performance, low cost and small individual differences. The method proposed can be conveniently embedded in the wearable device as an alternative of interaction.

P355 *An improved visual-tactile P300 brain computer interface [#17168]*

Hongyan Sun, Jing Jin, Yu Zhang, Bei Wang and Xingyu Wang, East China University of Science and Technology, China

Recently, the bimodal BCI has attracted more and more attention. Previous studies have reported that the classification performance of bimodal system was better than that of unimodal system. Based on the fundamental visual-tactile P300 BCI, this paper made a change on the flash pattern of visual stimuli expecting to improve its performance by enhancing the link between visual and tactile modalities. Two patterns were tested in this paper, which respectively were picture-vibrate pattern (producing the visual effect of vibration) and color- change pattern (changing blue to green). The results showed that the picture- vibrate pattern achieved higher classification accuracy and information transfer rate than color-change pattern. The average online bit rate of picture-vibrate pattern including the breaking time between selections, reached 12.49 bits/min, while the color-change pattern's online bit rate reached 8.87 bits/min on average.

P356 *Identify Non-fatigue State to Fatigue State Using Causality Measure during Game Play [#17543]*

Yuying Zhu, Yining Wu, Hui Su, Sanqing Hu, Tong Cao, Jianhai Zhang and Yu Cao, Hangzhou Dianzi University, China; The University of Massachusetts Lowell, United States

In this paper, Granger causality (GC) and New causality (NC) analysis methods are applied in frequency domain to reveal causality changes from non-fatigue state to fatigue state with EEG signals during video game-playing. EEG signals were recorded while a subject was playing video-games. Results show that fatiguing phenomenon was observed in 15 subjects using NC in [20, 30]Hz while only 13 subjects were identified with GC for comparison. The NC further showed the bi-directional causality changes between the two hemispheres during unilateral forearm movements. We noticed that half of the subjects had predominant active hemisphere while the other half showed the opposite, especially to the ones with higher fatigue level. The findings demonstrate that the NC method is better than the GC to reveal causal influence between homologous motor areas of active and inactive hemispheres in this study.

P357 *EEG Comparison between Normal and Developmental Disorders in Perception and Imitation of Facial Expressions with the NeuCube [#17603]*

Yuma Omori, Hideaki Kawano, Akinori Seo, Zohreh Gholami Doborjeh, Nikola Kasabov and Maryam Gholami Doborjeh, Kyushu Institute of Technology, Japan; Auckland University of Technology, New Zealand

This paper is a feasibility study of using the NeuCube spiking neural network (SNN) architecture for modeling EEG brain data related to

perceiving versus mimicking facial expressions. We collected EEG patterns during perception and imitation of facial expressions for each emotion. Comparing the collected data in perceiving and mimicking facial expressions, EEG patterns were very similar. This fact suggest that it seems that there are mirror neurons on facial expression in the human brain. Recently, some studies have been reported that mirror neuron system does not work well in the case of subjects with brain disorders. In this study, we calculated and visualized differences between EEG patterns when we perceived facial expressions and mimicking facial expressions for healthy and developmental disorders.

P358 *Decentralized Force/Position Fault-Tolerant Control for Constrained Reconfigurable Manipulators with Actuator Faults [#17067]*

Fan Zhou, Bo Dong and Yuanchun Li, Changchun University of Technology, China

This paper addresses the problems of decentralized force/position fault-tolerant control for constrained reconfigurable manipulators. A novel decentralized force/position control method is proposed for constrained reconfigurable manipulators without torque sensing by estimating the joint torques with only position measurements. In addition, a modified sliding mode controller is designed to guarantee force/position tracking performance, and the actuator faults in independent subsystem can be compensated by using an adaptive algorithm. The stability of closed-loop system is analyzed using the Lyapunov method. Finally, simulations are performed to verify the advantages of the proposed method.

P359 *Backward Path Tracking Control for Mobile Robot with Three Trailers [#17076]*

Jin Cheng, Bin Wang and Yuan Xu, University of Jinan, China

The path tracking control problem of a mobile robot with three trailers in backward motion is addressed in this paper. Based on the proposed feedback control law, which can stabilize the orientations of the tractor and trailers on the desired reference angle, a fuzzy controller is designed to track given path. The controller is applicable to line segment path and is stable in backward motion. Numerical simulation experiments are implemented and the results show that the designed controller has excellent performance in backward tracking of line path.

P360 *An Analog Probabilistic Spiking Neural Network with On-Chip Learning [#17383]*

Hung-Yi Hsieh, Pin-Yi Li and Kea-Tiong Tang, National Tsing Hua University, Taiwan

Portable or biomedical applications typically require signal processing, learning, and classification in conditions involving limited area and power consumption. Analog implementations of learning algorithms can satisfy these requirements and are thus attracting increasing attention. Probabilistic spiking neural network (PSNN) is a hardware friendly algorithm that is relax in weight resolution requirements and insensitive to noise and VLSI process variation. In this study, the probabilistic spiking neural network was implemented using analog very-large-scale integration (VLSI) to verify their hardware compatibility. The circuit was fabricated using 0.18um CMOS technology. The power consumption of the chip was less than 10uW with a 1V supply and the core area of chip was 0.43mm2. In order to verify the chip learning performance, two databases are used which are electronic nose data and electrocardiography data. The chip can classify the electronic nose data with 92.3% accuracy and classify the electrocardiography data with 100% accuracy. The low power and high learning performance features make the chip suitable for portable or biomedical applications.

P361 *Deep Retinal Image Segmentation: A FCN-based Architecture With Short And Long Skip Connections For Retinal Image Segmentation [#17300]*

Zhongwei Feng, Jie Yang, Lixiu Yao, Yu Qiao, Qi Yu and Xun Xu, Shanghai Jiao Tong University, China; Shanghai General Hospital, China

This paper presents Deep Retinal Image Segmentation, a unified framework of retinal image analysis that provides both optic disc and exudates segmentation. The paper presents a new formulation of fully Convolutional Neural Networks (FCNs) that allows accurate segmentation of the retinal images. A major modification in these retinal image segmentation tasks are to improve and speed-up the FCNs training by adding short and long skip connections in standard FCNs architecture with class-balancing loss. The proposed method is experimented on the DRIONS-DB dataset for optic disc segmentation and the privately dataset for exudates segmentation, which achieves strong performance and significantly outperforms the-state-of-the-art. It achieves 93.12% sensitivity (Sen), 99.56% specificity (Spe), 89.90% Positive predictive value (PPV) and 90.93% F-score for optic disc segmentation while 81.35% Sen, 98.76% Spe, 81.64% PPV and 81.50% F-score for exudates segmentation respectively.

P362 *A novel Osmosis-inspired Algorithm for Multiobjective Optimization [#17782]*

Corina Rotar, Barna Iantovics and Arik Sabri, University of Alba Iulia, Romania; Petru Maior University, Romania; Istanbul University, Turkey

Many real-life difficult problems imply more than one optimization criterion and often require multiobjective optimization techniques. Among these techniques, nature-inspired algorithms, for instance, evolutionary algorithms, mimic various natural process and systems and succeed to perform appropriately for hard optimization problems. Besides, in chemistry, osmosis is the natural process of balancing the concentration of two solutions. This process takes place at the molecular level. Osmosis's practical applications are multiple and target medicine, food safety, and engineering. However, osmosis process is not yet recognized as a rich source of inspiration for designing computational tools. At first glance, this well-known chemical process seems appropriate as a metaphor in nature-inspired computation as it can underlie the development of a search and optimization procedure. In this paper, we develop a novel algorithm called OSMIA (Osmosis inspired Algorithm) for multiobjective optimization problems. The proposed algorithm is inspired by the well-known physio-chemical osmosis process. For validation purposes, we have realized a case study in that we compared our proposed algorithm with the state-of-art algorithm NSGAII using some well-known test problems. The conclusions of the case study emphasize the strengths of the proposed novel OSMIA algorithm.

P363 *SPMVP: Spatial PatchMatch Stereo with Virtual Pixel Aggregation [#17645]*

Peng Yao, Hua Zhang, Yanbing Xue and Shengyong Chen, Tianjin University of Technology, China

Stereo matching is one of the critical problems in the field of computer vision and it has been widely applied to 3D Reconstruction, Image Refocusing and etc. Recently proposed PatchMatch (PM) stereo algorithm effectively overcomes the limitation of integer-value within the support window but it still inferior in twofold: 1) view propagation of PM stereo algorithm generally yields underwhelming particle propagation; 2) it still suffers from a coarse performance in textureless regions. To mitigate these weaknesses, a Spatial-PM stereo algorithm without view propagation is proposed for improving the original one at first. Then a virtual pixel based cost aggregation framework with two sped-up strategies is proposed for tackling the problem of textureless mismatching. Jointing the two incremental improvements, we name the novel one as Spatial PatchMatch Stereo with Virtual Pixel Aggregation (SPMVP). Experiments show that SPMVP achieves superior results than other four challenging PM based stereo algorithms both in integer and subpixel level accuracy on all 31 Middlebury stereo pairs; and also performs better on Microsoft i2i stereo videos.

P364 *Robust Facial Alignment for Face Recognition [#17753]*

Kuang-Pen Chou, Dong-Lin Li, Mukesh Prasad, Mahardhika Pratama, Sheng-Yao Su, Haiyan Lu, Chin-Teng Lin and Wen-Chieh Lin, National Chiao Tung University, Taiwan; University of Technology Sydney, Australia; Nanyang Technological University, Singapore

This paper proposes a robust real-time face recognition system that utilizes regression tree based method to locate the facial feature points.

The proposed system finds the face region which is suitable to perform the recognition task by geometrically analyses of the facial expression of the target face image. In real-world facial recognition systems, the face is often cropped based on the face detection techniques. The misalignment is inevitably occurred due to facial pose, noise, occlusion, and so on. However misalignment affects the recognition rate due to sensitive nature of the face classifier. The performance of the proposed approach is evaluated with four benchmark databases. The experiment results show the robustness of the proposed approach with significant improvement in the facial recognition system on the various size and resolution of given face images.

Thursday, November 16, 4:00PM-6:00PM

Invited Session: ThuB1 Dynamics of neural systems and implications to neural information processing

Thursday, November 16, 4:00PM-6:00PM, Room: Kaixuan 7, Organizers: K. Y. Michael Wong and Changsong Zhou, Chairs: K. Y. Michael Wong and Changsong Zhou

4:00PM *Testing and Understanding Second-Order Statistics of Spike Patterns Using Spike Shuffling Methods [#17117]*

Zedong Bi and Changsong Zhou, HKBU Shenzhen Institute of Research and Continuing Education, China; Hong Kong Baptist University, Hong Kong

We introduce a framework of spike shuffling methods to test the significance and understand the biological meanings of the secondorder statistics of spike patterns recorded in experiments or simulations. In this framework, each method is to evidently alter a specific pattern statistics, leaving the other statistics unchanged. We then use this method to understand the contribution of different second-order statistics to the variance of synaptic changes induced by the spike patterns self-organized by an integrate-and-fire (LIF) neuronal network under STDP and synaptic homeostasis. We find that burstiness/regularity and heterogeneity of cross-correlations are important to determine the variance of synaptic changes under asynchronous states, while heterogeneity of cross-correlations is the main factor to cause the variance of synaptic changes when the network moves into strong synchronous states.

4:15PM *Self-connection of Thalamic Reticular Nucleus Modulating Absence Seizures [#17183]*

Daqing Guo, Mingming Chen, Yang Xia and Dezhong Yao, University of Electronic Science and Technology of China, China

Accumulating evidence has suggested that the corticothalamic system not only underlies the onset of absence seizures, but also provides functional roles in controlling absence seizures. However, few studies are involved in the roles of self-connection of thalamic reticular nucleus (TRN) in modulating absence seizures. To this end, we employ a biophysically based corticothalamic network mean-field model to explore these potential control mechanisms. We find that the inhibitory projection from the TRN to specific relay nuclei of thalamus (SRN) can shape the self-connection of TRN controlling absence seizures. Under certain condition, the self-connection of TRN can bidirectionally control absence seizures, which increasing or decreasing the coupling strength of the self- connection of TRN could successfully suppress absence seizures. These findings might provide a new perspective to understand the treatment of absence epilepsy.

4:30PM *Learning a Continuous Attractor Neural Network from Real Images [#17255]*

Xiaolong Zou, Zilong Ji, Xiao Liu, Yuanyuan Mi, K. Y. Michael Wong and Si Wu, Beijing Normal University, China; Institute of Basic Medical Sciences, China; Hong Kong University of Science and Technology, Hong Kong

Continuous attractor neural networks(CANNs) have been widely used as a canonical model for neural information representation. It remains, however, unclear how the neural system acquires such a network structure in practice. In the present study, we propose a biological plausible scheme for the neural system to learn a CANN from real images. The scheme contains two key issues. One is to generate high-level representations of objects, such that the correlation between neural representations reflects the sematic relationship between objects. We adopt a deep neural network trained by a large number of natural images to achieve this goal. The other is to learn correlated memory patterns in a recurrent neural network. We adopt a modified Hebb rule, which encodes the correlation between neural representations into the connection form of the network. We carry out a number of experiments to demonstrate that when the presented images are linked by a continuous feature, the neural system learns a CANN successfully, in term of that these images are stored as a continuous family of stationary states of the network, forming a sub-manifold of low energy in the network state space. The biological plausibility of our method and the potential applications of the learned CANN to real-world problems will continue to be explored in future works.

4:45PM *Active Prediction in Dynamical Systems [#17320]*

Chun-Chung Chen, Kevin Sean Chen and C. K. Chan, Academia Sinica, Taiwan; National Taiwan University, Taiwan

Using a hidden Markov model (HMM) that describes the position of a damped stochastic harmonic oscillator as a stimulus input to a data processing system, we consider the optimal response of the system when it is targeted to predict the coming stimulus at a time shift later. We quantify the predictive behavior of the system by calculating the mutual information (MI) between the response and the stimulus of the system. For a passive sensor, the MI typically peaks at a negative time shift considering the processing delay of the system. Using an iterative approach of maximum likelihood for the predictive response, we show that the MI can peak at a positive time shift, which signifies the functional behavior of active prediction. We find the phenomena of active prediction in bullfrog retinas capable of producing omitted stimulus response under periodic pulse stimuli, by subjecting the retina to the same HMM signals encoded in the pulse interval. We confirm that active prediction requires some hidden information to be recovered and utilized from the observation of past stimulus by replacing the HMM with a Ornstein--Uhlenbeck process, which is strictly Markovian, and showing that no active prediction can be observed.

5:00PM *A biophysical model of the early olfactory system of honeybees [#17374]*

Ho Ka Chan and Thomas Nowotny, University of Sussex, United Kingdom

Experimental measurements often can only provide limited data from an animal's sensory system. In addition, they exhibit large trial-to-trial and animal-to-animal variability. These limitations pose challenges to building mathematical models intended to make biologically relevant predictions. Here, we present a model of the early olfactory system of honeybees aiming to overcome these limitations. The model generates olfactory response patterns which conform to the statistics derived from experimental data for a variety of their properties. This allows the full dimensionality of the sensory input space to be considered as well as avoiding overfitting the underlying data sets. Several known biological mechanisms, including processes of chemical binding and activation of receptors, and spike generation and transmission in the antennal lobe network, are incorporated in the model at a minimal level. It can therefore be used to study how experimentally observed phenomena are shaped by

these underlying biophysical processes. We verified that our model can replicate some key experimental findings that were not used when building it. Given appropriate data, our model can be generalized to the early olfactory systems of other insects. It hence provides a possible framework for future numerical and analytical studies of olfactory processing in insects.

5:15PM *The Dynamics of Bimodular Continuous Attractor Neural Networks With Moving Stimuli [#17566]*

Min Yan, Wenhao Zhang, He Wang and K. Y. Michael Wong, Hong Kong University of Science and Technology, Hong Kong; Carnegie Melon University, United States

The single-layer continuous attractor neural network (CANN) model has been applied successfully to describe the tracking of moving stimuli of a single modality. Experimental evidence shows that stimuli of different modalities interact with each other in the neural system. To study these interaction effects, we generalize the single-module structure to a bimodular one. We found that when there is one static stimulus in one module and a moving one in the other, the network have very different behaviors depending on whether the inter-modular couplings are excitatory or inhibitory. We further compare the model with experimental observations that illustrate the interactions between two sensory modalities, such as the motion-bounce Illusion. Agreement between model and experimental results can be obtained for appropriate choice of parameters.

5:30PM *Encoding Multisensory Information in Modular Neural Networks [#17569]*

He Wang, Wen-Hao Zhang, K. Y. Michael Wong and Si Wu, Hong Kong University of Science and Technology, Hong Kong; Carnegie Mellon University, United States; Beijing Normal University, China

The brain is capable of integrating information in multiple sensory channels in a Bayesian optimal way. Based on a decentralized network model inspired by electrophysiological recordings, we consider the structural pre-requisites for optimal multisensory integration. In this architecture, same-channel feedforward and recurrent links encode the unisensory likelihoods, whereas reciprocal couplings connecting the different modules are shaped by the correlation in the joint prior probabilities. Moreover, the statistical relationship between the difference in the optimal network structures and the difference in the priors and the likelihoods clearly shows that the network can encode multisensory information in a distributed manner. Our results generate testable predictions for future experiments and are likely to be applicable to other artificial systems.

5:45PM *Global stability criterion of complex-valued recurrent neural networks with mixed time-delays and impulsive effect [#17057]*

Dongwen Zhang, Haijun Jiang, Cheng Hu, Zhiyong Yu and Da Huang, Xinjiang University, China

The global exponential stability problem for a class of complexvalued recurrent neural networks with both asynchronous time-varying delays and impulse is concerned in this paper. By using Schur complement and Lyapunov functional, some new sufficient criteria to ascertain globally exponential stability of the equilibrium point are obtained in terms of linear matrix inequality. An example is given to illustrate the effectiveness of the results.

Invited Session: ThuB2 Data-driven control for complex systems with power systems applications

Thursday, November 16, 4:00PM-6:00PM, Room: Zhujiang 2, Organizers: Qinmin Yang, Dianwei Qian, Qichao Zhang, Yuanheng Zhu, Dongbin Zhao, Bin Wang, Zhen Zhang and Chengdong Li, Chairs: Qinmin Yang and Dongbin Zhao

4:00PM *Dynamic cyclone wind-intensity prediction using co-evolutionary multi-task learning [#17484]*

Rohitash Chandra, University of Sydney, Australia

A new category called dynamic time series prediction is introduced to address robust "on the fly" prediction needed in events such as natural disasters. A co-evolutionary multi-task learning algorithm is presented which incorporates features from modular and multi-task learning. The algorithm is used for prediction of tropical cyclone wind-intensity. This addresses the need for a robust and dynamic pre- diction model during the occurrence of a cyclone. The results show that the method addresses dynamic time series effectively when compared to conventional methods.

4:15PM *Data-driven Nonlinear Adaptive Optimal Control of Connected Vehicles [#17203]*

Weinan Gao and Zhong-Ping Jiang, Georgia Southern University, United States; New York University, United States

This paper studies the cooperative adaptive cruise control (CACC) problem of connected vehicles with unknown nonlinear dynamics. Different from the existing literature on CACC, a data-driven optimal control policy is developed by global adaptive dynamic programming (GADP). Interestingly, the developed control policy achieves global stabilization of the nonlinear vehicular platoon system in the absence of the a priori knowledge of system dynamics. Numerical simulation results are presented to validate the effectiveness of the developed approach.

4:30PM *Multi-Agent Q Learning for Optimal Operation Management of Energy Internet [#17765]*

Lingxiao Yang, Qiuye Sun and Yue Han, Northeastern University, China; State Grid Liaoning Electric Power Research Institute, China

This paper proposes an optimal operation management methodology based on the multi- agent reinforcement learning (MARL) in energy internet (EI). An integrated approach to minimize the total cost of operation of such an electrical, natural gas and district heating network simultaneously is studied. A novel multi-agent Q learning method is presented to form a coordinated optimal management strategy of energy internet with multiple We-Energy(WE), and an equal interval sampling method is proposed to find the optimal discrete action sets so as to enhance the performance of the control areas. Furthermore, a global Q operator is designed to produce a global Q function considering the local reward from each agent which optimizes simultaneously. The proposed method verified by case studies applied to the modified energy network. Compared with the centralized approach, the test results show that the proposed method can provide a fast solution for the optimal operation management which can be applied to multiple We-Energy internet with sufficient accuracy.

4:45PM *Mixed Installation to Optimize the Position and Type Selection of Turbines for Wind Farms [#17877]*

Xiaoyu Tang, Yun Shen, Siliang Li, Qinmin Yang and Youxian Sun, Zhejiang University, China; WindMagics (Wuhan) Energy Corporation, China

The optimal deployment of turbines in a wind farm, namely micro-sitting, is crucial to improve the economical returns of a wind power plant. Traditionally, a wind farm layout is designed with identical turbines. In this work, installation of multiple types of turbines is introduced in the first time to further increase the efficiency of the farm, namely mixed installation. Firstly, The optimization problem of micro-siting with mixed installation is established, which is then approached via a GA-based method, obtaining the type selection and positioning of turbines simultaneously. Finally, a complex scenario with practical wind conditions is utilized to demonstrate the feasibility of the proposed scheme.

5:00PM *Off-Policy Reinforcement Learning for Partially Unknown Nonzero-Sum Games [#17693]*

Qichao Zhang and Dongbin Zhao, Institute of Automation, Chinese Academy of Sciences, China

In this paper, the optimal control problem of nonzero-sum (NZS) games with partially unknown dynamics is investigated. The offpolicy reinforcement learning (RL) method is proposed to approximate the solution of the coupled Hamilton-Jacobi (HJ) equations. A single critic network structure for each player is constructed using neural network (NN) technique. To improve the applicability of the off-policy RL method, the tuning laws of critic weights are designed based on the offline learning and online learning methods, respectively. The simulation study demonstrates the effectiveness of the proposed algorithms.

5:15PM *Consensus Based Distributed Reinforcement Learning for Nonconvex Economic Power Dispatch in Microgrids [#17839]*

Fangyuan Li, Jiahu Qin, Yu Kang and Weixing Zheng, University of Science and Technology of China, China; Western Sydney University, Australia

A common assumption for economic power dispatch (EPD) is a perfect knowledge of cost functions. However, this assumption can be violated in cases when it is too difficult to establish an accurate model of the generation unit. In this paper, we formulate the EPD problem in a unified notation, based on which various reinforcement learning techniques can be applied. Then, a consensus based distributed reinforcement learning (CBDRL) algorithm is developed to solve the EPD problem. The CBDRL algorithm is fully distributed in sense that it requires only local computation and communication, which will contribute to a microgrid of higher scalability and robustness. Finally, the effectiveness and performance of the proposed algorithm is verified through case studies.

5:30PM *FMR-GA -- A Cooperative Multi-agent Reinforcement Learning Algorithm Based on Gradient Ascent [#17171]*

Zhen Zhang, Dongqing Wang, Dongbin Zhao and Tingting Song, Qingdao University, China; Institute of Automation, Chinese Academy of Sciences, China

Gradient ascent methods combined with Multi-Agent Reinforcement Learning (MARL) have been studied for years as a potential direction to design new MARL algorithms. This paper proposes a gradient-based MARL algorithm -- Frequency of the Maximal Reward based on Gradient Ascent (FMR-GA). The aim is to reach the maximal total reward in repeated games. To achieve this goal and simplify the stability analysis procedure, we have made effort in two aspects. Firstly, the prob-ability of getting the maximal total reward is selected as the objective function, which simplifies the expression of the gradient and facilitates reaching the learning goal. Secondly, a factor is designed and is added to the gradient. This will produce the de-sired stable critical points corresponding to the optimal joint strategy. We propose a MARL algorithm called Probability of Maximal Reward based on Infinitsmall Gra-dient Ascent (PMR-IGA), and analyze its convergence in two-player two-action and two-player three-action repeated games. Then we derive a practical MARL algorithm FMR-GA from PMR-IGA. Theoretical and simulation results show that FMR-GA will converge to the optimal strategy in the cases presented in this paper.

ThuB3 Neurodynamics

Thursday, November 16, 4:00PM-6:00PM, Room: Zhujiang 3, Chairs: Bo Zhao and Calin-Adrian Popa

4:00PM *Synchronization of Memristor-based Time-delayed Neural Networks via Pinning Control [#17041]*

Zhanyu Yang, Biao Luo and Derong Liu, University of Science and Technology Beijing, China; Institute of Automation, Chinese Academy of Sciences, China; Guangdong University of Technology, China

As the realization of memristor by HP Lab, more and more researchers pay attention to the memristor-based neural networks (MNNs). In this paper, a pinning control method is applied to drive two MNNs to achieve synchronization. Conditions about the pinning controllers are given to guarantee the asymptotic synchronization of MNNs with time-varying delays. Furthermore, MNNs are nonlinear state-dependent systems with discontinuous right-hand sides such that all the dynamic anal- yses are under the framework of Filippov's solutions and the theory of differential inclusions. The effectiveness of the proposed pinning method is verified by a numerical example.

4:15PM *Identifying Intrinsic Phase Lag in EEG Signals from the Perspective of Wilcoxon Signed-Rank Test [#17189]*

Yunqiao Wu, John Q Gan and Haixian Wang, Southeast University, China; University of Essex, United Kingdom

In brain functional network connectivity analysis, phase synchronization has been effective in detecting regions demonstrating similar dynamics over time. The previously proposed connectivity indices such as phase locking value (PLV), phase lag index (PLI) and weighted phase lag index (WPLI) are widely used. They are, however, influenced by volume conduction or noise. In addition, appropriate thresholds have to be chosen in order to employ them successfully, which leads to uncertainty. In this paper, a novel connectivity index named phase lag based on the Wilcoxon signed-rank test (PLWT) is proposed under the framework of Wilcoxon signed-rank test, which avoids using thresholds to identify effective connections. We analyzed and compared PLWT with previous indices by simulating volume conduction and testing the scale-free character of brain networks constructed based on EEG signals. The experimental results demonstrated that PLWT can be utilized as a reliable and convincing measure to reveal true connections while effectively diminishing the influence of volume conduction.

4:30PM *Exponential Stability of Matrix-Valued BAM Neural Networks with Time-Varying Delays [#17757]*

Calin-Adrian Popa, Polytechnic University Timisoara, Romania

Matrix-valued BAM neural networks are a generalization of real-valued BAM neural networks, for which the states, weights, and outputs are square matrices. This paper gives a sufficient criterion expressed in terms of linear matrix inequalities, for which the equilibrium point of these networks with time-varying delays is exponentially stable. A numerical example is provided to demonstrate the effectiveness of the proposed criterion.

4:45PM *Asymptotic Stability of Delayed Octonion-Valued Neural Networks with Leakage Delay [#17828]*

Calin-Adrian Popa, Polytechnic University Timisoara, Romania

This paper gives a sufficient criterion for the asymptotic stability of the equilibrium point of delayed octonion-valued neural networks with leakage delay. Defined over the normed division algebra of octonions, these networks represent a generalization of the complex- and quaternion-valued neural networks that have been intensely studied over the last few years, which doesn't fall into the Clifford-valued category. A numerical example is given to prove the effectiveness of the main result.

5:00PM *Pinning Synchronization in Heterogeneous Networks of Harmonic Oscillators [#17394]*

Zhengxin Wang, Jingbo Fan, He Jiang and Haibo He, Nanjing University of Posts and Telecommunications, China; University of Rhode Island, United States

In this paper, a networked heterogeneous system coupled of multiple nonidentical harmonic oscillators is investigated. The synchronization problem for the networked heterogeneous system is studied. To synchronize the heterogeneous network, a leader is introduced. Based on the pinning control, a distributed control input is proposed to synchronize the heterogeneous network to the leader. By Lyapunov functional method and matrix theory, sufficient conditions for guaranteeing quasi-synchronization between the heterogeneous network and the leader are obtained. The theoretical results show that all the heterogeneous oscillators can tend eventually to the leader oscillator within a bounded error. Finally, numerical simulations are provided to verify the effectiveness of the theoretical results.

5:15PM *Prediction of Tropical Storms using Self-organizing Incremental Neural Networks and Error Evaluation [#17095]*

Wonjik Kim and Osamu Hasegawa, Tokyo Institute of Technology, Japan

In this paper, we propose a route prediction method that uses a self-organizing incremental neural network. For the training and testing of the neural network, only the latitude and longitude of the tropical storm and atmospheric information around East Asia are required. Our proposed method can predict the movement of a tropical storm with only a short calculation time, and the prediction accuracy is close to the accuracy of the Japan Meteorological Agency. This paper describes the algorithm used for the neural network training, the process for handling the data sets and the method used to predict the storm trajectory. Additionally, experimental results that indicate the performance of our method are presented in the results section.

5:30PM *Stability of Periodic Orbits and Fault Tolerance in Dynamic Binary Neural Network [#17690]*

Shunsuke Aoki and Toshimichi Saito, HOSEI University, Japan

The dynamic binary neural network is characterized by ternary connection parameters and can generate various binary periodic orbits. This paper considers two interesting problems based on typical examples. First, effect of connection sparsity on stability of target periodic orbits is considered: adding branches adequately to the most sparse network, stability of the periodic orbits can be reinforced. Second, fault tolerance of the network is considered: cutting one branch from the network, storage and stability of the periodic orbits are preserved in high probability.

5:45PM *Basic Analysis of Cellular Dynamic Binary Neural Networks [#17843]*

Kazuma Makita, Takahiro Ozawa and Toshimichi Saito, Hosei University, Japan; HOSEI University, Japan

This paper studies cellular dynamic binary neural networks that can generate various periodic orbits. The networks is characterized by signum activation function and local connection parameters. In order to visualize/analyze the dynamics, we present a feature plane of two simple feature quantities. We also we present normal form equations into which the network dynamics is integrated. Using the feature plane and normal form equation, typical phenomena are investigated.

ThuB4 Big data analysis

Thursday, November 16, 4:00PM-6:00PM, Room: Zhujiang 5, Chairs: Ping Guo and Houda Jmila

4:00PM *Low Frequency Words Compression in Neural Conversation System [#17698]*

Sixing Wu, Ying Li and Zhonghai Wu, Peking University, China

Recently, Encoder-Decoder, a framework for sequence-to-sequence (seq2seq) tasks has been widely used in the open domain generation-based conversation system. One of the most difficult challenges in Encoder-Decoder based open domain conversation systems is the Unknown Words Issue, that is, numerous words become out-of-vocabulary words (OOVs) due to the restriction of vocabulary's volume, while a conversation system always tries to avoid their appearances. This paper proposes a novel approach named Low Frequency Words Compression (LFWC) to address this problem by selectively using K-Components shared symbol for word representations of low frequency words. Compared to the standard Encoder- Decoder works at word-level, our LFWC Encoder-Decoder works at symbol-level, and we propose Sequence Transform to transform a word-level sequence into a symbol-level sequence and LFWC-Predictor to decode from a symbol-level sequence into a word-level sequence. To measure the interference of OOVs in neural conversation system, besides log-perplexity (LP), we apply two more suitable metrics UP-LP and UP-Delta to evaluate the interference of OOVs. The experiment shows that the performance of decoding from compressed symbol-level sequences to word-level sequences achieves a recall_1 score of 60.9%, which is much above 16.7% of baseline, with the strongest compression ratio. It also shows our approach outperforms the standard Encoder-Decoder model in reducing interference of OOVs, which achieves almost the half score of UP-Delta in the most of configurations.

4:15PM *Assessing the Performance of Deep Learning Algorithms for Newsvendor Problems [#17235]*

Yanfei Zhang and Junbin Gao, University of Sydney Business School, Australia

In retailer management, the Newsvendor problem has widely attracted attention as one of basic inventory models. In the traditional approach to solving this problem, it relies on the probability distribution of the demand. In theory, if the probability distribution is known, the problem can be considered as fully solved. However, in any real world scenario, it is almost impossible to even approximate or estimate a better probability distribution for the demand. In recent years, researchers start adopting machine learning approach to learn a demand prediction model by using other feature information. In this paper, we propose a supervised learning that optimises the demand quantities for products based on feature

information. We demonstrate that the original Newsvendor loss function as the training objective outperforms the recently suggested quadratic loss function. The new algorithm has been assessed on both the synthetic data and real-world data, demonstrating better performance.

4:30PM *Accelerating Core Decomposition in Large Temporal Networks using GPUs [#17808]*

Heng Zhang, Haibo Hou, Libo Zhang, Hongjun Zhang and Yanjun Wu, Chinese Academy of Sciences, China; China Academy of Information and Communications Technology, China

In recent times, many real-world networks are naturally modeled as temporal networks, such as neural connection in biological networks over time, the interaction between friends at different time in social networks, etc. To visualize and analysis these temporal networks, core decomposition is an efficient strategy to distinguish the relative "importance" of nodes. Existing works mostly focus on core decomposition in non-temporal networks and pursuing efficient CPU-based approaches. However, applying these works in temporal networks makes core decomposition an already computationally expensive task. In this paper, we propose two novel acceleration methods of core decomposition in the large temporal networks using the high parallelism of GPU. From the evaluation results, the proposed acceleration methods achieves maximum 4.1 billions TEPS (traversed edges per second), which corresponds to up to 26.6X speedup compared to a single threaded CPU execution.

4:45PM *An Iterative Model for Predicting Film Attendance [#17267]*

Yang Yue, Ying Li, Tong Jia and Zhonghai Wu, Peking University, China

As an important index during film distribution, film attendance is frequently taken into consideration by distribution companies and theater lines when making decisions about budget allocation. Lacking automatic solutions, film attendance is usually estimated by human expertise, which costs many efforts but still cannot achieve satisfactory accuracy. Therefore, it is important to predict film attendance automatically and accurately during film distribution. In this paper, we propose an approach to predicting film attendance of incoming days with film metadata, audience want data, and attendance pattern. An Attendance Iterative Model (AIM) is constructed by iteratively combining random forest based Base Model and SVM based Auxiliary model. The approach has been evaluated with all films released in China in 2015 - 2016. The result indicates that our model performs well for various films at most times, which MAE maintains within 2 - 8. Additionally, our iterative model outperforms multi-model with reasonable accuracy and satisfied flexibility of prediction time range.

5:00PM *Estimating Virtual Network Function requirements using Machine learning techniques [#17370]*

Houda Jmila, Mohamed Ibn Khedher and Mounim A. El-Yacoubi, Telecom SudParis, France

Resource Management in the network function virtualization (NFV) environment is a challenging task. The continuously varying demands of virtual network functions (VNF) call for dynamic algorithms to efficiently scale the allocated resources and meet fluctuating needs. In this context, studying the behavior of a VNF as a function of its environment helps to model its resource requirements and thus allocate them dynamically. This paper investigates the use of machine learning techniques to estimate VNFs needs in term of CPU as a function of the traffic they will process. We propose and adapt a Support Vector Regression (SVR) based approach to resolve the problem. Results show its efficiency and superiority compared to the state of the art.

5:15PM *Profile-based Ant Colony Optimization for Energy-Efficient Virtual Machine Placement [#17451]*

Fares Alharbi, Yu-Chu Tian, Maolin Tang and Md Hasanul Ferdaus, Queensland University of Technology, Australia; The University of Melbourne, Australia

Cloud computing data centers contain a large number of physical machines (PMs) and virtual machine (VMs). This number can increase the energy consumption of the data centers especially when the VMs placed inappropriately on the PMs. This paper presents a new VM placement approach with the objective of minimizing the total energy consumption of a data center. VM placement problem is formulated as a combinatorial optimization problem. Since this problem has been proven to be an NP hard problem, Ant Colony Optimization (ACO) algorithm is adopted to solve the formulated problem. Information heuristic of ACO is used differently based on PM energy efficiency. Experimental results show that the proposed approach scales well on large data centers and significantly outperforms selected benchmark (ACOVMP) in terms of energy consumption.

5:30PM *A Small Scale Multi-Column Network for Aesthetic Classification Based on Multiple Attributes [#17386]*

Chaoqun Wan and Xinmei Tian, University of Science and Technology of China, China

Image aesthetic quality assessment, which devotes to distinguish whether an image is beautiful or not, has drawn a lot of attention in recent years. Recently deep learning has shown great power in data analysis and has been widely used in this field. However, on the one hand, deep learning is an end-to- end learning method that can be easily influenced by noisy data. On the other hand, prior information concluded from the experience of human perception of aesthetics, which widely applied in traditional aesthetic assessment methods, has not been effectively utilized in deep learning based aesthetic quality assessment methods. Therefore, in this paper we embed these prior information in deep learning as guidance for aesthetic quality assessment. Firstly, we design an extreme small network with only 38K parameters for better training. Then we propose a multi-column network architecture to embed prior information into our deep learning model. We train our proposed network on AVA dataset, which is widely used for aesthetic assessment. The experimental results show that prior information indeed guides our network to learn better.

5:45PM *Layer Removal for Transfer Learning with Deep Convolutional Neural Networks [#17609]*

Weiming Zhi, Zhenghao Chen, Henry Wing Fung Yueng, Zhicheng Lu, Seid Miad Zandavi and Yuk Ying Chung, University of Auckland, New Zealand; University of Sydney, Australia

It is usually difficult to find datasets of sufficient size to train Deep Convolutional Neural Networks (DCNNs) from scratch. In practice, a neural network is often pre-trained on a very large source dataset. Then, a target dataset is transferred onto the neural network. This approach is a form of transfer learning, and allows very deep networks to achieve outstanding performance even when a small target dataset is available. It is thought that the bottom layers of the pre-trained network contain general information, which are applicable to different datasets and tasks, while the upper layers of the pre-trained network contain abstract information relevant to a specific dataset and task. While studies have been conducted on the fine- tuning of these layers, the removal of these layers have not yet been considered. This paper explores the effect of removing the upper convolutional layers of a pre-trained network. We empirically investigated whether removing upper layers of a deep pre-trained network can improve performance for transfer learning. We found that removing upper pre-trained layers gives a significant boost in performance, but the ideal number of layers to remove depends on the dataset. We suggest removing pre-trained convolutional layers when applying transfer learning on off-the-shelf pre- trained DCNNs. The ideal number of layers to remove will depend on the dataset, and remain as a parameter to be tuned.

ThuB5 Data mining 2

Thursday, November 16, 4:00PM-6:00PM, Room: Zhujiang 7, Chairs: Pengfei Duan and Shiliang Sun

4:00PM *Extracting Deep Semantic Information for Intelligent Recommendation [#17343]*

Wang Chen, Hai-Tao Zheng and Xiao-Xi Mao, Tsinghua-Southampton Web Science Laboratory, China

In recent years, there have been many works focusing on combing ratings and reviews to improve the performance of recommender system. Comparing with the rating based algorithms, these methods can be used to alleviate the data sparsity problem in a certain extent. However, they lack the ability to extract the deep semantic information from plaintext reviews. In addition, they do not take the consistence of the latent semantic space of user profiles and item representations into account. To address these problems, we propose a novel method named as Deep Semantic Hybrid Recommendation Method (DSHRM). We utilize deep learning technologies to extract user profiles and item representations from reviews and make sure both of them are in a consistent latent semantic space. We combine ratings and reviews to generate better recommendations. Extensive experiments on real-world datasets show that our method significantly outperforms other six state-of-the-art methods, including LFM, SVD++, CTR, RMR, BoWLF and LMLF methods.

4:15PM *A Hybrid Method of Sine Cosine Algorithm and Differential Evolution for Feature Selection [#17721]*

Mohamed Abd ElAziz, Ahmed A. Ewees, Oliva Diego, Pengfei Duan and Shengwu Xiong, Wuhan University of Technology, China; Damietta University, Egypt; Universidad de Guadalajara, Mexico

The feature selection is an important step to improve the performance of classifier through reducing the dimension of the dataset, so the time complexity and space complexity are reduced. There are several feature selection methods are used the swarm techniques to determine the suitable subset of features. The sine cosine algorithm (SCA) is one of the recent swarm techniques that used as global optimization method to solve the feature selection, however, it can be getting stuck in local optima. In order to solve this problem, the differential evolution operators are used as local search method which helps the SCA to skip the local point. The proposed method is compared with other three algorithms to select the subset of features used eight UCI datasets. The experiments results showed that the proposed method provided better results than other methods in terms of performance measures and statistical test.

4:30PM *Feature Selection based on Improved Runner-Root Algorithm using Chaotic Singer Map and Opposition-Based Learning [#17787]*

Rehab Ali Ibrahim, Diego Oliva, Ahmed Ewees and Songfeng Lu, Huazhong university of Science and Technology, China; Universidad de Guadalajara, Mexico; Damietta University, Egypt

The feature selection (FS) is an important step for data analysis. FS is used to reduce the dimension of data by selecting the relevant features; while removing the redundant, noisy and irrelevant features that lead to degradation of the performance. Several swarm techniques are used to solve the FS problem and these methods provide results better than classical approaches. However, most of these techniques have limitations such as slow convergence and time complexity. These limitations occur due that all the agents update their position according to the best one. However, this best agent may be not the optimal global solution for FS, therefore, the swarm getting stuck in a local solution. This paper proposes an improved Runner-Root Algorithm (RRA). The RRA is combined with chaotic Singer map and opposition-based learning to increase its accuracy. The experiments are performed in eight datasets and the performance of the proposed method is compared against swarm algorithms.

4:45PM *LWMC: A Locally Weighted Meta-Clustering Algorithm for Ensemble Clustering [#17852]*

Dong Huang, Changdong Wang and Jianhuang Lai, South China Agricultural University, China; Sun Yat-sen University, China

The last decade has witnessed a rapid development of the ensemble clustering technique. Despite the great progress that has been made, there are still some challenging problems in the ensemble clustering research. In this paper, we aim to address two of the challenging problems in ensemble clustering, that is, the local weighting problem and the scalability problem. Specifically, a locally weighted meta-clustering (LWMC) algorithm is proposed, which is featured by two main advantages. First, it is highly efficient, due to its ability of working and voting on clusters. Second, it incorporates a locally weighted voting strategy in the meta-clustering process, which can exploit the diversity of clusters by means of local uncertainty estimation and ensemble- driven cluster validity. Experiments on eight real-world datasets demonstrate the superiority of the proposed algorithm in both clustering quality and efficiency.

5:00PM *Discovery of Interconnection among Knowledge Areas of Standard Computer Science Curricula by a Data Science Approach [#17092]*

Yoshitatsu Matsuda, Takayuki Sekiya and Kazunori Yamaguchi, The University of Tokyo, Japan

Computer Science Curricula 2013 (CS2013) is a widely-used standard curricula of computer science, which has been developed jointly by the ACM and the IEEE Computer Society. CS2013 consists of 18 Knowledge Areas (KAs) such as Programming Languages and Software Engineering. Though it is obvious that there are strong interconnections among the KAs, it was hard to investigate the interconnections objectively and quantitatively. In this paper, the interconnections among the KAs of CS2013 are investigated by a data science approach. For this purpose, a collection of actual syllabi from the world's top-ranked universities was constructed. Then, every actual syllabus is projected to the KA space by a probabilistic model-based method named simplified, supervised Latent Dirichlet Allocation (denoted by ssLDA). Consequently, the following interesting properties of the interconnections among the KAs were discovered: (1) There are the high interconnections among the KAs in each syllabi; (2) A plausible hierarchical structure of the KAs is found by utilizing the interconnections; (3) The structure shows that the KAs are classified into the three principal independent factors (HUMAN, THEORY, and IMPLEMENTATION). The factor of IMPLEMENTATION can be divided into PROGRAMMING and SYSTEM. The factor of SYSTEM can be divided further into DEVICES and NETWORK.

5:15PM *A Probabilistic Model for the Cold-Start Problem in Rating Prediction using Click Data [#17661]*

ThaiBinh Nguyen and Atsuhiro Takasu, SOKENDAI, Japan; National Institute of Informatics, Japan

One of the most efficient methods in collaborative filtering is matrix factorization, which finds the latent vector representations of users and items based on the ratings of users to items. However, a matrix factorization based algorithm suffers from the cold-start problem: it cannot find latent vectors for items to which previous ratings are not available. This paper aims to utilize click data, which can be collected in abundance, to address the cold-start problem. We propose a probabilistic item embedding model that learns item representations from click data, and a model named EMB-MF, that connects it with a probabilistic matrix factorization for rating prediction. The experiments on three real-world datasets demonstrate that the proposed model is not only effective in recommending items with no previous ratings, but also outperforms competing methods, especially when the data is very sparse.

5:30PM *Dynamic Forest Model for Sentiment Classification [#17236]*

Mingming Li, Jiao Dai, Wei Liu and Jizhong Han, University of Chinese Academy of Sciences, China; Institute of Information Engineering,Chinese Academy of Sciences, China

Sentiment classification is a useful approach to analyse the emotional polarity from user reviews, and method based on machine learning has achieved a great success. In the era of Web2.0, the emotional intensity of terms will change with time and events, while a large number of Out-Of-Vocabulary (OOV) terms are appearing. But the method of machine learning pays little attention to them because they focus to reduce the computational complexity. To address the problem, we proposed a dynamic forest model, which can describe the emotional intensity of the term in single-word granularity, and can append OOV dynamically and adjust their emotional intensity value. Experiments show that in the Chinese environment, our model greatly boosts the performance compared with the method based machine learning, while the time is saved by halves.

5:45PM *Online Multi-Label Passive Aggressive Active Learning Algorithm Based on Binary Relevance [#17783]*

Xizhi Guo, Yongwei Zhang and Jianhua Xu, Nanjing Normal University, China

Online multi-label learning is an efficient classification paradigm in machine learning. However, traditional online multi-label methods often need requesting all class labels of each incoming sample, which is often human cost and time- consuming in labeling classification problem. In order to tackle these problems, in the paper, we present online multi-label passive aggressive active (MLPAA) learning algorithm by combining binary relevance (BR) with online passive aggressive active (PAA) method. The proposed MLPAA algorithm not only uses the misclassified labels to update the classifier, but also exploits correctly classified examples with low prediction confidence. We perform extensive experimental comparison of our algorithm and other methods using nine different data sets. The encouraging results of our experiments validate the effectiveness of the proposed method.

ThuB6 Machine learning 4

Thursday, November 16, 4:00PM-6:00PM, Room: Kaixuan 3, Chairs: Huanhuan Chen and Kok Wai Wong

4:00PM *Multi-Roles Graph based Extractive Summarization [#17505]*

Zhibin Chen, Yunming Ye, XiaoFei Xu and Feng Li, Harbin Institute of Technology, China

In this paper, we propose a multi-roles graph model for extractive single-document summarization. In our model, we consider that each text can be expressed in some important words which we call roles. We design three roles, including noun role, verb role and numeral role, and build a multi-roles graph according to these three roles to represent a text. And then we project this graph into three single role graphs according to the role of nodes. After that, we extract some import features from these four graphs by applying a modified PageRank algorithm and then combine them with some statistical features such as sentence position and the length of sentence to represent each sentence. Finally we train a random forest model to learn the pattern of selecting important sentences to generate summaries. To evaluate our model, we perform some experiments on DUC2001 and DUC2002 and achieve 13.9% improvement over latest methods. Besides, we also obtain best results in ROUGE-2 compared with some classic methods.

4:15PM *Regularized Multi-source Matrix Factorization for Diagnosis of Alzheimer's Disease [#17407]*

Xiaofan Que, Yazhou Ren, Jiayu Zhou and Zenglin Xu, University of Electronic Science and Technology of China, China; Michigan State University, United States

In many real-world systems with multiple sources of data, data are often missing in a block-wise way. For example, in the diagnosis of Alzheimer's disease, doctors may collect patients data from MRI images, PET images and CSF tests, while some patients may have done the MRI scan and the PET scan only, while other patients may have done the MRI scan and the CSF test only. Despite various data imputation technologies exist, in general, they neglect the correlation among multi-sources of data and thus may lead to sub-optimal performances. In this paper, we propose a model called regularized multi-source matrix factorization (RMSMF) to alleviate this problem. Specifically, to model the correlation among data sources, RMSMF firstly uses non-negative matrix factorization to factorize the observed multi-source data into the product of subject factors and feature factors. In this process, we assume different subjects from the same data source share the same feature factors. Furthermore, similarity constraints are forced on different subject factors by assuming for the same subject, the subject factors are similar among all sources. Moreover, self-paced learning with soft weighting strategy is applied to reduce the negative influence of noise data and to further enhance the performance of RMSMF.We apply our model on the diagnosis of the Alzheimer's disease. Experimental results on the ADNI data set have demonstrated its effectiveness.

4:30PM *Emotion Classification from Electroencephalogram Using Fuzzy Support Vector Machine [#17321]*

Anuchin Chatchinarat, Kok Wai Wong and Chun Che Fung, Murdoch University, Australia

Realization of Human Emotion classification from Electroencephalogram (EEG) has great potential. Various methods in machine learning have been applied for EEG emotion classification and among these techniques, Support Vector Machines (SVMs) has demonstrated that it can provide good classification results. Therefore, SVM has been used widely in Affective Brain-Computer Interfaces (aBCI). However, EEG signals are non-stationary and they normally associate with outliers and uncertainties, and these issues could affect the performance of SVM. This study proposes the use of Fuzzy Support Vector Machine (FSVM) to deal with these issues. A benchmark dataset, Database for Emotion Analysis using Physiological Signals (DEAP), was used for subject-dependence classification. The experimental results showed that FSVM could deal with uncertainties and outliers, and enhanced the accuracies of arousal, valence and dominance classifications when compared to the SVM. Moreover, it was found that when gamma band was used as a feature from the two channels gave the best performance in comparison to other bands.

4:45PM *Wake-Sleep Variational Autoencoders for Language Modeling [#17165]*

Xiaoyu Shen, Hui Su, Shuzi Niu and Dietrich Klakow, Saarland University, Germany; University of Chinese Academy of Science, China

Variational Autoencoders (VAEs) are known to easily suffer from the KL-vanishing problem when combining with powerful autoregressive models like recurrent neural networks (RNNs), which prohibits their wide application in natural language processing. In this paper, we tackle this problem by tearing the training procedure into two steps: learning effective mechanisms to encode and decode discrete tokens (wake step) and generalizing meaningful latent variables by reconstructing dreamed encodings (sleep step). The training pattern is similar to the wake-sleep algorithm: these two steps are trained alternatively until an equilibrium is achieved. We test our model in a language modeling task. The results demonstrate significant improvement over the current state-of-the-art latent variable models.

5:00PM *Text Classification using Lifelong Machine Learning [#17801]*

Muhammad Hassan Arif, Xin Jin, Jianxin Li and Muhammad Iqbal, Beihang University, China; National Internet Emergency Center, China; Xtracta Ltd, New Zealand

This paper proposes a novel lifelong machine learning model for text classification. The proposed model tries to solve problems as humans do i.e. it learns small and simple problems, retains the knowledge learnt from those problems, mines the useful information from the stored knowledge and reuses the extracted knowledge to learn future problems. The proposed approach adopts rule based learning classifier systems and a new encoding scheme is proposed to identify building units of knowledge which can be reused for future learning. The fitter building units from the learning system trained against small problems of text classification domain are extracted and utilized in high dimensional social media text classification problems to achieve scalable learning. The experimental results show that proposed continuous learning approach successfully solves complex high dimensional problems by reusing the previously learned fitter building blocks of knowledge.

5:15PM *Linear Dimensionality Reduction for Time Series [#17822]*

Nikolaos Gianniotis, Heidelberg Institute for Theoretical Studies, Germany

Visualisation by dimensionality reduction is an important tool for data exploration. In this work we are interested in visualising time series. To that end we formulate a latent variable model that mirrors probabilistic principal component analysis (PPCA). However, as opposed to PPCA which maps the latent variables directly to the data space, we first map the latent variables to the parameter space of a recurrent neu- ral network, i.e. each latent projection instantiates a recurrent network. Each instantiated recurrent network in turn is responsible for modelling a time series in the dataset. Hence, each latent variable is indirectly mapped to a time series. Incorporating the recurrent network in the la- tent variable model helps us account for the temporal nature of the time series and capture their underlying dynamics. The proposed algorithm is demonstrated on two benchmark problems and a real world dataset.

5:30PM *An Effective Martin Kernel for Time Series Classification [#17349]*

Liangang Zhang, Yang Li and Huanhuan Chen, University of Science and Technology of China, China

Time series classification has attracted a lot of attention in recent years. However, the original data often corrupted with noise. To alleviate this problem, many approaches try to perform nonlinear transformation, such that the resulting space could give out the most relevant features. Since the resulting space is not a Euclidean space, strong assumptions are needed for many kernel- based methods for the purpose of obtaining a reasonable measurement. In this paper we propose a novel approach based on Martin distance. The Martin distance is applied to measure the pairwise distance in the resulting space, without imposing strong assumptions on model states. Experiments on several benchmark datasets demonstrate the advantages of the proposed kernel on its effectiveness and performance.

5:45PM *Three-dimensional Surface Feature for Hyperspectral Imagery Classification [#17173]*

Sen Jia, Kuilin Wu, Meng Zhang and Jie Hu, Shenzhen University, China

Gabor surface feature (GSF) uses the first order and second order derivatives of Gabor magnitude pictures (GMPs) to jointly represent image. However, GSF can not excavate the contextual information that hides in the spectral-spatial structure of three-dimensional hyperspectral imagery since GSF can only deal with spatial relationships. Meanwhile, GSF runs on GMPs with multi-scale and multi-orientation, which leads to dimensional explosion problem. Aiming at these two problems, three-dimensional surface feature (3DSF) approach is proposed for hyperspectral imagery in this paper. 3DSF directly deals with the raw hyperspectral imagery data and utilizes its first order derivative magnitude to jointly represent hyperspectral imagery. Experiments on three real hyperspectral datasets, including Pavia University, Houston University and Indian Pines, verify the effectiveness of the proposed 3DSF approach.

ThuB7 Deep learning 4

Thursday, November 16, 4:00PM-6:00PM, Room: Kaixuan 5, Chairs: Yao Lu and Qinglai Wei

4:00PM *Towards an affective computational model for machine consciousness [#17614]*

Rohitash Chandra, University of Sydney, Australia

In the past, computational models for machine consciousness have been proposed with varying degrees of challenges for implementa- tion. Affective computing focuses on the development of systems that can simulate, recognize, and process human affects which refer to the experi- ence of feeling or emotion. The affective attributes are important factors for the future of machine consciousness with the rise of technologies that can assist humans and also build trustworthy relationships between hu- mans and artificial systems. In this paper, an affective computational model for machine consciousnesses with a system of management of the major features. Real-world scenarios are presented to further illustrate the functionality of the model and provide a road-map for computational implementation.

4:15PM *Tree structure CNN for Automated Theorem Proving [#17114]*

Kebin Peng and Dianfu Ma, Beihang University, China

The most difficult and heavy work of Automated Theorem Proving(ATP) is that people should search in millions of intermediate steps to finish proof. In this paper, we present a novel neural network, which can effectively help people to finish this work. Specifically, we design a tree-structure CNN, involving bidirectional LSTM. We compare our model with other neural network models and make experiments on HOLStep dataset, which is a machine learning dataset for Higher-order logic theorem proving. Being compared to previous approaches, our model improves accuracy significantly, reaching 90% accuracy on the test set.

4:30PM *Music Genre Classification using Masked Conditional Neural Networks [#17147]*

Fady Medhat, David Chesmore and John Robinson, University of York, United Kingdom

The ConditionaL Neural Networks (CLNN) and the Masked ConditionaL Neural Networks (MCLNN) exploit the nature of multi-dimensional temporal signals. The CLNN captures the conditional temporal influence between the frames in a window and the mask in the MCLNN enforces a systematic sparseness that follows a filterbank-like pattern over the network links. The mask induces the network to learn about time-frequency representations in bands, allowing the network to sustain frequency shifts. Additionally, the mask in the MCLNN automates the exploration of a range of feature combinations, usually done through an exhaustive manual search. We evaluated the MCLNN performance using the Ballroom and Homburg datasets of music genres. MCLNN achieved accuracies that are competitive to state-of-the-art handcrafted attempts in addition to models based on Convolutional Neural Networks.

4:45PM *Compressing Low Precision Deep Neural Networks Using Sparsity-Induced Regularization in Ternary Networks [#17594]*

Julian Faraone, Nicholas Fraser, Giulio Gamberdella, Michaela Blott and Philip H.W. Leong, University of Sydney, Australia; Xilinx Research Labs, Ireland

A low precision deep neural network training technique for producing sparse, ternary neural networks is presented. The technique incorporates hardware implementation costs during training to achieve significant model compression for inference. Training involves three stages: network training using L2 regularization and a quantization threshold regularizer, quantization pruning, and finally retraining. Resulting networks achieve improved accuracy, reduced memory footprint and reduced computational complexity compared with conventional methods, on MNIST and CIFAR10 datasets. Our networks are up to 98\% sparse and 5 and 11 times smaller than equivalent binarized and ternary models, translating to significant resource and speed benefits for hardware implementations.

5:00PM *Soft Margin Softmax for Deep Classification [#17326]*

Xuezhi Liang, Xiaobo Wang, Zhen Lei, Shengcai Liao and Stan Z. Li, Chinese Academy of Sciences, China

In deep classification, the softmax loss (Softmax) is arguably one of the most commonly used components to train deep convolutional neural networks (CNNs). However, such a widely used loss is limited due to its lack of encouraging the discriminability of features. Recently, the large-margin softmax loss (L-Softmax) is proposed to explicitly enhance the feature discrimination, with hard margin and complex forward and backward computation. In this paper, we propose a novel soft-margin softmax (SM-Softmax) loss to improve the discriminative power of features. Specifically, SM-Softamx only modifies the forward of Softmax by introducing a non-negative real number m, without changing the backward. Thus it can not only adjust the desired continuous soft margin but also be easily optimized by the typical stochastic gradient descent (SGD). Experimental results on three benchmark datasets have demonstrated the superiority of our SM-Softmax over the baseline Softmax, the alternative L-Softmax and several state-of-the-art competitors.

5:15PM *Regularized Deep Convolutional Neural Networks for Feature Extraction and Classification [#17854]*

Khaoula Jayech, University of Sousse, Tunisia

Deep Convolutional Neural Networks (DCNNs) are the state-of-the-art in fields such as visual object recognition, handwriting and speech recognition. The DCNNs include a large number of layers, a huge number of units, and connections. Therefore, with the huge number of parameters, overfitting can occur. In order to prevent the network against this problem, regularization tech-niques have been applied in different positions. In this paper, we show that with the right combination of applied regularization techniques such as fully connected dropout, max pooling dropout, L2 regularization and He initialization, it is possible to achieve good results in object recognition with small networks and without data augmentation.

5:30PM *Disparity Estimation Using Convolutional Neural Networks with Multi-Scale Correlation [#17123]*

Samer Jammal, Tammam Tillo and Jimin Xiao, Xi'an Jiaotong-Liverpool University, China; University of Bozen-Bolzano, Italy

Disparity estimation is a long-standing task in computer vision and multiple approaches have been proposed to solve this problem. A recent work based on convolutional neural networks, which uses a correlation layer to perform the matching process, has achieved state-of-the-art results for the disparity estimation task. This correlation layer employs a single kernel unit which is not suitable for low texture content and repeated patterns. In this paper we tackle this problem by using a multi-scale correlation layer with several correlation kernels and different scales. The major target is to integrate the information of the local matching process by combining the benefits of using both a small correlating scale for fine details and bigger scales for larger areas. Furthermore, we investigate the training approach using horizontally elongated patches that fits the disparity estimation task. The results obtained demonstrate the benefits of the proposed approach on both synthetic and real images.

5:45PM *A Width-Variable Window Attention Model for Environmental Sensors [#17263]*

Yingju Xia, Cuiqin Hou, Jun Sun, Jing Shang, Ryozo Takasu and Masao Kondo, Fujitsu Research and Development Center Co.,LTD, China; Peking University, China; Fujitsu Laboratories LTD., Japan

Air pollution is a major problem in modern cities and developing countries. Fine particulate matter (PM2.5) is a growing public health concern and become the most serious air pollution. In this study, we formulate the PM2.5 inference problem in conventional environmental sensors as a sequence-to-sequence problem. We adopt the encoder-decoder LSTM (Long short term memory) framework to solve the PM2.5 inference problem. A novel width-variable window attention mechanism is proposed for the encoder-decoder LSTM system. The proposed method learn the position and width of the attention window simultaneously. The proposed method is evaluated on large scale data and the experimental results show that it achieves better performance on two datasets with different concentration of PM2.5.

ThuB8 Social networks

Thursday, November 16, 4:00PM-6:00PM, Room: Kaixuan 6, Chairs: Qing Ma and Long Cheng

4:00PM *A Linear Time Algorithm for Influence Maximization in Large-scale Social Networks [#17109]*

Hongchun Wu, Jiaxing Shang, Shangbo Zhou and Yong Feng, Chongqing University, China

Influence maximization is the problem of finding k seed nodes in a given network as information sources so that the influence cascade can be maximized. To solve this problem both efficiently and effectively, in this paper we propose LAIM: a linear time algorithm for influence maximization in large-scale social networks. Our LAIM algorithm consists of two parts: (1) influence computation; and (2) seed nodes selection. The first part approximates the influence of any node using its local influence, which can be efficiently computed with an iterative algorithm. The second part selects seed nodes in a greedy manner based on the results of the first part. We theoretically prove that the time and space complexities of our algorithm are proportional to the network size. Experimental results on six real-world datasets show that our approach significantly outperforms other state-of- the-art algorithms in terms of influence spread, running time and memory usage.

4:15PM *Category Prediction of Questions Posted in Community-Based Question Answering Services Using Deep Learning Methods [#17184]*

Qing Ma, Reo Kato and Masaki Murata, Ryukoku University, Japan; Tottori University, Japan

This paper presents methods of predicting categories of questions posted in community-based question answering (CQA) services using deep learning methods, which are implemented with stacked denoising autoencoders (SdA), as well as deep belief networks (DBN). We compare them with conventional machine learning methods, i.e., multi-layer perceptron (MLP) and support vector machines (SVM). We also compare their performance when using dropout regularization. The experimental results indicate that (1) the proposed methods reach much higher prediction precision than that provided by CQA services, (2) deep learning with dropout has higher prediction precision than the conventional machine learning methods, whether or not the dropout regularization is used, i.e., DBN with dropout reaches the highest precision and SdA with dropout reaches the next highest precision among all the methods in general, and the SdA with dropout in a specific case reaches the highest

precision across all experiments, (3) increasing the dimensions of feature vectors representing the questions is an effective measure for improving the prediction precision, (4) prediction precision can be further improved using titles in addition to the actual questions and by improving the quality of the corpus used for training.

4:30PM *LCE: A Location Category Embedding Model for Predicting the Category Labels of POIs [#17390]*

Yue Wang, Meng Chen, Xiaohui Yu and Yang Liu, Shandong University, China; York University, Canada

The proliferation of location-based social networks, makes it possible to record human mobility using an array of points-of-interest (POIs). Exploring the semantic meanings of POIs can be of great importance to many urban computing applications, e.g., personalized route recommendation and user trajectory clustering. Nonetheless, such information is not always available in practice. This paper aims at predicting the category labels, which will provide a succinct summarization of POIs. In particular, we first propose a Location Category Embedding (LCE) model, which projects user POIs and their associated category labels into the same vector space, and then identify the POIs' most related category labels according to their similarities. To capture the influence that might affect users' moving behavior, LCE considers sequential pattern, personal preference, and temporal influence, and further models the connection between the POIs and the three factors. Experimental results on two real-world datasets prove the effectiveness of the proposed method.

4:45PM *Collective Actions in Three Types of Continuous Public Goods Games in Spatial Networks [#17209]*

Zimin Xu, Qiaoyu Li and Jianlei Zhang, Nankai University, China

Collective action in the provision of pubic goods is analyzed in the framework of three kinds of public goods dilemmas routinely encountered in real-life situations. We study the evolution of cooperation in structured populations within three PGG models: the traditional public goods game (PGG), complementary public goods game (PPGG) and containable public goods game (TPGG), differing in supplying patterns of public goods. In addition, we extend the combination of dual strategy (cooperation and defection) to a portfolio of multiple strategies. We reveal that, is a fundamental property promoting cooperation in groups of selfish ndividuals, irrespective of which social dilemma applies. For a parallel comparison, it is found that the system in PGG and PPGG can perform comparatively better than TPGG, which reduces the provision of the public goods. Our study can be helpful in ffectively portraying the characteristics of cooperative dilemmas in real social systems.

5:00PM *Layer-Prioritized Influence Maximization in Social Networks [#17105]*

Qianwen Zhang, Yuzhu Wu and Jinkui Xie, East China Normal University, China

Influence maximization, first proposed by Kempe, is the problem of finding seed nodes that maximizes the number of nodes within influenced spread. However, not only influenced number, but also influence layer is a crucial element which may play an important role in viral marketing. In this paper, we design a new framework, layer-prioritized influence maximization (LPIM), to address the problem of influence maximization with an emphasis on influence layer. The proposed framework is mainly composed of three parts: (1) graph clustering. (2) seed subgraph detecting. (3) seed node selection. We also demonstrate the effective and efficient of our proposed framework by experiments on large collaboration networks and complexity analysis respectively.

5:15PM *Motifs Iteration Model for Network Representation [#17526]*

Lintao Lv, Zengchang Qin and Tao Wan, Beihang University, China

Social media mining has become one of the most popular research areas in Big Data with the explosion of social networking information from Facebook, Twitter, LinkedIn, Weibo and so on. Understanding and representing the structure of a social network is a key in social media mining. In this paper, we propose the Motif Iteration Model (MIM) to represent the structure of a social network. As the name suggested, the new model is based on iteration of basic network motifs. In order to better show the properties of the model, a heuristic and greedy algorithm called Vertex Reordering and Arranging (VRA) is proposed by studying the adjacency matrix of the three- vertex undirected network motifs. The algorithm is for mapping from the adjacency matrix of a network to a binary image, it shows a new perspective of network structure visualization. In summary, this model provides a useful approach towards building link between images and networks and offers a new way of representing the structure of a social network.

5:30PM *Inferring Social Network User's Interest based on Convolutional Neural Network [#17708]*

Yanan Cao, Shi Wang, Xiaoxue Li, Cong Cao, Yanbing Liu and Jianlong Tan, Institute of Information Engineering, Chinese Academy of Sciences, China; Institute of Computing Technology, Chinese Academy of Sciences, China

Learning microblog users' interest has important significance for constructing more precise user profile, and can be useful for some commercial applications such as personalized advertisement, or potential customer analysis. Existing works generally utilize text mining or label propagation methods to solve this problem, which leverage either the user's publicly available comments or the us- er's social links, but not both. As we will show, these learning methods achieve limited precision rates. To address this challenge, we consider the interest infer-ence task as a multi-value classification problem, and solve it using a convolu-tional neural network architecture. We innovatively present an ego social-attribute network model which integrates the target users' attributes, social links and their comments, and represent the ego SA network as the input fed to CNN. As a re-sult, we assign each microblog user one or more interest labels (such as "loving sports"), which is different from previous approaches using non-uniform interest keywords (such as "basketball", "tennis", etc.). Experimental results on SMP CUP and Zhihu dataset showed that the precision rate of user interest inference reached 77.9% at best.

5:45PM *Enhanced Deep learning Models for Sentiment Analysis in Arab Social Media [#17875]*

Mariem Abbes, Zied Kechaou and Adel M Alimi, University of Sfax, Tunisia

While research associated with English sentiment analysis has already achieved sig-nificant progress and success, a remarkable effort have been made to extend the focus of interest to cover the Arabic language domain. Indeed, most of the Arabic sentiment analysis systems tend to still rely on costly hand- crafted features, where features representation seems to rest on manual pre- processing procedures for the intended accuracy to be achieved. This is mainly due to the Arabic language morphological complexity, linguistic specificities and lack of the resources. For this purpose, deep learning techniques for Sentiment Analysis turn out to be very versatile and popular. It is in this context that the present paper can be set, with the major focus of the interest being laid on proposing a novel automated information processing systems based deep learning whereby Arab social media attached sentiment can be analyzed and categorized into a sentiment classification dataset show that RNN outperforms DNN in term of precision.

Friday, November 17, 1:30PM-3:30PM

FriA1 Computer vision 3

Friday, November 17, 1:30PM-3:30PM, Room: Kaixuan 7, Chairs: Jinwen Ma and Bo Zhao

1:30PM *Sharp and Real Image Super-Resolution Using Generative Adversarial Network [#17129]*

Dongyang Zhang, Jie Shao, Gang Hu and Lianli Gao, University of Electronic Science and Technology of China, China

Recent studies have achieved great progress on accuracy and speed of single image super-resolution (SISR) based on neural networks. Most current SISR methods use mean squared error (MSE) loss as objective function. As a result, they can get high peak signal-to-noise ratios (PSNR) which are however not in full agreement with the visual qualities by experiments, and thus the output from these methods could be prone to blurry and over-smoothed. Especially at large upscaling factors, the output images are perceptually unsatisfactory in general. In this paper, we firstly propose a novel residual network architecture based on generative adversarial network (GAN) for image super- resolution (SR), which is capable of inferring photo-realistic images for 4* upscaling factors. Perceptual loss is applied as the objective function to make output image sharper and more real. In addition, we adopt some tricks to preprocess the input dataset and use improved techniques to train the generator and discriminator separately, which are proved to be effective for the result. We validate our GAN-based approach on CelebA dataset with mean opinion score (MOS) as performance measure. The results demonstrate that the proposed approach performs better than previous methods.

1:45PM *End-to-End Disparity Estimation with Multi-Granularity Fully Convolutional Network [#17365]*

Guorun Yang and Zhidong Deng, Tsinghua University, China

Disparity estimation is a challenging task in the field of computer stereo vision. In this paper, we propose a multi-granularity fully convolutional network architecture for end- to-end dense disparity estimation. First, we use single well-pretrained residual network for extraction of multi-granularity and multi-layer features. Second, correlation layers at three different granularities are used to gain hierarchical matching cues between left and right feature maps. Third, we conduct concatenation-deconvolution operations to output disparity maps. Finally, the experimental results show that our method achieves state of the art results, taking the second place on the KITTI Stereo 2012 task.

2:00PM *A Pixel-to-Pixel Convolutional Neural Network for Single Image Dehazing [#17601]*

Chengkai Zhu, Yucan Zhou and Zongxia Xie, Tianjin University; Hong Kong University of Science and Technology, China; Tianjin University, China

Estimating transmission maps is the key to single image dehazing. Recently, Convolutional Neural Networks based methods (CNNs), which aim to minimize the difference between the predictions and the transmission maps, have achieved promising dehazing results and outperformed traditional feature-based algorithms. However, two transmission maps with the same estimation error can produce quite different dehazing results. Therefore, these models are incapable to directly affect the quality of the restorations. To address this issue, we propose a pixel- to-pixel dehazing convolutional neural network in this paper, which learns a map from the hazy images to the haze-free screens. Specifically, we intuitively maximize the visual similarity between the predicted images and the ground truth with some visual-relevant loss functions, e.g., the mean square error and the gradient difference loss. Experiments on synthetic dataset and real images demonstrate that our method is effective and outperforms the state-of-the-art dehazing methods.

2:15PM *End-to-end Scene Text Recognition with Character Centroid Prediction [#17769]*

Wei Zhao and Jinwen Ma, Peking University, China

Scene text recognition tries to extract text information from natural images, being widely applied in computer vision and intelligent information processing. In this paper, we propose a novel end-to-end approach to scene text recognition with a specially trained fully convolutional network for predicting the centroid and pixel class of each character. With the help of this new information, we can solve the instance or character segmentation problem effectively and then combine the recognized characters into words to accomplish the text recognition. It is demonstrated by the experimental results on ICDAR2013 dataset that our proposed method with character centroid prediction can get a promising result on scene text recogntion.

2:30PM *Region-based Face Alignment with Convolution Neural Network Cascade [#17844]*

Yu Zhang, Fei Jiang and Ruimin Shen, Shanghai Jiao Tong University, China

Most face alignment approaches perform landmark detection over the entire face. However, it has been shown that the difficulty for landmark detection is unbalanced among different facial parts. Thus, in this paper, we propose a novel region-based facial landmark detection algorithm based on a two-level convolutional neural networks (CNNs). In the first level, we partition the whole face into four regions including three facial components (eyebrow-eyes, nose, and mouth) and the face contour. Regions are detected through an improved CNN model which is incorporated with a feature fusion scheme. To simultaneously detect three facial components and face contour landmarks, a novel weighted loss function combining bounding box regression with landmark localization is presented. In the second level, the landmarks are separately detected for three facial components. Experimental results on the public benchmarks demonstrate the superiority of the proposed algorithm over several state-of-the-art face alignment algorithms.

2:45PM *Generating Low-rank Textures via Generative Adversarial Network [#17202]*

Shuyang Zhao and Jianwu Li, Beijing Institute of Technology, China

Achieving structured low-rank representation from the original image is a challenging and significant task, owing to the capacity of the low-rank structure in expressing structured information from the real world. It is noteworthy that, most of the existing methods to obtain the low-rank textures, treat this issue as a ``transformational problem", which lead to the poor quality of the images with complex backgrounds. In order to jump out of this interference, we try to explore this issue as a ``generative problem" and propose the Low-rank texture Generative Adversarial Network (LR-GAN) using an unsupervised image-to-image network. Our method generates the high-quality low- rank texture gradually from the low-rank constraint after many iterations of training. Considering that the low-rank constraint is difficult to optimize (NP- hard problem) in the loss function, we introduce the layer of the low-rank gradient filter to approach the optimal low-rank solution. Experimental results demonstrate that the proposed method iseffective on both synthetic and real world images.

3:00PM *Multi-scale Region Proposal Network trained by Multi-domain Learning for Visual Object Tracking [#17140]*

Yang Fang, Seunghyun Ko and Geun-Sik Jo, Inha University, Korea (South)

This paper presents a multi-scale region proposal network (RPN) for visual object tracking, inspired by Faster R-CNN and Yolo detectors which adopt an RPN to significantly speed up the detection time and achieve

state-of-the- art detection performance. We expand them to apply a multi-scale region proposal network for visual tracking. Our proposed network can utilize both fine-grained features from shallow convolutional layers and discriminative features from deep convolutional layers. The features of shallow layers are good at accurate objects localization, and the features of deep convolutional layers can efficiently distinguish between target objects and backgrounds. A multi-domain learning mechanism is applied to train our network in an end-to-end way.To predict a new target object and its location in a new frame, we propose an re-ranking algorithm to determine a true object by exploiting spatial modeling, scale variants and color attributes of object proposals. Our tracker is validated on the OTB-15 object tracking benchmark, and achieves 0.603 for the success rate and 0.760 for the precision rate of the one-pass evaluation. Additionally, our tracker can run at 22 frames per second, which is very close to real-time speed. Experiment results show its outstanding performance in both tracking accuracy and speed by comparing it with existing state-of-the-art methods.

3:15PM *Deep Part-based Image Feature for Clothing Retrieval [#17458]*

Laiping Zhou, Zhengzhong Zhou and Liqing Zhang, Shanghai Jiao Tong University, China

In this paper, we propose a straightforward way to extract part-based features only with the supervision of part-based attributes. As we know, regions can be highlighted by labels through weakly-supervised segmentation algorithms, and deep features can be extracted from CNN convolutional layers. We develop a new approach to combine them, leading to simpler procedure with only one CNN forward pass and better interpretation. We apply this method to our database of over 100,000 clothing images, and achieve comparable results to the state of the art. Moreover, the part-based features support functionalities of tuning weights among the parts, and substituting visual part features from other clothes. Because of its simplicity, the method is promising to be transferred to other image retrieval domains.

FriA2 Computational intelligencen 3

Friday, November 17, 1:30PM-3:30PM, Room: Zhujiang 2, Chairs: Jian Wang and Zeng-Guang Hou

1:30PM *Bayesian curve fitting based on RBF neural networks [#17380]*

Michael Li and Santoso Wibowo, Central Queensland University, Australia

In this article, we introduce a novel method for solving curve fitting problems. Instead of using polynomials, we extend the base model of radial basis functions (RBF) neural net-work by adding an extra linear neuron and incorporating the Bayesian learning. The unknown function represented by datasets is approximated by a set of Gaussian basis functions with a linear term. The additional linear term offsets the localized behavior induced by basis functions, while the Bayesian approach effectively reduces overfitting. The presented approach is initially utilized to assess two numerical examples, then further on the method is applied to fit a number of experimental datasets of heavy ion stopping powers (MeV energetic carbon ions in various elemental materials). Due to the linear correction, the pro-posed method significantly improves accuracy of fitting and outperforms the conventional numerical-based algorithms. Through the theoretical results, the numerical examples and the application of fitting noisy data of stopping powers, we demonstrate the suitability of the proposed method.

1:45PM *An Improved Conjugate Gradient Neural Networks Based on a Generalized Armijo Search Method [#17629]*

Bingjie Zhang, Tao Gao, Long Li, Zhanquan Sun and Jian Wang, China University of Petroleum, China

In this paper, by constructing a generalized Armijo search method, a novel conjugate gradient (CG) model has been proposed to training a common three-layer backpropagation (BP) neural network. Compared with the classical gradient descent method, this algorithm efficiently accelerates the convergence speed due to the existence of the additional conjugate direction. Essentially, the optimal learning rate of each epoch is determined by the given inexact line search strategy. The presented model does not significantly increase the computational cost in dealing with real applications. Two benchmark simulations have been performed to illustrate the promising advantages of the proposed algorithm.

2:00PM *Removing Bias from Diverse Data Clusters for Ensemble Classification [#17729]*

Sam Fletcher and Brijesh Verma, Central Queensland University, Australia

Diversity plays an important role in successful ensemble classification. One way to diversify the base-classifiers in an ensemble classifier is to diversify the data they are trained on. Sampling techniques such as bagging have been used for this task in the past, however we argue that since they maintain the global distribution, they do not engender diversity. We instead make a principled argument for the use of k-Means clustering to create diversity. When creating multiple clusterings with multiple k values, there is a risk of different clusterings discovering the same clusters, which would then train the same base-classifiers. This would bias the ensemble voting process. We propose a new approach that uses the Jaccard Index to detect and remove similar clusters before training the base-classifiers, reducing classification error by removing repeated votes. We demonstrate the effectiveness of our proposed approach by comparing it to three state-of-the- art ensemble algorithms on eight UCI datasets.

2:15PM *An Efficient Algorithm for Complex-valued Neural Networks through Training Input Weights [#17776]*

Qin Liu, Zhaoyang Sang, Hua Chen, Jian Wang and Huaqing Zhang, China University of Petroleum, China

Complex-valued neural network is a type of neural networks, which is extended from real number domain to complex number domain. Fully complex extreme learning machine (CELM) is an efficient algorithm, which owes faster convergence than the common complex backpropagation (CBP) neural networks. However, it needs more hidden neurons to reach competitive performance. Recently, an efficient learning algorithm is proposed for the single-hidden layer feed-forward neural network which is called the upper-layer-solution- aware algorithm (USA). Motivated by USA, an efficient algorithm for complex- valued neural networks through training input weights (GGICNN) has been proposed to train the split complex-valued neural networks in this paper. Compared with CELM and CBP, an illustrated experiment has been done in detail. which observes the better generalization ability and more compact architecture for the proposed algorithm.

2:30PM *Feature Selection Using Smooth Gradient $L_1/2$ Regularization [#17786]*

Hongmin Gao, Yichen Yang, Bingyin Zhang, Long Li, Huaqing Zhang and Shujun Wu, China University of Petroleum, China; Hengyang Normal University, China

In terms of $L_{1/2}$ regularization, a novel feature selection method for a neural framework model has been developed in this paper. Due to the non-convex, non-smooth and non-Lipschitz characteristics of $L_{1/2}$ regularizer, it is difficult to directly employ the gradient descent method in training multilayer perceptron neural networks. A smoothing technique has been considered to approximate the original $L_{1/2}$ regularizer. The proposed method is a two-stage updating approach. First, a multilayer network model with smoothing $L_{1/2}$ regularizer is trained to eliminate the unimportant features. Second, the compact model without regularization has been simulated until there is no improvements for the performance. The experiments demonstrate that the presented algorithm significantly reduces the redundant features while keeps a considerable model accuracy.

2:45PM *Top-k Merit Weighting PBIL for Optimal Coalition Structure Generation of Smart Grids [#17563]*

Sean Hsin-Shyuan Lee, Jeremiah D. Deng, Lizhi Peng, Martin K. Purvis and Maryam Purvis, University of Otago, New Zealand; University of Jinan, China

The cooperation of agents in smart grids to form coalitions could bring benefit both for agent itself and the distribution power system. To tackle the problem as a game of partition form function poses significant computing challenges due to the huge search space for the optimization problem. In this paper, we propose a stochastic optimization approach using Population Based Incremental Learning (PBIL) algorithm with top-k Merit Weighting and a customized strategy for choosing the initial probability to solve the problem. Empirical results show that the proposed algorithm gives competitive performance compared with a few stochastic optimization algorithms.

3:00PM *A Swarm Optimization-based Kmedoids Clustering Technique for Extracting Melanoma Cancer Features [#17777]*

Amin Khatami, Saeed Mirghasemi, Abbas Khosravi, Houshyar Asadi and Saeid Nahavandi, Deakin University, Australia; Victoria University of Wellington, New Zealand

Melanoma is a dangerous type of skin cancers. It is alarming to see the increase of this noxious disease in modern societies, however, it can be cured by surgical excision if it is detected early. In this paper, a swarm-based clustering technique for detecting melanoma is developed. Meaningful colour features from images are extracted, and a new objective function is introduced by applying an efficient and fast linear transformation to detect Melanoma. Specifically, the proposed technique consists of three main phases. The first phase is a pre-processing stage to organize data into proper attributes, while the subsequent two phases comprise iterative swarm optimisation procedures. The iterative swarm optimisation procedures involve a linear transformation to convert the existing colour components into a new colour space, formulation of the Kmedoids objective function, and error minimisation of the particle swarm optimisation (PSO) solutions. The Otsu threshold technique is utilised to provide binary images. The proposed technique is efficient and effective due to its linearity and simplicity.

3:15PM *A Deep Learning-Based Model For Tactile Understanding on Haptic Data Percutaneous Needle Treatment [#17857]*

Amin Khatami, Yonghang Tai, Abbas Khosravi, Lei Wei, Mohsen Moradi Dalvand, Min Zou and Saeid Nahavandi, Deakin University, Australia; Yunnan First People's Hospital, China

Tactile understanding during surgery is essential in medical simulation. To improve a remote surgical operation one step further, in this paper, we develop a sequence classification technique, categorising different tissues, evaluating on biomechanics data. The importance of the proposed model is emphasised when problems such as a delay is occurring during simulation. Monitoring, predicting, and understanding the sense of tissue which is supposed to be involved in operation is vital during surgery. To achieve this, different deep structural techniques are investigated to find the effect of deep features for tactile and kinaesthetic understanding. The experimental results reveal that residual networks outperform others with respect to different terms. The results are accurate and fast which enables the technique to perform in real-time.

FriA3 Robotics and control

Friday, November 17, 1:30PM-3:30PM, Room: Zhujiang 3, Chairs: Bin Xu and Yongchun Fang

1:30PM *A learning-based decentralized optimal control method for modular and reconfigurable robots with uncertain environment [#17051]*

Bo Dong, Keping Liu, Hui Li and Yuanchun Li, Changchun University of Technology, China

This paper presents a novel decentralized control approach for modular and reconfigurable robots (MRRs) with uncertain environment contact under a learning-based optimal compensation strategy. Unlike the known optimal control methods that are merely suitable for specific classes of robotic systems without implementing dynamic compensations, in this investigation, the dynamic model of the MRR system is described as a synthesis of interconnected subsystems, in which the obtainable local dynamic information is utilized effectively to construct the feedback controller, thus making the decentralized optimal control problem of the MRR system be formulated as an optimal compensation issue of the model uncertainty. A policy iteration algorithm is employed to solve the Hamilton-Jacobi-Bellman (HJB) equation with a modified cost function, which is approximated by constructing a critic neural network, and then the approximate optimal control policy can be derived. The asymptotic stability of the closed- loop MRR system is proved by using the Lyapunov theory. At last, simulations are performed to verify the effectiveness of the proposed decentralized optimal control approach.

1:45PM *Cloud-based knowledge sharing in cooperative robot tracking of multiple targets with deep neural network [#17573]*

Hui Bao, HuaiMin Wang, Bo Ding and SuNing Shang, National University of Defense Technology, China

Cooperative robot tracking of multiple targets plays an important role in many realistic robot applications. In order to minimize the time during which any target is not tracked, target trading among robots at runtime is a common phenomenon. After a period of successful tracking, the robot can gain a lot of knowledge about the target details, for example, the appearance changes caused by motion and illumination. However, the accumulated knowledge is dropped simply in existing research while robots trading targets, which makes each robot has to learn the knowledge of target details from scratch. The absence of knowledge sharing heavily influences the tracking accuracy in practice. In this paper, we propose a novel approach named Cloudroid Tracking which enables knowledge sharing through the support of the back-end cloud infrastructure. Our approach adopts the deep learning neural network and its online tuning mechanisms to enable the knowledge accumulation. And then, we enable the dynamic connection of multiple neural networks on the cloud infrastructure and multiple robots. No matter how the target changes, the robot can connect to the corresponding neural network which is responsible for a specific target. The experimental results on both open dataset and real robots show that our approach can promote the accuracy for robot tracking significantly.

2:00PM *Composite Learning Control of Hypersonic Flight Dynamics without Back-stepping [#17697]*

Yixin Cheng, Tianyi Shao, Rui Zhang and Bin Xu, Northwestern Polytechnical University, China; Shanghai Aerospace Control Technology Institute, China; Research Institute of Northwestern Polytechnical University in Shenzhen, China

In this paper, composite neural control is proposed for hypersonic flight control in presence of unknown dynamics. Using high gain observer (HGO), the controller of attitude subsystem is designed without back-stepping. This strategy simplifies the process of controller design and reduces the computation burden of parameter updating. To construct the composite neural controller, the filtered modeling error is further considered in the weight updating of RBF NN. Moreover, the composite neural controller can achieve the fast learning of system uncertainty. Simulation is presented to demonstrate the effectiveness of the design.

2:15PM *Disturbance Observer Based Optimal Attitude control of NSV Using Theta-D Method [#17733]*

Rongsheng Xia, Qingxiang Wu and Xiaohui Yan, Nanjing University of Aeronautics and Astronautics, China

In this paper, a disturbance observer based optimal attitude control scheme using theta-D method is presented for the near space vehicle (NSV). Firstly, theta-D method is used to design the optimal controller for the nominal system without considering the disturbance. Secondly, nonlinear disturbance observer (NDO) technique is applied to estimate the disturbance and the estimation result can be used as the disturbance compensation term. Then, the composite controller consisting of optimal controller and disturbance compensation term is proposed. The closed-loop system signals are proved to be uniformly ultimately bounded (UUB) using Lyapunov method. Finally, simulation results show the effectiveness of proposed control scheme.

2:30PM *Kinematic, Static and Dynamic Analyses of Flapping Wing Mechanism Based on ANSYS Workbench [#17231]*

Youpeng Li, Chen Qian, Bingqi Zhu and Yongchun Fang, Nankai University, China; Hohai University, China

A method for kinematic, static and dynamic analyses of single degree of freedom flapping wing aircraft is shown in this paper. All the analyses are realized completely by using ANSYS Workbench. A 3D model built in SolidWorks is imported into ANSYS Workbench. Firstly, a rigid body dynamic analysis is implemented to judge the connections among joints and get the maximum joint forces to find potentially dangerous positions of the movement. Then, a static analysis is carried out to check deformation and stress of the mechanism. On the basis of the above analyses, modal analysis and transient dynamic analysis are respectively achieved to determine the stress under dynamic loads, with the obtained results clearly demonstrating the rationality of the designed flapping wing mechanism.

2:45PM *Homography-Based Visual Servo Tracking Control of Wheeled Mobile Robots with Simutaneous Depth Identification [#17273]*

Yu Qiu, Baoquan Li, Wuxi Shi and Yimei Chen, Tianjin Polytechnic University, China

In this paper, a visual servo tracking control method is developed for the wheeled mobile robot subject to nonholonomic motion constraints, while the unknown feature depth information is simultaneously identied in the visual servoing process. Firstly, a video feature points are prerecorded as the desire trajectory for the mobile robot. Secondly, Euclidean homographies are constructed by utilizing projective geometric relationships of feature points. Subsequently, trajectory tracking errors are obtained after Euclidean homographies decomposition. Then, the kinematic controller is designed for the mobile robot to achieve the visual servo trajectory tracking task. Moreover, by utilizing the concurrent learning framework, the historical and current system data is used to construct an adaptive updating mechanism for recovering the unknown feature depth. Finally, Lyapunov techniques are utilized to prove that system tracking errors and the depth identication errors simultaneously converge to zero. Simulation results are collected to prove the efficiency and utility of the proposed strategy.

3:00PM *Amended Disturbance Observer Compensation -based Vibration Control for an all-Clamped Stiffened Plate [#17581]*

Shengquan Li, Juan Li, Jiawei Zhou, Yanqiu Shi and Shenghua Yuan, Yang Zhou University, China

The design of an acceleration sensor based active vibration control for an all- clamped stiffened panel with boned piezoelectric patches is studied. The problem of unmodeled error, harmonic effect and acceleration sensor noise, which degrade the performance of the system or even induce instability in real vibration control system, are considered. An amended disturbance observer plus linear feedback control strategy is developed to suppress these defects. First, the unmodeled error of the current controlled mode, harmonic effects, uncontrolled mode effects and high-frequency measurement noise, etc., are regarded as the lumped disturbances which can be estimated by the DOB, and the estimated value is used for the feed-forward compensation design. Then, a PID controller combing the acceleration sensor feedback is employed for the feedback design. A rigorous analysis is also given to show why the DOB can effectively suppress the lumped disturbances. In order to verify the proposed algorithm, the dSPACE real-time simulation plat-form is used and an experimental platform for the all-clamped stiffened panel smart piezoelectric structure active vibration control is set up. The experimental results demonstrate the effectiveness, practicality and strong anti-disturbance abil-ity of the proposed control strategy.

3:15PM *Consensus Maneuvering of Uncertain Nonlinear Strict-feedback Systems [#17094]*

Yibo Zhang, Dan Wang and Zhouhua Peng, Dalian Maritime University, China

In this paper, a consensus maneuvering problem is investigated for uncertain nonlinear systems in strict-feedback form. Consensus maneuvering controllers are developed based on a modular design approach. Specifically, an estimation module is proposed, where a neural network is employed for approximating the unknown nonlinearities. Then, a controller module is designed based on a modified dynamic surface control method. Finally, the input-to-state stability of the close-loop system is analyzed via cascade theory, and the consensus maneuvering error is proved to converge to a residual set.

FriA4 Pattern recognition 1

Friday, November 17, 1:30PM-3:30PM, Room: Zhujiang 5, Chairs: Huajin Tang and Qinmin Yang

1:30PM *On-Road Object Detection Based On Deep Residual Networks [#17565]*

Kang Chen, Qi Zhao, Yaorong Lin and Jun Zhang, South China University of Technology, China

In this paper, we explore the performance of deep residual networks in on-road object detection based on Faster R-CNN algorithm. We first optimize the setting of anchors through cluster analysis of training data. To achieve higher accuracy, we introduce a network design to combine multi-layers features. We also use a ROI spatial pyramid pooling layer to improve system performance on small objects. Experiment results show that the proposed method achieves better performance compared with baseline method.

1:45PM *Handwritten digit string recognition by combination of residual network and RNN-CTC [#17261]*

Hongjian Zhan, Qingqing Wang and Yue Lu, East China Normal University, China

Recurrent neural network (RNN) and connectionist temporal classification (CTC) have showed successes in many sequence labeling tasks with the strong ability of dealing with the problems where the alignment between the inputs and the target labels is unknown. Residual network is a new structure of convolutional neural network and works well in various computer vision tasks. In this paper, we take advantage of the architectures mentioned above to create a new network for handwritten digit string recognition. First we design a residual network to extract features from input images, then we employ a RNN to model the contextual information within feature sequences and predict recognition results. At the top of this network, a standard CTC is applied to calculate the loss and yield the final results. These three parts compose an

end-to-end trainable network. The proposed new architecture achieves the highest performances on ORAND-CAR-A and ORAND-CAR-B with recognition rates 89.75% and 91.14%, respectively. In addition, the experiments on a generated captcha dataset which has much longer string length show the potential of the proposed network to handle long strings.

2:00PM *Robustness of Selective Desensitization Perceptron Against Irrelevant and Partially Relevant Features in Pattern Classification [#17870]*

Tomohiro Tanno, Kazumasa Horie, Jun Izawa and Masahiko Morita, University of Tsukuba, Japan

Recent practical studies have shown that a selective desensitization neural network (SDNN) is a high-performance function approximator that is robust against redundant input dimensions. This paper examined the classification performance of a single- output-SDNN, which we refer to as a selective desensitization perceptron (SDP), through a numerical experiment on binary classification problems that include some irrelevant features and partially relevant features and compared these results with multilayer perceptron (MLP) and support vector machine (SVM) classification methods. The results show that SDP was highly effective not only in dealing with irrelevant features but also in a dataset including a partially relevant feature, which is irrelevant in most of the domain but affects the output in a specific domain. These results indicate that the previously observed SDNN's high-performance in the practical problems might be originated from the fact that SDP does not require a precise feature selection with taking account of the various degrees of feature relevance.

2:15PM *Single Sample Face Recognition Based on Global Local Binary Pattern Feature Extraction [#17070]*

Meng Zhang, Li Zhang and Chengxiang Hu, Soochow University, China

To improve the recognition rate of single sample per person (SSPP), in this paper we propose a novel single sample face recognition method based on global LBP feature extraction. We first calculate the LBP value of each pixel based on the whole image and obtain the corresponding LBP image. Then, we segment the LBP image into non- overlapping image blocks. For each image block, we take its statistical histograms as its global LBP feature. Finally, we use the nearest neighbor (NN) classifier for face classification. Experimental results on three widely used face databases, including AR, FERET and ORL databases, demonstrate the effectiveness and robustness of the proposed method.

2:30PM *Multi-task modular backpropagation for feature-based pattern classification [#17443]*

Rohitash Chandra, University of Sydney, Australia

Modular knowledge development in neural networks have the potential to feature robust decision given sudden changes in the environ- ment or the data during real-time implementation. It can also provide a means to address robustness in decision making given certain features of the data are missing post training stage. In this paper, we present a multi-task modular backpropagation algorithm that features develop- mental learning where the training takes into account several groups of features that constitute the overall task. The proposed algorithm em- ploys multi-task learning where knowledge from previously trained neural network modules are used to guide knowledge developmental in future modules. The results show that it is possible to implement a modular network without losing training or generalization performance.

2:45PM *The Abstraction for Trajectories with Different Numbers of Sampling Points [#17337]*

Peng Li, Qing Xu, Hao Wei, Yuejun Guo, Xiaoxiao Luo and Mateu Sbert, Tianjin University, China

Trajectory abstraction is an efficient way to handle the large amount of information included in complex trajectory data. Based on the previous work, this paper proposes an improved framework for abstracting trajectories, which consists of three major stages. First, the original trajectories in different lengths are matched into groups according to their similarities, and then a non-local denoising approach, based on the wavelet thresholding technique, is performed on these groups to summarize trajectories. Last, a combined version of the compacted trajectories is obtained as the final trajectory abstraction. To avoid loss of trajectory features introduced by the resampling technique, we provide a novel method to convert trajectories in different lengths into suppositional equal, which serves for the similarity measurement and the wavelet thresholding. Extensive experiments on real and synthetic trajectory datasets demonstrate that the proposed trajectory abstraction achieves very potential results dealing with complex trajectory data.

3:00PM *An Event-Driven Computational System with Spiking Neurons for Object Recognition. [#17571]*

Yuhao Ma, Rong Xiao and Huajin Tang, Sichuan University, China

We propose a biologically plausible computational system using spiking neural networks for object recognition, which processes the data from a temporal contrast address event representation (AER) sensor. The spike-based features are obtained through event-driven Gabor function and LIF neurons. And a time-to-first spike operation (also as a temporal Winner-Take-All (WTA) operation) with lateral reset in the same pooling area is implemented for reducing memory and computational costs. An address lookup table (LUT) is also applied to adjust the feature maps via address mapping and reordering. Then, the extracted spike feature patterns are classified by tempotron neurons. Our system can not only capture temporal visual information, but also learn features entirely based on the timing spikes information. Experiments conducted on two AER datasets have proved its efficiency for object recognition.

3:15PM *A Metric Learning Method Based on Damped Momentum with Threshold [#17736]*

Le Zhang, Lei Liu and Zhiguo Shi, University of Science and Technology Beijing, China

The convolutional neural networks in deep learning have become one of the mainstream algorithms of face recognition technology. Moreover, metric learning is also an important method to train deep learning models, as its ability of verification is very powerful, especially for the face images which are often used in CNNs. Recently, a new type method of metric learning named Center Loss has been proposed. It is simple to use and can enhance the model performance obviously. However, since the updating mechanism of Center Loss is simplistic, it can hardly process large- scale data when the categories are too much. This paper proposes an improved algorithm of Center Loss to accelerate the updating process of feature centers of original algorithm with a damped momentum, which urges deep learning models to have more rapid and steady convergence and better performance. Meanwhile, almost no additional computation cost is added since the new method has an optional threshold. The experimental results show that the improved Center Loss algorithm can further improve the recognition ability of the model, which is very helpful to enhancing the user experience of complex face recognition systems.

FriA5 Machine learning 5

Friday, November 17, 1:30PM-3:30PM, Room: Zhujiang 7, Chairs: Keiji Tatsumi and Dongbin Zhao

1:30PM *A multiobjective multiclass support vector machine restricting classifier candidates based on k-means clustering [#17518]*

Keiji Tatsumi, Yuki Kawashita and Takahumi Sugimoto, Osaka University, Japan

In this paper, we propose a reduction method for the multiobjective multiclass support vector machine (MMSVM) which can maintain the discrimination ability and reduce the computational complexity of the original MMSVM. The proposed method finds some centroids of each class by a k-means clustering and obtains a classifier based on the centroids where the normal vectors of the corresponding discriminant hyperplanes are given by weighted sums of the centroids, while the geometric margins are exactly maximized between class pairs. Through some numerical experiments for benchmark problems, we observed that the proposed method can reduce the computational complexity without decreasing its generalization ability.

1:45PM *Multi-Label Learning with Label-Specific Feature Selection [#17812]*

Yan Yan, Shining Li, Zhe Yang, Xiao Zhang, Jing Li, Anyi Wang and Jingyu Zhang, Northwestern Polytechnical University, China

In multi-label learning, an efficient approach with label-specific features named LIFT has been presented, since different labels may have some distinct characteristics. However, the construction of label-specific features by simply assigning equal weight to each instance ignores the relevance among samples, which might increase the dimensionalities and result in a large amount of redundant information. In order to reduce the redundancy, a novel yet effective multi-label learning approach with weighted label-specific feature selection by using information theory (WFSI-LIFT) is proposed. In WFSI-LIFT, we employ the information theory to implement label-specific feature selection and assign different weights to the different class instance according to imbalance rate(IR). And then, comprehensive experiments across 8 real-world multi-label data sets indicate that, WFSI-LIFT can not only reduce the dimensionalities of label-specific features and enhance the performance compared with LIFT, but also validate the superiority of our approach against other well-established multi- label learning algorithms.

2:00PM *Neural Networks for Efficient Nonlinear Online Clustering [#17588]*

Yanis Bahroun, Eugenie Hunsicker and Andrea Soltoggio, Loughborough University, United Kingdom

Unsupervised learning techniques, such as clustering and sparse coding, have been adapted for use with data sets exhibiting nonlinear relationships through the use of kernel machines. These techniques often require an explicit computation of the kernel matrix, which becomes expensive as the number of inputs grows, making it unsuitable for efficient online learning. This paper proposes an algorithm and a neural architecture for online approximated nonlinear kernel clustering using any shift-invariant kernel. The novel model outperforms traditional low-rank kernel approximation based clustering methods, it also requires significantly lower memory requirements than those of popular kernel k-means while showing competitive performance on large data sets.

2:15PM *A Novel Newton-Type Algorithm for Nonnegative Matrix Factorization with Alpha-Divergence [#17077]*

Satoshi Nakatsu and Norikazu Takahashi, Okayama University, Japan

We propose a novel iterative algorithm for nonnegative matrix factorization with the alpha-divergence. The proposed algorithm is based on the coordinate descent and the Newton method. We show that the proposed algorithm has the global convergence property in the sense that the sequence of solutions has at least one convergent subsequence and the limit of any convergent subsequence is a stationary point of the corresponding optimization problem. We also show through numerical experiments that the proposed algorithm is much faster than the multiplicative update rule.

2:30PM *Stochastic Sequential Minimal Optimization for Large-scale Linear SVM [#17224]*

Shili Peng, Qinghua Hu, Jianwu Dang and Zhichao Peng, Tianjin University, China

Linear support vector machine (SVM) is a popular tool in machine learning. Compared with nonlinear SVM, linear SVM produce competent performances, and is more efficient in tacking larg-scale and high dimensional tasks. In order to speed up its training, various algorithms have been developed, such as Liblinear, SVM-perf and Pegasos. In this paper, we propose a new fast algorithm for linear SVMs. This algorithm uses the stochastic sequence minimization optimization (SSMO) method. There are two main differences between our algorithm and other linear SVM algorithms. Our algorithm updates two variables, simultaneously, rather than updating a single variable. We maintain the bias term b in discriminant functions. Experiments indicate that the proposed algorithm is much faster than some state of the art solvers, such as Liblinear, and achieves higher classification accuracy.

2:45PM *Large-Margin Supervised Hashing [#17462]*

Xiaopeng Zhang, Hui Zhang, Yong Chen and Xianglong Liu, Beihang University, China

Learning to hash embeds objects (e.g. images/documents) into a binary space with the semantic similarities preserved from the original space, which definitely benefits large-scale tough tasks such as image retrieval. By leveraging semantic labels, supervised hashing methods usually achieve better performance than unsupervised ones in real-world scenarios. However, most existing supervised methods do not sufficiently encourage inter-class separability and intra-class compactness which is quite crucial in discriminative hashcodes. In this paper, we propose a novel hashing method called Large-Margin Supervised Hashing (LMSH) based on a non-linear classification framework. Specifically, LMSH introduces the angular decision margin which could adjust inter- class separability and intra-class compactness through a hyper-parameter for more discriminative codes. Extensive experiments on three public datasets are conducted to demonstrate the LMSH's superior performance to some state-of-the-arts in image retrieval tasks.

3:00PM *A hybrid evolutionary algorithm for protein structure prediction using the Face-Centered Cubic lattice model [#17825]*

Daniel Varela and Jose Santos, University of Corunna, Spain

A hybrid combination between Differential Evolution (DE) and a local search procedure was used for the protein structure prediction problem. The Face- Centered Cubic lattice model was employed for the protein conformation representation. A Lamarckian combination between the global search of DE and the local search provides better results for obtaining protein conformations with minimal energy under the same number of fitness evaluations in comparison with DE alone. The results were validated with several benchmark protein sequences.

3:15PM *Bridging the Gap between Probabilistic and Deterministic Models: A Simulation Study on a Variational Bayes Predictive Coding Recurrent Neural Network Model [#17525]*

Ahmadreza Ahmadi and Jun Tani, Dept. of Electrical Engineering, KAIST, Korea (South); Okinawa Institute of Science and Technology, Japan

The current paper proposes a novel variational Bayes predictive coding RNN model, which can learn to generate fluctuated temporal patterns from exemplars. The model learns to maximize the lower bound of the weighted sum of the regularization and reconstruction error terms. We examined how this weighting can affect development of different types of information processing while learning fluctuated temporal patterns. Simulation results show that strong weighting of the reconstruction term causes the development of deterministic chaos for imitating the randomness observed in target sequences, while strong weighting of the regularization term causes the development of stochastic dynamics imitating probabilistic processes observed in targets. Moreover, results indicate that the most generalized learning emerges between these two extremes. The paper

concludes with implications in terms of the underlying neuronal mechanisms for autism spectrum disorder.

FriA6 Time series analysis & Robotics control

Friday, November 17, 1:30PM-3:30PM, Room: Kaixuan 3, Chairs: Thibaut Castaings and Tieshan Li

1:30PM *Time Series Forecasting using GRU Neural Network with Multi-lag after Decomposition [#17275]*

Xu Zhang, Furao Shen, Jinxi Zhao and Guohai Yang, Nanjing University, China; Nanjing Melangy Energy Science and Technology Co.Ltd, China

Time series forecasting has a wide range of applications in society, industry, market, etc. In this paper, a new time series forecasting method (FCD-MLGRU) is proposed for solving short-term forecasting problem. First we decompose the original time series using Filtering Cycle Decomposition (FCD) proposed in this paper, secondly we train the Gated Recurrent Unit (GRU) Neural Network to forecasting the subseries respectively. In the process of training and forecasting, the multi-time-lag sampling and ensemble forecasting method is adopted, which reduces the dependence on the selection of time lag and enhance the generalization and stability of the model. The comparative experiments on the real data sets and theoretical analysis show that our proposed method performs better than other related methods.

1:45PM *Position-based Content Attention for Time Series Forecasting with Sequence-to-sequence RNNs [#17369]*

Yagmur Gizem Cinar, Hamid Mirisaee, Parantapa Goswami, Eric Gaussier, Ali Ait-Bachir and Vadim Strijov, University of Grenoble Alpes, France; Viseo Technologies, France; Coservit, France; Computing Centre of Russian Academy of Sciences, Russia

We propose here an extended attention model for sequence-to-sequence recurrent neural networks (RNNs) designed to capture (pseudo-)periods in time series. This extended attention model can be deployed on top of any RNN and is shown to yield state-of-the-art performance for time series forecasting on several univariate and multivariate time series.

2:00PM *Dynamics analysis of underactuated cherrypicker systems with friction [#17435]*

Yiming Wu, Yifa Liu, Ning Sun and Yongchun Fang, Nankai University, China

The cherrypicker system has long mechanical arms and an unactuated bucket, which helps raise up workers to implement difficult aerial works on high up towers, power lines, and buildings. However, due to the gravity and inertia, the bucket has residual vibration which brings safety concerns. In order to design controllers to suppress the oscillation, this paper first provides a dynamic model of a two-armed cherrypicker system with friction by using Lagrange's modeling method and also derives the matrix form dynamic equation. Numerical simulation results verify the feasibility of the model.

2:15PM *Energy Management of Planetary Gear Hybrid Electric Vehicle based on Improved Dynamic Programming [#17318]*

Xin Tang, Liang Chu, Nan Xu, Di Zhao and Zhe Xu, Jilin University, China; China FAW Group Corporation, China

Dynamic Programming (DP) is often used in hybrid electric vehicle (HEV) energy management strategies to optimize fuel economy performance. When using the DP algorithm to find the optimal State of Charge (SOC) trajectory, we found that the optimal SOC trajectory is more than one. However, the traditional DP algorithm can just show the one optimal path from masses of optimal SOC trajectories. In this paper, we proposed an improved DP algorithm to find a region that is made up of many optimal trajectories. Planetary gear hybrid electric vehicles as a research object in this paper and obtained the better fuel economy by the proposed algorithm with a lower computational complexity. At the same time, this method can offer the possibility for the further optimization of the vehicle ride comfort in the future.

2:30PM *Event-based Target Tracking Control for a Snake Robot Using a Dynamic Vision Sensor [#17850]*

Zhuangyi Jiang, Zhenshan Bing, Kai Huang, Guang Chen, Long Cheng and Alois Knoll, Technical University of Munich, Germany; Sun Yat-sen University, China

Dynamic Vision Sensor (DVS) is a promising neuromorphic vision sensor for autonomous locomotion control of mobile robots, as the DVS acquires visual information by mimicking retina to sense and encode the world as neural signals. In this paper, we present an autonomous target detecting and tracking control approach for a snake-like robot with a monocular DVS. By using Hough transform based on the Spiking Neural Network (SNN), the target pole is detected as two parallel lines from the event-based visual input. Then a depth estimation method based on the pose and motion of the robot is proposed. Furthermore, by combining the periodic motion feature of the snake-like robot, an adaptive tracking method based on the estimated depth information is introduced. Experiments are conducted on a snake-like robot to demonstrate the practicality and accuracy of our proposed method to track a target pole dynamically with a monocular DVS.

2:45PM *Enabling Imagination: Generative Adversarial Network-Based Object Finding in Robotic Tasks [#17538]*

Huimin Che, Ben Hu, Bo Ding and HuaiMin Wang, National University of Defense Technology, China

The skill to find objects in a real world situation is important for mobile robots. Existing works of robotic vision-based object finding is based on the traditional training and classification paradigm, which means that a robot can only detect objects with the fixed and pre-trained classification labels. It is of great challenge for robots to find an untrained object, even if a complex description of the object has been given. In this paper, we proposed a vision-based object detection approach for robotic finding names Generative Search. It is inspired by the object detection model that when an unfamiliar object needs to be found through a complex description, human would "imagine" the object in his or her brain and then find the object which is mostly like the imagined object profile. By adopting a Generative Adversarial Network(GAN), our approach enables the robot to generate the object virtually according to the given description. Then, we use pre-trained deep neural networks to match the generated image with images in the robotic vision. At the implementation level, we adopt the cloud robotic architecture to promote the algorithm efficiency. The experiments on both open datasets and real robotic scenarios have proved the significant promotion of object finding accuracy when a robot searching an unfamiliar object with a complex description.

3:00PM *A Causal Multi-Armed Bandit Approach for Domestic Robots' Failure Avoidance [#17587]*

Nathan Ramoly, Amel Bouzeghoub and Beatrice Finance, Telecom SudParis, France; David laboratory, France

As there is a growing need for domestic healthcare, multiple projects are aiming to bring domestic robots in our homes. These robots aim to help users in their everyday life through various actions. However, they are subjected to task failure, making them less efficient and, possibly, bothering to the users. In this work, we aim to prevent task failures by understanding their causes through robot's experience. In order to guarantee high accuracy, our approach uses highly semantic data as well as user validation. Our approach can consolidate its knowledge or discover new possible causes, and uses a multi-armed bandit solution: R-UCB. In order to make it more efficient, R-UCB was improved using causal induction and causal graphs. Experiments show our proposition to achieve a very high rate of correct failure prevention.

3:15PM *Compositional Sentence Representation from Character within Large Context Text [#17470]*

Geonmin Kim, Hwaran Lee, Bokyeong Kim and Soo-young Lee, Korea Advanced Institute of Science and Technology, Korea (South)

This paper describes a Hierarchical Composition Recurrent Network (HCRN) consisting of a 3-level hierarchy of compositional models: character, word and sentence. This model is designed to overcome two problems of representing a sentence on the basis of a constituent word sequence. The first is a data sparsity problem when estimating the embedding of rare words, and the other is no usage of inter-sentence dependency. In the HCRN, word representations are built from characters, thus resolving the data- sparsity problem, and inter-sentence dependency is embedded into sentence representation at the level of sentence composition. We propose a hierarchy- wise language learning scheme in order to alleviate the optimization difficulties when training deep hierarchical recurrent networks in an aend- to-end fashion. The HCRN was quantitatively and qualitatively evaluated on a dialog act classification task. In the end, the HCRN achieved the state-of- the-art performance with a test error rate of 22.7% for dialog act classification on the SWBD-DAMSL database.

FriA7 Sensory perception & Data mining & Information security

Friday, November 17, 1:30PM-3:30PM, Room: Kaixuan 5, Chairs: Shunji Satoh and Ding Wang

1:30PM *Performance Comparison of Motion Encoders: Hassenstein-Reichardt and Two-detector Models [#17091]*

Hideaki Ikeda and Toru Aonishi, Tokyo Institute of Technology, Japan

Several motion-detection models have been proposed based on insect visual system studies. We specifically examine two models, the Hassenstein-Reichardt (HR) model and the two-detector (2D) model, before selecting model the more efficient motion encoders. We analytically obtained the mean and variance of stationary responses of the HR and the 2D models to white noise to evaluate performances of the two models. Especially when analyzing the 2D model, we calculated higher-order cumulants of a rectified Gaussian. Results show that the 2D model gives almost equal performance to that of the HR model in a biologically reasonable case.

1:45PM *A Joint Learning Framework of Visual Sensory Representation, Eye Movements and Depth Representation For Developmental Robotic Agents [#17452]*

Tanapol Prucksakorn, Sungmoon Jeong and Nak Young Chong, Japan Advanced Institute of Science and Technology, Japan

In this paper, a novel visual learning framework for developmental robotics agents, which is to mimic the developmental learning concept from human infants, is proposed. It can be applied to the agent to autonomously perceive depth by simultaneously developing their visual sensory representation, eye movement control and depth representation knowledge through integrating multiple visual depth cues during self-induced lateral body movement. Based on the active efficient coding theory (AEC), the sparse coding and reinforcement learning methods are tightly coupled with each other by sharing a unified cost function to update the performance of the sensory coding model and eye motor control. The generated multiple eye motor control signals for different visual depth cues are used together as inputs for the multi-layer neural networks for representing the given depth from simple human-robot interaction. We have shown that the proposed learning framework, which is implemented on the Hoap-3 humanoid robot simulator, can effectively learn how to autonomously develop the sensory visual representation, eye motor control and depth perception with self- calibrating ability at the same time.

2:00PM *Formulation of Border-Ownership Assignment in Area V2 as an Optimization Problem. [#17448]*

Zaem Arif Zainal and Shunji Satoh, The University of Electro-Communications, Japan

Border-ownership (BO) assignment, or the assignment of borders to an occluding object, is a primary step in visual perception. Physiological experiments have revealed the existence of neurons in area V2 that respond selectively to objects placed on a specific side of their response field. Although existing models can reproduce this phenomenon, they are not based on a clear computational theory. For this study, we formulated BO assignment as a well-defined optimization problem. We hypothesize that information related to BO assignment can be expressed as a conservative vector field. This conservative vector field is proposed as the gradient of a scalar field that carries information related to the depth order of the overlapping object. Conservative vector fields have zero curl (rotation). Using this theorem, we construct and solve an optimization problem. Numerical simulations demonstrate that a model based on our derived algorithm solves BO assignment for problems of perceived order and occlusion. Deduced neural networks provide insight into possible characteristics of lateral connections in area V2.

2:15PM *Wireless Network Gateway Placement By Evolutionary Graph Clustering [#17504]*

Maolin Tang and Chien-An Chen, Queensland University of Technology, Australia

Gateway placement is an important problem in the design of a backbone wireless network (BWN) as it directly affects the installation and ongoing running costs of the BWN. From a computational point of view, the gateway placement problem is a constrained combinatorial optimization problem. In this paper, we transform the gateway problem into a graph clustering problem and design a repairing genetic algorithm (RGA) to solve the graph clustering problem. Different from traditional GAs, this RGA embeds a procedure that can detect and repair those infeasible solutions generated by the crossover and mutation operators. Experimental results show that the infeasible solution detecting and repairing procedure can not only reduce the computation time of the RGA, but also improve the quality of the solutions generated by the RGA. In this paper, we also conduct an empirical study of the computational efficiency of the RGA. The analysis result shows that its computational efficiency is quadratic, which is computationally efficient.

2:30PM *A Visual Analysis of Changes to Weighted Self-Organizing Map Patterns [#17136]*

Younjin Chung, Joachim Gudmundsson and Masahiro Takatsuka, The University of Sydney, Australia

Estimating output changes by input changes is the main task in causal analysis. In previous work, input and output Self-Organizing Maps (SOMs) were associated when conducting causal analysis of multivariate and nonlinear data. Based on the SOM association, a weight distribution of the output conditional on a given input was obtained over the output map space. Such a weighted SOM pattern of the output changes when the input changes. In order to analyze the pattern change, it is important to measure the difference of the patterns. Many methods have been proposed for measuring the dissimilarity of patterns; however, it is still a major challenge to identify how patterns are different. In this paper, we propose a visual approach for analyzing changes to weighted SOM patterns. This approach extracts features that represent the difference of patterns by change and facilitates overall and detailed comparisons of pattern changes. Ecological data are used to demonstrate the usefulness of our approach and the experimental results show that it visualizes the change information effectively.

2:45PM *A Multi-attention-based Bidirectional Long Short-Term Memory Network for Relation Extraction [#17264]*

Lingfeng Li, Yuanping Nie, Weihong Han and Jiuming Huang, National University of Defense Technology, China

Compared to conventional methods, recurrent neural networks and corresponding variants have been proved to be more effective in relation extraction tasks. In this paper, we propose a model that combines a bidirectional long short- term memory network with a multi-attention mechanism for relation extraction. We designed a bidirectional attention mechanism to extract word-level features from a single sentence and chose a sentence-level attention mechanism to focus on features of a sentence set. Our experiments were conducted on a public dataset to evaluate the performance of the model. The experimental results demonstrate that the multi-attention mechanism can make full use of all informative features of a single sentence and a sentence set and our model achieves state-of-the-art performance.

3:00PM *An Integrated Chaotic System with Application to Image Encryption [#17414]*

Jinwen He, Rushi Lan, Shouhua Wang and Xiaonan Luo, Guilin University of Electronic Technology, China

Chaotic maps are widely applied in many applications. This paper proposes an integrated chaotic system (ICS) to improve the performance of some representative chaotic maps. ICS conducts cascade and nonlinear combination operations to three seed maps such that it has more complex chaotic behaviors and high security levels. A new image encryption algorithm is also developed using ICS. Simulation results on different types of images and security analysis demonstrate that the proposed approach has satisfactory properties in image encryption.

3:15PM *Fast, Automatic and Scalable Learning to Detect Android Malware [#17768]*

Mahmood Yousefi-Azar, Len Hamey, Vijay Varadharajan and Mark McDonnell, Macquarie University, Australia; University of South Australia, Australia

We propose a novel scheme for Android malware detection. The scheme has two extremely fast phases. First term-frequency simhashing (tf-simhashing) extracts a fixed sized vector for each binary file. The hashing algorithm embeds the requency of n-grams of bytes into the output vector which can be reshaped into an image representation. In the second phase, we propose a convolutional extreme learning machine (CELM) learns to distinguish between hashes of malicious and clean files as a two class classification task. This scalable scheme is extremely fast in both learning and predicting. The results show that tf-imhashing in an image-shape representation together with CELM provides better performance than three non- parametric models and one state-of-the-art parametric model.

FriA8 Computational intelligence and its applications

Friday, November 17, 1:30PM-3:30PM, Room: Kaixuan 6, Chairs: Xiaolin Hu and Lidan Wang

1:30PM *Training the Hopfield Neural Network for Classification Using a STDP-Like Rule [#17643]*

Xiaolin Hu and Tao Wang, Tsinghua University, China; Huawei Technology, China

The backpropagation algorithm has played a critical role in training deep neural networks. Many studies suggest that the brain may implement a similar algorithm. But most of them require symmetric weights between neurons, which makes the models less biologically plausible. Inspired by some recent works by Bengio et al., we show that the well-known Hopfield neural network (HNN) can be trained in a biologically plausible way. The network can take hierarchical architectures and the weights between neurons are not necessarily symmetric. The network runs in two alternating phases. The weight change is proportional to the firing rate of the presynaptic neuron and the state (or membrane potential) change of the postsynaptic neuron between the two phases, which approximates a classical spike-timing-dependent-plasticity (STDP) rule. Several HNNs with one or two hidden layers are trained on the MNIST dataset and all of them converge to low training errors. These results further push our understanding of the brain mechanism for supervised learning.

1:45PM *Improving Hashing by Leveraging Multiple Layers of Deep Networks [#17670]*

Xin Luo, Zhen-Duo Chen, Gao-Yuan Du and Xin-Shun Xu, Shandong University, China

Hashing methods usually consist of two crucial steps: encoding data with features and learning hash functions. Recently, some deep neural networks based hashing methods have been proposed and shown their efficiency as deep models can offer discriminative features. However, few deep hashing methods consider to leverage features from multiple layers. It is well known that different layers can provide different types of features, e.g., high, mid and low-level features, etc. Thus, a model is expected to obtain good performance if it could leverage the features from multiple layers simultaneously. Motivated by this, in this paper, we propose a novel technique to leverage different types of features from multiple layers of deep neural network, which can improve the accuracy. Experiments on real datasets show that the performance of end-to-end deep hashing is significantly enhanced; moreover, non-deep hashing can also benefit from our proposed technique of leveraging multiple layers' features.

2:00PM *A Radiomics Approach for Automated Identification of Aggressive Tumors on Combined PET and Multi-parametric MRI [#17517]*

Tao Wan, Bixiao Cui, Yaping Wang, Zengchang Qin and Jie Lu, Beihang University, China; Xuanwu Hospital Capital Medical University, Chile; Xuanwu Hospital Capital Medical University, China

We present a computerized image-based method to automatically identify aggressive tumors on combined positron emission tomography and magnetic resonance imaging (PET-MRI) using radiomics texture features from both PET and multi-parametric MRI (MP-MRI). The work aims at investigating the potential use of new composite textures from PET-MRI for the assessment of different biological properties present in cancer and non-cancer regions, and eventually for early detection of malignant tumors in real clinical practice. Towards this goal, a large number of radiomics features are extracted to characterize the intratumoural heterogeneity and microarchitectural morphologic differences within tumors. These image attributes are valuable for determining tumor aggressiveness. The radiomics model was evaluated on three types of cancers (pancreas, gallbladder, and liver). Compared to single image modality (PET or MRI), the fused PET and MP-MRI achieved the best classification performance in differentiating cancer and non-cancer regions with the area of under curve (AUC) of 0.87 for pancreas cancer, 0.89 for gallbladder cancer, and 0.82 for liver cancer. The results indicated that PET-MRI based imaging biomarkers could be useful in identifying aggressive tumors.

2:15PM *A new vector space model based on the deep learning [#17823]*

Hanen Karamti, Mohamed Tmar and Faiez Gargouri, University of Sfax, Tunisia

Deep learning has become one of the top performing methods for many computer vision tasks such as images retrieval. It has been deployed so far to bring improvements to learning feature representations and similarity measures. In this article, we present a new method to represent and to retrieve im- ages called vectorization. This method transforms any matching model of images to a vector space model providing a score using the Convo- lutional Neural Networks. The results obtained by this model are illus- trated through some experiments.

2:30PM *Robust Deep Face Recognition with Label Noise [#17642]*

Jirui Yuan, Wenya Ma, Pengfei Zhu and Karen Egiazarian, Tampere University of Technology, Finland; Tianjin University, China

The performance of face recognition has been greatly improved due to the development of deep learning techniques. Whereas, face recognition is still suffering from diverse variations of face images, especially for face identification. The high expense of labelling data makes it hard to get massive face data with correct identification information. In real-world applications, the collected data are mixed with severe label noise, which significantly degrades the generalization ability of deep learning models. In this paper, to alleviate the impact of the label noise, we propose a robust deep face recognition (RDFR) method by automatic outlier removal. The noisy faces are automatically recognized and removed, which can boost the performance of the learned deep models. Experiments on large-scale face datasets LFW, CCFD, and COX show that RDFR can effectively remove the label noise and improve face recognition performance.

2:45PM *Deep Metric Learning with Symmetric Triplet Constraint for Person Re-identification [#17523]*

Sen Li, Xiao-Yuan Jing, Xiaoke Zhu, Xinyu Zhang and Fei Ma, Wuhan University, China

Deep metric learning is an effective method for person reidentification (PR-ID). In practice, impostor samples generally own more discriminative information than other well separable negative samples (WSN-samples). Specifically, existing triplet-based deep learning methods with asymmetric triplet constraint can not effectively remove impostors because they treat all different types of negative samples equally. To utilize discriminative information in negative samples more efficiently, we build a symmetric triplet constraint based deep metric learning network (STDML). STDML designs a symmetric triplet margin maximized objective function, which requires impostors to leave more than a margin from positive pair and requires the distance between WSN-samples maximized, simultaneously. Experiments on three benchmark datasets (CUHK03, CUHK01 and VIPeR) achieve better performance than existing methods and significantly improved the effectiveness of exploiting discriminative information from WSN-samples.

3:00PM *3HAN: A Deep Neural Network for Fake News Detection [#17868]*

Sneha Singhania, Nigel Fernandez and Shrisha Rao, International Institute of Information Technology Bangalore, India

The rapid spread of fake news is a serious problem calling for AI solutions. We employ a deep learning based automated detector through a three level hierarchical attention network (3HAN) for fast, accurate detection of fake news. 3HAN has three levels, one each for words, sentences, and the headline, and constructs a news vector: an effective representation of an input news article, by processing an article in an hierarchical bottom-up manner. The headline is known to be a distinguishing feature of fake news, and furthermore, relatively few words and sentences in an article are more important than the rest. 3HAN gives a differential importance to parts of an article, on account of its three layers of attention. By experiments on a large real-world data set, we observe the effectiveness of 3HAN with an accuracy of 96.77\%. Unlike some other deep learning models, 3HAN provides an understandable output through the attention weights given to different parts of an article, which can be visualized through a heatmap to enable further manual fact checking.

3:15PM *A multimodal vigilance monitoring system based on fuzzy logic architecture [#17188]*

Ahmed Snoun, Ines Teyeb, Olfa Jemai and Mourad Zaied, University of Gabes, Tunisia

This paper deals with the problem of vigilance level monitoring. A novel method of hypovigilance detection is presented in this work. It is based on the analysis of eyes' blinking and head posture. The fusion task of both systems is achieved by the fuzzy logic technique which allows us to obtain five vigilance levels. This paper contains two key contributions. The first is the amelioration of our previous works in the classification field employing fast wavelet network classifier(FWT) by using another classification system based on a deep learning architecture. It provides more accurate results than the wavelet network classifier. The second resides in the conception of a driver alertness control system able to detect five vigilance levels which is different from previous works of the literature characterized by two, three or four levels. Experiments, using different datasets, prove the good performance of our new approach.

Friday, November 17, 1:30PM-6:00PM

Plenary Poster Session: P3 Poster Session 3

Friday, November 17, 1:30PM-6:00PM, Room: Poster Area, Chairs: Ping Guo and Zhigang Zeng

P501 *Adaptation-Oriented Near-Optimal Control and Robust Synthesis of an Overhead Crane System [#17113]*

Ding Wang, Institute of Automation, Chinese Academy of Sciences, China

In this paper, we develop an adaptation-oriented approximate optimal control strategy and apply it to perform robust stabilization of an overhead crane system including complex nonlinearity. Via employing a novel updating rule to the adaptive critic structure, the near-optimal control law can be learnt based on the converged weight vector. By further considering the dynamical uncertainties, it is proven that the developed near-optimal control law can achieve uniform ultimate boundedness of the closed-loop state vector, thereby guaranteeing a certain extent of robustness for the uncertain nonlinear plant. An experimental simulation with respect to the overhead crane system is also conducted to verify the performance of the present control method.

P502 *Deep CNN Identifier for dynamic modelling of unmanned helicopter [#17405]*

Shaofeng Chen, Yang Cao, Yu Kang, Rongrong Zhu and Pengfei Li, University of Science and Technology of China, China

Unmanned helicopter has broad application prospects, both in civil and military field . Helicopter is a strong coupled with many phenomena, inherently unstable, high-order, time-varying nonlinear complex system. It is a great challenge to investigate the system identification of helicopter, particularly when the non- stationary flight regimes are considered. In this paper, we address the system identification as dynamic regression. Inspired by the feature expression ability of deep learning, we use Deep convolutional neural networks (CNN) to represent dynamics model of helicopter. The parameters of the network are directly learned from the real flight data of helicopter. We provide model initialization method and optimization details for training. Since it captures the hidden states in aerobatic maneuvers without a-priori, the proposed identifier manifests strong robustness and high accuracy, even for untrained aerobatic maneuvers. The effectiveness of the proposed method is verified by various experiments on the real-world flight data from Stanford Autonomous Helicopter Project. Specifically, the Deep CNN identifier improves 71.60% overall in RMS acceleration prediction over the lasted Deep Rectified Linear Unit (ReLU) Network Model.

P503 *Packet-dropouts Compensation for Networked Control System via Deep ReLU Neural Network [#17408]*

Yi Cui, Yang Cao, Yu Kang, Pengfei Li and Xuefeng Wang, University of Science and Technology of China, China

This paper introduces a packet-dropouts compensation strategy for networked control systems. To achieve robustness with respect to packet-dropouts, the predictions of the feedback losses in network transmission are included in the data packets. To achieve high-precision predictions, a deep ReLU neural network is used to build the relationships between the system input and feedback losses. We show how to design the parameters of the deep neural network to ensure stability of the resulting feedback control systems when the number of packet- dropouts is bounded. Simulation results indicate that the proposed compensation strategy can achieve much better control performances than the widely used zero- input or hold-input strategies, especially when the system inputs include abundant noises.

P504 *Backstepping and ADRC techniques applied to one-DOF link manipulator with external disturbances and input saturation [#17755]*

Yang Yang and Jie Tan, Nanjing University of Posts and Telecommunications, China

In this paper, via the active disturbance rejection control (ADRC), backstepping technique as well as the auxiliary system, we focus on the position control problem for one-DOF link manipulator with external disturbances and input saturation. The extended state observer (ESO) does not depend on the accurate model of systems, which is utilized to compensate external disturbances. The auxiliary system is employed to overcome the control input saturation. It is shown, from the input to state stability (ISS) and Lyapunov stability theorem, that the tracking error can be gradually converged into arbitrarily small neighborhood of the origin. The simulation results are given to illustrate the effectiveness of the proposed tracking control scheme.

P505 *Thyroid Nodule Classification using Hierarchical Recurrent Neural Network with Multiple Ultrasound Reports [#17245]*

Dehua Chen, Cheng Shi, Mei Wang and Qiao Pan, Donghua University, China

Precise thyroid nodule classification is a key issue in endocrine clinic domain, which can enhance a patient's chance for survival. The reports of type-B ultrasound examination are important data source for thyroid nodule classification, and patients with thyroid nodules normally undergo several periodic ultrasound examinations during the process of diagnosis and treatment. However, most of the existing methods rely on feature engineering of single ultrasound reports and they did not take into consideration the historical records of the patients. In this paper, we propose a Hierarchical Recurrent Neural Network (HRNN) for thyroid nodule classification using historical ultrasound reports. HRNN consists of three layers of Long Short-Term Memory (LSTM) Neural Networks. Each LSTM layer is trained to produce the higher-level representations. We evaluate HRNN on real-world thyroid nodule ultrasound reports. The experiment results show that HRNN outperforms the baseline models with ultrasound reports.

P506 *Liver Segmentation and 3D Modeling Based on Multilayer Spiral CT Image [#17780]*

Yanhua Liang and Yongxiong Sun, Jilin University, China

The 3D reconstruction can facilitate the diagnosis of liver disease by making the target easier to identify and revealing the volume and shape much better than 2D imaging. In this paper, in order to realize 3D reconstruction of liver parenchyma, a series of pretreatments are carried out, including windowing conversion, filtering and liver parenchyma extraction. Furthermore, three kinds of modeling methods were researched to reconstruct the liver parenchyma containing surface rending, volume rendering and point rendering. The MC (marching cubes) algorithm based on 3D region growth is proposed to overcome the existence of a large number of voids and long modeling time for the contours of traditional MC algorithms. Simulation results of the three modeling methods show different advantages and disadvantages. The surface rendering can intuitively image on the liver surface modeling, but it cannot reflect the inside information of the liver. The volume rendering can reflect the internal information of the liver, but it requires a higher computer performance. The point rendering modeling speed is quickly compared to the surface rendering and the volume rendering, whereas the modeling effect is rough. Therefore, we can draw a conclusion that different modeling methods should be selected for different requirements.

P507 *Computer-Aided Diagnosis in Chest Radiography with Deep Multi-Instance Learning [#17449]*

Kang Qu, Xiangfei Chai, Tianjiao Liu, Yadong Zhang, Biao Leng and Zhang Xiong, Beihang University, China; Huiying Medical Technology Inc (Beijing), China; Tsinghua University, China

The Computer-Aided Diagnosis (CAD) for chest X-ray image has been investigated for many years. However, it has not been widely used since limited accuracy. Deep learning opens a new era for image recognition and classification. We propose a novel framework called Deep Multi-Instance Learning (DMIL) on chest radiographic images diagnosis, which combines deep learning and multi-instance learning. Besides, we preprocess images with the alignment based on the key points. This framework can effectively improve the diagnosis effect in the image level annotation. We quantify the framework on three datasets, respectively with different amounts and different classification tasks. The proposed framework obtained the AUC of 0.986, 0.873, 0.824 respectively in classification tasks of the enlarged heart, the pulmonary nodule, and the abnormal. The experiments we implement demonstrate that the proposed framework outperforms the other methods in various evaluation criteria.

P508 *A Hybrid Model: DGnet-SVM for the Classification of Pulmonary Nodules [#17459]*

Yixuan Xu, Guokai Zhang, Yuan Li, Ye Luo and Jianwei Lu, Tongji University, China

We investigate the problem of benign and malignant pulmonary nodules classification for thoracic Computed Tomography (CT) images. Although various methods have been proposed to solve this problem, they have bottlenecks of poor input image quality and subjective or shallow feature extraction. In this paper, we propose a Denoise GoogLeNet model with the classifier of Support Vector Machine (DGnet-SVM) to improve the final classification accuracy. We apply Denoise Network to improve the CT image quality by reducing the noise, and GoogLeNet is utilized to extract high-level features for better generalization of data. Furthermore, SVM is applied to classify the nodules owing to its great classification performance. The experimental results show that our hybrid model outperforms other state-of-the-art methods with the accuracy of 0.89 based on five-fold cross validation and the AUC is 0.95. The advantages of the proposed model and our future work are also discussed.

P509 *Deep Learning Features for Lung Adenocarcinoma Classification with Tissue Pathology Images [#17503]*

Jia He, Lin Shang, Hong Ji and XiuLing Zhang, Nanjing University, China; Beijing Computing Center, China

This paper presents the approach for lung adenocarcinoma diagnosis, using deep convolutional neural networks (CNN) to learn the features from the tissue pathology images. Our multi-stage procedure can detect the lung cancer of adenocarcinoma, in which the preprocessing consists of image enhancement and class imbalance treatment. Then Gradient-weighted Class Activation Mapping (Grad-CAM) and Guided-Backpropagation visualization techniques are employed to produce the visual explanations for decisions from our CNN model. Learned features and details for the specific areas have been generated through the model. Data is collected from 22 different patients with 270 lesion images and 24 normal ones. Experimental results on this data set has achieved F1-score with 0.963. Moreover, the study is not only to pursue precise classification on the tissue pathology images of lung adenocarcinoma, but also learn the specific areas in images which will need more concern by doctors.

P510 *The Analysis and Classify of sleep stage using Deep Learning Network from single-channel EEG signal [#17545]*

SongYun Xie, Yabing Li, Xinzhou Xie, Wei Wang and Xu Duan, Northwestern Polytechnical University, China

Electroencephalogram(EEG)-based sleep stage analysis is helpful for diagnosis of sleep disorder. However, the accuracy of previous EEG-based method is still unsatisfactory. In order to improve the classification performance, we proposed an EEG-based automatic sleep stage classification method, which combined convolutional neural network (CNN) and time-frequency decomposition. The time- frequency image (TFI) of EEG signals is obtained by using the smoothed short-time Fourier transform. The features derived from the TFI have been used as an input feature of a CNN for sleep stage classification. The proposed method achieves the best accuracy of 88.83%. The experimental results demonstrate that deep learning method provides better classification performance compared to other methods.

P511 *Thin-cap fibroatheroma detection with deep neural networks [#17048]*

Tae Joon Jun, Soo-Jin Kang, June-Goo Lee, Jihoon Kweon, Wonjun Na, Daeyoun Kang, Dohyeun Kim, Daeyoung Kim and Young-Hak Kim, Korea Advanced Institute of Science and Technology, Korea (South); University of Ulsan College of Medicine, Korea (South); Asan Institute for Life Sciences, Korea (South)

Acute coronary syndromes (ACS) frequently results in unstable angina, acute myocardial infarction, and sudden coronary death. The most of ACS are related to coronary thrombosis that mainly caused by plaque rupture followed by plaque erosion. Thin-cap fibroatheroma (TCFA) is a well-known type of vulnerable plaque which is prone to serious plaque rupture. Intravascular ultrasound (IVUS) is the most common methods for imaging coronary arteries to determine the amount of plaque built up at the epicardial coronary artery. However, since IVUS has relatively lower resolution than that of optical coherence tomography (OCT), TCFA detection with IVUS is considerably difficult. In this paper, we propose a novel method of TCFA detection with IVUS images using machine learning technique. 12,325 IVUS images from 100 different patients were labeled with equivalent frames from OCT images. Deep feed-forward neural network (FFNN) was applied to a different number of selected features based on the Fisher's exact test. As a result, IVUS derived TCFA detection achieved 0.87 area under the curve (AUC) with 78.31% specificity and 79.02% sensitivity. Our experimental result indicates a new possibility for detection of TCFA with IVUS images using machine learning technique.

P512 *Generalization of Local Temporal Correlation Common Spatial Patterns using Lp-norm (0<p<2) [#17194]*

Na Fang and Haixian Wang, Southeast University, China

As one of the effective feature extraction methods, common spatial patterns (CSP) is widely used for classification of multichannel electroencephalogram (EEG) signals in the motor imagery-based brain-compute interface (BCI) system. The formulation of the conventional CSP based on L2-norm, however, implies that it is sensitive to the presence of outliers. Local temporal correlation common spatial patterns (LTCCSP), as an extension of CSP by introducing the local tem- poral correlation information into the covariance modelling of the classical CSP algorithm, extracts more discriminative features. In order to further improve the robustness of the classification, in this paper, we generalize the LTCCSP algorithm by replacing the L2-norm with Lp-norm (0<p<2) in the objective function, called LTCCSP-Lp. An iterative algorithm is designed under the framework of minorization-maximization (MM) optimization algorithm to obtain the optimal spatial filters of LTCCSP-Lp. The iterative solution is justified in theory and the effectiveness of our novel proposed method is verified by experimental results on a toy example and datasets of BCI competitions.

P513 *Neuromorphic Hardware using Simplified Elements and Thin-Film Semiconductor Devices as Synapse Elements - Simulation of Hopfield and Cellular Neural Network - [#17108]*

Tomoya Kameda, Mutsumi Kimura and Yasuhiko Nakashima, Nara Institute of Science and Technology, Japan

Neuromorphic hardware using simplified elements and thin-film semiconductor devices as synapse elements is proposed. It is assumed that amorphous metal- oxide semiconductor devices are used for the synapse elements, and the charac- teristic degradation is utilized for the learning rule named modified Hebbian learn-ing. First, we explain an architecture and operation of a Hopfield neural network. Next, we model the electrical characteristic of the thin-film semiconductor devices and simulate the letter recognition by the neural network. Particularly in this presentation, we show a degradation map. On the other hand, we also explain an architecture and operation of a cellular neural network, model the thin-film semi-conductor devices, and simulate the letter recognition. Particularly in this presen-tation, we evaluate connection schemes. It is found that the cellular neural net-work has higher performance when it has diagonal connections. Moreover, we compare the Hopfield and cellular neural network. It is found that the Hopfield neural network has higher performance, although the cellular neural network has a simple structure.

P514 *A Brain Network Inspired Algorithm: Pre-trained Extreme Learning Machine [#17142]*

Yongshan Zhang, Jia Wu, Zhihua Cai and Siwei Jiang, China University of Geosciences, China; Macquarie University, Australia

Extreme learning machine (ELM), a brain inspired neural network, is a promising learning method for training ``generalized'' single hidden layer feedforward neural networks (SLFNs), which has attracted significant interest recently for its fast learning speed, good generalization ability and ease of implementation. However, due to its manually selected network parameters (e.g., the input weights and hidden biases), the performance of ELM may be easily deteriorated. In this paper, we propose a novel pre-trained extreme learning machine (P-ELM for short) for classification problems. In P-ELM, the superior network parameters are pre-trained by an ELM-based autoencoder (ELM-AE) and embedded with the underlying data information. Experiments and comparisons on face image recognition and handwritten image annotation applications demonstrate that P-ELM is promising and achieves superior results compared to the original ELM and other state-of-the-art ELMs.

P515 *K-Hop Community Search Based On Local Distance Dynamics [#17216]*

Lijun Cai, Tao Meng, Tingqin He, Lei Chen and Ziyun Deng, Hunan University, China; ChangSha Commerce and Tourism College, China

Community search aims at finding a meaningful community that contains the query node and also maximizes (minimizes) a goodness metric, which has attracted a lot of attention in recent years. However, most of existing metric-based algorithms either tend to include the irrelevant subgraphs in the identified community or have computational bottleneck. Contrary to the user-defined metric algorithm, how can we search the natural community that the query node belongs to? In this paper, we propose a novel community search algorithm based on the concept of k-hop and local distance dynamics model, which can natural capture a community that contains the query node. The basic idea is to envision the nodes which k-hop away from the query node as an adaptive local dynamical system, where each node only interacts its local topological structure. Relying on a proposed local distance dynamics model, the distances among node will change over time, where the nodes sharing the same community with the query node tend to gradually move together while other nodes will keep far away from each other. Such interplay eventually leads to a steady distribution of distances and a meaningful community is naturally found. Extensive experiments on large real-world networks with ground-truth demonstrate the effectiveness and efficiency of our community search algorithm and has good performance compared to state-of-the-art algorithm.

P516 *An Improved Feedback Wavelet Neural Network for Short-term Passenger Entrance Flow Prediction in Shanghai Subway System [#17279]*

Bo Zhang, Shuqiu Li, Liping Huang and Yongjian Yang, Jilin University, China

Subway traffic prediction is of great significance for scheduling and anomalies detection. A novel model of multi-scale mixture feedback wavelet neural network(MMFWNN) is proposed to predict the short-term entrance flow of Shanghai subway stations. Firstly, passengers are classified into two categories of commuter and non-commuter by mining the travel pattern and identifying the travel pattern stability, which finds that the non-commuters travel is more susceptible to the meteorology status. The proposed prediction model adds a transitional layer to adapt the feedback mechanism, thus to improve the robustness with associative memorizing and optimization calculation. Thus MMFWNN is advantageous to the nonlinear time-varying short-term traffic flow prediction. We evaluate our model in the Shanghai subway system. The experimental results show that the MMFWNN model is more accurate in predicting the short-term passenger entrance flow in subway stations.

P517 *Modeling Server Workloads for Campus Email Traffic Using Recurrent Neural Networks [#17312]*

Spyros Boukoros, Anupiya Nugaliyadde, Angelos Marnerides, Costas Vassilakis, Polychronis Koutsakis and Kok Wai Wong, Technische Universitat Darmstadt, Germany; Murdoch University, Australia; Lancaster University, United Kingdom; University of Peloponnese, Greece

As email workloads keep rising, email servers need to handle this ex- plosive growth while offering good quality of service to users. In this work, we focus on modeling the workload of the email servers of four universities (2 from Greece, 1 from the UK, 1 from Australia). We model all types of email traffic, including user and system emails, as well as spam. We initially tested some of the most popular distributions for workload characterization and used statistical tests to evaluate our findings. The significant differences in the prediction accu- racy results for the four datasets led us to investigate the use of a Recurrent Neu- ral Network (RNN) as time series modeling to model the server workload, which is a first for such a problem. Our results show that the use of RNN modeling leads in most cases to high modeling accuracy for all four campus email traffic datasets.

P518 *Power Consumption Prediction for Dynamic Adjustment in Hydrocracking process based on State Transition Algorithm and Support Vector Machine [#17496]*

Xiaofang Chen, Yingcan Qian and Yalin Wang, Central South University, China

Power consumption is an important part of energy consumption in hydrocracking, which occupies about 43%-47% of the total energy consumption. In the daily production management, the real-time power consumption is manually recorded from the voltmeter. However, it is difficult to collect the power consumption especially in the dynamic adjustment. In this paper, a power consumption prediction model is proposed for dynamic adjustment in the hydrocracking process, which is based on state transition algorithm (STA) and support vector machine (SVM). A SVM regression model is developed to map the complex nonlinear relationship between power parameters and the power consumption in the dynamic adjustment of hydrocracking, and the state transition algorithm is used to optimize the parameters of SVM regression model. The experimental results demonstrate that the prediction accuracy of the model is close to the fitting accuracy and the modeling time is reduced.

P519 *Power users behavior analysis and application based on large data [#17741]*

Xiaoya Ren, Guotao Hui, Yanhong Luo, Yingchun Wang, Dongsheng Yang and Ge Qi, Northeastern University, China

In this paper, a persona and users' segmentation model are established by analyzing the power users' data. In order to further complete the historical database, the paper adopts the method of questionnaire to collect information. Then, according to the power user's own attributes and payment characteristics, the index system is established. Different indexes are chosen basis different demands of users. Different construction methods are adopted for different models. In order to realize the power users' segmentation, this paper uses K- means clustering method to analyze a historical payment data and investigative payment data. Due to the properties of power users are different, their payment behavior will also have obvious differences. Through users' segmentation, the correlation analysis between the natural attributes and the payment method is realized. In the big data platform, the characteristics of the behavior of the customer payment are formed by processing and analyzing the characteristics data of the customers' electricity payment. On this basis, combined with the existing customer base information and feature information, the power persona is formed by the deeply fusion data and cross analysis. Then use the persona to analyze the clustering results, which can clearly shows the payment preferences, characteristics and needs of users. In the end, different user groups have adopted different methods of electricity payment planning. Finally, power users' persona is implemented. It can be proved that the model is effective in dealing with massive data, and provides reliable data support for decision making.

P520 *Accelerated Matrix Factorisation Method for Fuzzy Clustering [#17756]*

Mingjun Zhan and Li Bo, South China University of Technology, China

Factorised fuzzy c-means (F-FCM) based on semi nonnegative matrix factorization is a new approach for fuzzy clustering. It does not need the weighting exponent parameter compared with traditional fuzzy c-means, and not sensitive to initial conditions. However, F-FCM does not propose an efficient method to solve the constrained problem, and just suggests to use a lsqlin() function in MATLAB which lead to slow convergence rate and nonconvergence. In this paper, we propose a method to accelerate the convergence rate of F-FCM combining with a non-monotone accelerate proximal gradient (nmAPG) method. We also propose an efficient method to solve the proximal mapping problem when implementing nmAPG. Finally, the experiment results on synthetic and real-world datasets show the performances and feasibility of our method.

P521 *Mining Mobile Phone Base Station Data Based on Clustering Algorithms with Application to Public Traffic Route Design [#17398]*

Wen Shen, Zhihua Wei and Zhiyuan Zhou, Tongji University, China

It attracts a lot of attention that how to use mobile phone base station data to predict user behavior and design the public traffic route. In this paper, we extend the classic algorithms to design the shuttle bus route. The contribution of this paper is mainly manifested on (1) we integrate the classical machine learning methods DBSCAN and GMM to complete mobile phone base station data modeling, so that to learn the residents' spatial travel pattern and temporal habits; (2) we apply the Public Route Scale Estimation Model to design the shuttle bus routes and departure intervals based on the modeling results of (1). Experimental results show that our model based on DBSCAN and GMM can effectively mine the significance of historical data of mobile phone base station and can successfully be applied to real-world problems like public traffic route design.

P522 *Question Recommendation in Medical Community-Based Question Answering [#17217]*

Hong Cai, Cuiting Yan, Airu Yin and Xuesong Zhao, Nankai University, China

The medical community question answering system (MCQA) which is a new kind of medical information exchange platform is becoming more and

more popular. Due to the number of patients is much more than the doctors, resulting in many patients can not get timely answers to their questions. Similar question recommendation is a common approach to solve this problem. The contributions of this paper are two- fold:(1) we propose a Siamese CNN model which measure correlation between questions and answers. (2) We first apply word2vec to learn the semantic relations between words and then construct a similar question retrieval model with answers. The study above can achieve a good performance in the real MCQA data set. It shows that our method can effectively extract similar questions recommendation list, shorten user's time to wait for an answer and improve user experience as well.

P523 *Deep Bi-directional Long Short-Term Memory Model for Short-term Traffic Flow Prediction [#17119]*

Jingyuan Wang, Fei Hu and Li Li, Southwest University, China

Short-term traffic flow prediction plays an important role in intelligent transportation system. Numerous researchers have paid much attention to it in the past decades. However, the performance of traditional traffic flow prediction methods is not satisfactory, for those methods cannot describe the complicated nonlinearity and uncertainty of the traffic flow precisely. Neural networks were used to deal with the issues, but most of them failed to capture the deep features of traffic flow and be sensitive enough to the time-aware traffic flow data. In this paper, we propose a deep bi-directional long short-term memory (DBL) model by introducing long short-term memory (LSTM) recurrent neural network, residual connections, deeply hierarchical networks and bi-directional traffic flow. The proposed model is able to capture the deep features of traffic flow and take full advantage of time-aware traffic flow data. Additionally, we introduce the DBL model, regression layer and dropout training method into a traffic flow prediction architecture. We evaluate the prediction architecture on the dataset from Caltrans Performance Measurement System (PeMS). The experiment results demonstrate that the proposed model for short-term traffic flow prediction obtains high accuracy and generalizes well compared with other models.

P524 *Odor Change of Citrus Juice during Storage Based on Electronic Nose Technology [#17081]*

Xue Jiang, Pengfei Jia, Siqi Qiao and Shukai Duan, Southwest University, China

In order to master the law of citrus juice odor components changes during the storing process, electronic nose composed of metal-oxide semiconductor (MOS) sensors array is used to monitor the odor during valencia oranges juice storing process. A self-made electronic nose system and experiment are described in detail, after data preprocessing, extreme learning machine (ELM) is used for analysis on samples. Analysis result indicates that the odor synthetized curve derived from the electronic nose technology can reflect overall trend of odor during valencia oranges juice storing process truly and effectively, and the experimental results prove that the E-nose can correctly distinguish the current stage of the stored valencia oranges juice and the classification accuracy of test data set is 96.29% when ELM is used as the classifier, which shows that the E-nose can be successfully applied to the qualitative analysis of citrus.

P525 *A Tag-Based Integrated Diffusion Model for Personalized Location Recommendation [#17156]*

Yaolin Zheng, Yulong Wang, Lei Zhang, Jingyu Wang and Qi Qi, Beijing University of Posts and Telecommunications, China

The location based services have attracted millions of users to share their locations via check-ins. It is highly important to recommend personalized POIs (Points-Of-Interest) to users in terms of their preference learned from historical data. In current research work, users' check-in behavior is wildly used to model user's preference. However, the sparsity of the check-in data makes it difficult to capture users' preferences accurately. This paper proposes a tag-based integrated diffusion recommender system for location recommendation, considering not only social influence but also venue features. Firstly, we model user location preference by combining the preference extracted from check-ins data and short text tips, where sentiment analysis techniques are used. Furthermore, we collect venue information by merging descriptions and tips and then generate tags of each venue, which are processed using keyword extraction approaches. Then we apply the recommendation algorithm with user's initial preference and obtain the final integrate diffusion results for each user, recommending top-N venues by descending order. We conduct experiments on Foursquare datasets of two cities, the results on both datasets show that our recommender system can produce better performance, providing more personalized and higher novel recommendations.

P526 *Relationship Measurement Using Multiple Factors Extracted from Merged Meeting Events [#17298]*

Zeng Chen, Keren Wang and Zheng Yang, National Key Laboratory of Science and Technology, China; Tsinghua University, China

With the popularity of mobile phones and mobile applications, it becomes possible to collect large-scale mobility data and do research on human mobility. Among these research, relationship mining from location information is a hot topic which has plenty of applications including marketing applications, social studies and even terrorist discovery. This paper focuses on measuring the relationship strength of user pairs according to their meeting events. A novel method using multiple factors extracted from merged meeting events is proposed for measuring relationship. Firstly, meeting events are merged and each merged meeting event is represented by several features, from which multiple factors can be drawn. Specifically, the duration factor and the diameter factor are proposed for measuring relationship on the basis of merged meeting events. Finally, a model synthesizing multiple factors (including location entropy factor, location personal factor, temporal factor, duration factor and diameter factor) is proposed to quantify the relationship between users in an unsupervised way. Experimental results on three different real datasets demonstrate that our method performs significantly more favorable than existing methods on the effectiveness.

P527 *Reinforcement Label Propagation Algorithm Based on History Record [#17314]*

Kai Liu, Yi Zhang, Kai Lu, Xiaoping Wang and Xin Wang, National University of Defense Technology, China

With the continuous development of Internet, social networks are becoming more and more complex, and the research on these complex networks has attracted many researchers' attention. A large number of community discovery algorithms have emerged, among which the label propagation algorithm is widely used because of its simplicity and efficiency. However, this algorithm has poor stability due to the randomness in the label propagation process. To solve the problem, we propose a reinforcement label propagation algorithm(RLPA) in this paper. In RLPA, a similarity matrix is generated from the historical records of classification, which can be adopted to obtain the final result of community detection. The experimental results show that our algorithm can not only get better performance in accuracy, but also has higher stability.

P528 *A Deep Learning Method to Detect Web Attacks Using a Specially Designed CNN [#17059]*

Ming Zhang, Boyi Xu, Shuai Bai, Shuaibing Lu and Zhechao Lin, Beijing Institute of System Engineering, China

With the increasing information sharing and other activities conducted on the World Wide Web, the Web has become the main venue for attackers to make troubles. The effective methods to detect Web attacks are critical and significant to guarantee the Web security. In recent years, many machine learning methods have been applied to detect Web attacks. We present a deep learning method to detect Web attacks by using a specially designed CNN. The method is based on analyzing the HTTP request packets, to which only some preprocessing is needed whereas the tedious feature extraction is done by the CNN itself. The experimental results on dataset HTTP DATASET CSIC 2010 show that the designed CNN has a good performance and the method achieves satisfactory results in detecting Web attacks, having a high detection rate while keeping a low false alarm rate.

P529 *Intrusion Detection Using Convolutional Neural Networks for Representation Learning [#17720]*

Zhipeng Li, Zheng Qin, Kai Huang, Xiao Yang and Shuxiong Ye, Tsinghua University, China

The intrusion detection based on deep learning method has been widely attempted for representation learning. However, in various deep learning models for intrusion detection, there is rarely convolutional neural networks (CNN) model. In this work, we propose a image conversion method of NSL-KDD data. Convolutional neural networks automatically learn the features of graphic NSL-KDD transformation via the proposed graphic conversion technique. We evaluate the performance of the image conversion method by binary class classification experiments with NSL-KDD Test+ and Test-21. Different structures of CNN are testified for comparison. On the two NSL-KDD test datasets, CNN performed better than most standard classifier although the CNN did not improve state of the art completely. Results show that the CNN model is sensitive to image conversion of attack data and our proposed method can be used for intrusion detection

P530 *Detect Malicious Attacks from Entire TCP Communication Process [#17096]*

Peng Fang, Liusheng Huang, Xinyuan Zhang, Hongli Xu and Shaowei Wang, University of Science and Technology of China, China

Malicious attack identification plays an essential role in network security monitoring. Current popular technologies are mainly to select a closely related set of attributes from a packet header for fingerprinting malicious attacks. Those methods are not effective enough because malicious attacks can be disguised as normal applications and we cannot observe their characteristics from only the packer's header. In this paper, we will employ the attributes generated from the entire TCP communication process to identify malicious attacks. A challenging point of our method is how to choose the right attributes from up to 248 properties of TCP flows for fingerprinting low proportion of malicious attacks. A wide variety of real-world viruses are analyzed as the malicious samples, such as extortion virus WannaCry. The experiment results demonstrate that the proposed method can not only fingerprint the viruses but also can accurately identify the types of virus.

P531 *Exploiting Cantor Expansion for Covert Channels over LTE-Advanced [#17302]*

Zhiqiang He, Liusheng Huang, Wei Yang and Zukui Wang, University of Science and Technology of China, China

Worldwide, the Long Term Evolution Advanced technology has an unprecedented development and popularization in recent years. With the advantages of mobile communication technology, more and more researchers are focused on the security of mobile communication. Until then, some researches about covert channels over the 4th generation mobile communication technology had been proposed. Cantor Expansion is a permutation to a bijection of natural number, so it can be used as a coding scheme for a covert channel. In this paper, a novel class of covert channel based on Cantor Expansion (for decoding) and its inverse operation (for encoding) is proposed and designed for this mobile network. The description, analyses and evaluation of this covert channel will be present in the main part of this paper. Moreover, the peak value of camouflage capability can reach 1470kbps. Nevertheless it doesn't affect the bandwidth of overt channel and it is difficult to be detected.

P532 *Design of Traffic Signal Controller Based on Network [#17244]*

Xiaoming Liu, Yulin Tian, Chunlin Shang, Peizhou Yan and Lu Wei, Beijing Key Lab of Urban Road Traffic Intelligent Tech., China

In the paper, a traffic signal controller based on network was designed after analyzing the development and actuality of traffic signal controllers. The controller consisted of Server, Network Bus and IP Nodes. Power line carrier communication module was designed as the medium of network communication, which could meet the requirements of traffic control network for network bandwidth and communication distance. The software based on Firework computing paradigm can achieve efficient data processing and improve the coordination and optimization ability of traffic control system. With precise actual control effect, the controller can reduce equipment cost, lower difficulties of upgrading and maintenance, and provide complete data support for collaborative optimization of traffic network.

P533 *Analysing the Evolution of Contrary Opinions on a Controversial Network Event [#17258]*

Qu Liu, Yuanzhuo Wang, Chuang Lin and Guoliang Xing, Tsinghua University, China; Institute of Computing Technology, Chinese Academy of Science, China

With the growing popularity of social networking services, network public opinion gradually plays an important role in social life. When a controversial network event happens, what people concern about is which opinion in the contrary opinions will be widely accepted by people and how long this event lasts. To solve this problem, we propose a social evolutionary game model based on Hawk-Dove game to simulate how contrary opinions evolve in social network. The effectiveness of our model is validated by actual data. This model can be used to estimate the potential dominant opinion group and the time length of the controversy. Besides, our simulation reveals some special features of the evolution process and results. This study may be useful for network public opinion supervision and market research.

P534 *Ten-Quarter Projection for Spanish Central Government Debt via WASD Neuronet [#17646]*

Yunong Zhang, Zhongxian Xue, Mengling Xiao, Yingbiao Ling and Chengxu Ye, Sun Yat-sen University, China; Qinghai Normal University, China

This paper makes a ten-quarter projection for Spanish central government debt (SCGD). Several Eurozone member states had been in debt crisis since 2008, including Spain. During the crisis, Spanish central government debt increased quickly. According to the data provided by the Bank of Spain, the SCGD reached to \EUR$969.5523$ billion in December 2016, and debt-to-GDP ratio was more than 100 percent in 2016. It is important to conduct a projection for SCGD so that the government can make better fiscal policies and preparation for risks in future. In this paper, we use a 3-layer feed-forward neuronet to conduct a projection for SCGD. We use weights and structure determination (WASD) algorithm to build such a neuronet model and train the neuronet with Spanish central government debt data from December 1994 to December 2016. Finally, three different trends of SCGD are shown via experiments: quick increasing trend, increasing trend and decreasing trend.

P535 *Single-image Super-resolution for Remote Sensing Data Using Deep Residual-Learning Neural Network [#17087]*

Ningbo Huang, Yong Yang, Junjie Liu, Xinchao Gu and Hua Cai, Changchun University of Science and Technology, China; Changchun Normal University, China

Single image super-resolution (SISR) plays an important role in remote sensing image processing. In recent years, deep convolutional neural networks have achieved state- of-the-art performance in the SISR field of common camera images. Although the SISR method based on deep learning is effective on general camera images, it is not necessarily effective on remote sensing images because of the significant difference between remote sensing images and common camera images. In this paper, the VDSR network (proposed by Kim et al. in 2016) was found to be invalid for Sentinel-2A remote sensing images; we then proposed our own neural network, which is called the remote sensing deep residual-learning (RS-DRL) network. Our network achieved better performance than VDSR on Sentinel-2A remote sensing images.

P536 *Learning Image Representation Based on Convolutional Neural Networks [#17199]*

Zhanbo Yang, Fei Hu, Jingyuan Wang, Jinjing Zhang and Li Li, Southwest University, China

Image similarity is widely applicable in image understanding and object tracking. It is easy for human to fulfill while difficult for machines. In this paper, we present a simple but efficient end-to-end mechanism to transfer an image into its corresponding representation in vector space based on Convolutional Neural Networks supervised by word2vec, which can then be applied to applications such as image classification and object detection, and a further work of image caption/description. We describe how we train the model to achieve a deep semantic understanding of the image along with its caption. We train our method on Flickr8k and Flickr30k datasets respectively, and evaluate on Corel1k benchmark dataset. Through the visualization of how our model extracts the features of images and produces similar vectors for similar images, we demonstrate the effectiveness of our proposed model.

P537 *Boxless Action Recognition in Still Images via Recurrent Visual Attention [#17412]*

Weijiang Feng, Xiang Zhang, Xuhui Huang and Zhigang Luo, National University of Defense Technology, China

Boxless action recognition in still images means recognizing human actions in the absence of ground-truth bounding boxes. Since no ground-truth bounding boxes are provided, boxless action recognition is more challenging than traditional action recognition tasks. Towards this end, AttSPP-net jointly integrates soft attention and spatial pyramid pooling into a convolutional neural network, and achieves comparable recognition accuracies even with some bounding box based approaches. However, the soft attention of AttSPP-net concentrates on only one fixation, rather than combining information from different fixations over time, which is the mechanism of human visual attention. In this paper, we take inspiration from this mechanism and propose a ReAttSPP-net for boxless action recognition. ReAttSPP-net utilizes a recurrent neural network model of visual attention in order to extract information from a sequence of fixations. Experiments on three public action recognition benchmark datasets including PASCAL VOC 2012, Willow and Sports demonstrate that ReAttSPP-net can achieve promising results and obtains higher recognition performance than AttSPP-net.

P538 *Ultra-Deep Neural Network for Face Anti-Spoofing [#17527]*

Xiaokang Tu and Yuchun Fang, Shanghai University, China

Face anti-spoofing is a hot research area in computer vision. With the progress of Deep Neural Networks (DNNs) in computer vision, some work has introduced neural networks into face anti-spoofing. However, the neural networks that most of the approaches use consist of only a few layers due to the limitation of training data. Inspired by the fact that deep efficiently trained neural networks are often possible to learn better representation than shallow networks. In this paper, we propose a fully data-driven ultra-deep model based on transfer learning. The model adopts a pre-trained deep residual network to learn highly discriminative features, and combines it with the Long Short-Term Memory (LSTM) units to discover long-range temporal relationships of from video frames for classification. We conduct extensive experiments on two most common benchmark datasets, namely, REPLAY-ATTACK and CASIA-FASD. Experimental results demonstrate that our ultra-deep network framework archives state-of-the-art performance.

P539 *Robust Adaptive Beamforming in Uniform Circular Array [#17438]*

Xin Song, Ying Guan, Jinkuan Wang and Jing Gao, Northeastern University at Qinhuangdao, China

Phase-mode transformation (PMT) is a commonly used technique to convert a uniform circular array (UCA) into a virtual uniform linear array (ULA). This method restores the Vandemonde structure of the steering vector and makes it easy to apply many existing beamforming algorithms to UCA. One such method is the famous Minimum Variance Distortionless Response (MVDR) algorithm, in which the array gain is equal to unity in the direction of arrival of the desired signal. However, due to the approximation errors of the PMT and signal steering vector mismatches, the performance of these algorithms degrades. To address these two issues, in this paper we develop a robust recursive updating algorithm based on worst-case performance optimization. We show that the proposed algorithm belongs to the class of the diagonal loading technique and the transformation matrix belongs to a certain ellipsoid set. Using the Lagrange multiplier method, we have also derived closed-form solution to the weight vector. Our robust algorithm has low implementation complexity and makes the mean output array SINR consistently close to the optimal one. Numerical experiments have shown that our method outperforms the MVDR algorithm.

P540 *Synchronization in networks of nonidentical discrete-time systems with directed graphs [#17606]*

Hongjing Liang, Yu Zhou, Qi Zhou, Hongyi Li and Ping Li, Bohai University, China; Guangdong University of Technology, China

This paper solves output synchronization problem for nonidentical discrete-time multi-agent systems with directed graphs. All the agents suffer the disturbance form the leader. For the discrete-time case, we use the stabilization region regulator method and the variable restructured method to solve the output synchronization problem. At last, we give an example to show the effectiveness of the main result.

P541 *A Compliance Control Strategy for Minimizing Base Attitude Disturbance Using Variable Stiffness Joint Space Manipulator [#17705]*

Xingyu Wu, Ming Chu and Zhenghong Dong, Beijing University of Posts and Telecommunications, China; Department of Information Equipment Academy of Equipment, China

The base attitude of a free-floating space robot is disturbed during capturing targets. Based on the variable stiffness technology, this paper presents a compliance control strategy for minimizing the base attitude disturbance. Firstly, the dynamic model of space manipulator system is established by using the Lagrange equation. Secondly, the differential evolution algorithm is utilized to design the control strategy of variable stiffness joint space manipulator. The simulation results reflect that the influence introduced by impact is obviously reduced, which verify the effectiveness of the control strategy.

P542 *Path Following for Unmanned Surface Vessels Based on Adaptive LOS Guidance and ADRC [#17743]*

Hongyun Huang and Yunsheng Fan, Dalian Maritime University, China

This paper investigates the path following control problem for an unmanned surface vessel. The method proposed based on an identified model. The ADRC course keeping controller is employed to identify the environmental disturbance and model parameter perturbation. An improved adaptive line-of-sight (ALOS) guidance is proposed to follow reference path. The path can be either straight line or curve. The adaptive control law guarantees the uniformly globally asymptotically stable of the closed-loop USV system. Simulation results show the effectiveness of the proposed control approach.

P543 *A Transferable Framework: Classification and Visualization of MOOC Discussion Threads [#17050]*

Lin Feng, Guochao Liu, Sen Luo and Shenglan Liu, Dalian University of Technology, China

Analysis of Massive Open Online Course (MOOC) forums data often use natural language processing (NLP) technology to extract keywords from discussions content as features. However, discussions in different course forums vary significantly, so the analyzed results obtained on these specific forums are not easily applied to other irrelevant forums. Besides, a lot of discussion threads are not related to the course in MOOCs forums. To address above problems, we analyze about 100,000 discussion threads from the forums of 60 MOOCs offered by Coursera, and design many features related to user interaction ways in different subforums. This work proposes a transferable framework to classify MOOC discussion threads using these features. The classification framework is not sensitive

to the subjects and the forum discussions, so the classification model can be used directly by other course forums without being trained again. Experiments show that the average classification performance with Area Under ROC Curve (AUC) is 0.8. This work also gives the methods to remove noisy discussion threads and visulize the interactive characteristic of MOOC forum threads using dimensionality reduction technology

P544 *A Simple Convolutional Transfer Neural Networks in Vision Tasks [#17122]*

Wenlei Wu, Zhaohang Lin, Xinghao Ding and Yue Huang, Tencent Computer Systems Company Limited, China; Xiamen University, China

Convolutional neural networks (ConvNets) is multi-stages trainable architecture that can learn invariant features in many vision tasks. Real-world applications of ConvNets are always limited by strong requirements of expensive and time- consuming labels generating in each specified task, so the challenges can be summarized as that labeled data is scarce while unlabeled data is abundant. The traditional ConvNets does not consider any information hidden in the large-scale unlabeled data. In this work, a very simple convolutional transfer neural networks (CTNN) has been proposed to address the challenges by introducing the idea of unsupervised transfer learning to ConvNets. We propose our model with LeNet5, one of the simplest model in ConvNets, where an efficient unsupervised reconstruction based pre-training strategy has been introduced to kernel training from both labeled and unlabeled data, or from both training and testing data. The contribution of the proposed model is that it can fully use all the data, including training and testing simultaneously, thus the performances can be improved when the labeled training data is insufficient. Widely used hand-written dataset MNIST, together with two retinal vessel datasets, DRIVE and STARE, are employed to validate the proposed work. The classification experiments results have demonstrated that the proposed CTNN is able to reduce the requirement of sufficient labeled training samples in real-world applications.

P545 *Dissimilarity-based sequential backward feature selection algorithm for fault diagnosis [#17214]*

Yangtao Xue, Li Zhang and Bangjun Wang, Soochow University, China

The aim of feature selection applied to fault diagnosis is to select an optimal feature subset that is relevant to the faults. The optimal feature subset with fewer features contains more discriminative information which can improve the performance of fault diagnosis models. A novel sequential backward feature selection method based on dissimilarity is proposed to detect the difference of features between normal and fault data. The proposed feature selection method can be used to find relevant features with fault. Furthermore, the fault diagnosis model combines the proposed feature selection method with support vector machine. Experimental results on a chemical process indicate that the proposed feature selection method is useful and superior in fault diagnosis.

P546 *Community detection in networks by using multiobjective membrane algorithm [#17524]*

Chuang Liu and Linan Fan, Shenyang University, China

This paper introduces a multi-objective optimization idea to solve the community detection. First, the problem of community detection is transformed into complex multi-objective optimization problem. Second, an evolutionary multi-objective membrane algorithm is proposed for discovering community structure. Finally, the proposed algorithm is conducted on the synthetic networks, and the experimental results demonstrate that our algorithm is effective and promising, and it can detect communities more accurately compared with PSO and GSA.

P547 *Double-coding Density Sensitive Hashing [#17572]*

Xiaoliang Tang, Xing Wang, Di Jia, Weidong Song and Xiangfu Meng, Liaoning Technical University, China

This paper proposes a double-coding density sensitive hashing (DCDSH) method. DCDSH accomplishes approximate nearest neighbor (ANN) search tasks based on its double coding scheme. First, DCDSH generates real-valued hash codes by projecting objects along the principle hyper-planes. These hyper-planes are determined by principle distributions and geometric structures of data set. Second, DCDSH derives binary hash codes based on these real-valued hash codes. Real-valued hash codes can avoid undesirable partition of objects in low density areas and effectively improve representation capability and discriminating power. Binary codes contribute to query speed owing to the low complexity for computing hamming distance. DCDSH integrates the advantages of these two kinds of hash codes. Experimental results on large scale high dimensional data show that the proposed DCDSH exhibits superior performance compared to several state-of-the-art hashing methods.

P548 *Particle Swarm Optimization based Salient Object Detection for Low Contrast Images [#17718]*

Nan Mu, Xin Xu, Xiaolong Zhang and Li Chen, Wuhan University of Science and Technology, China

Saliency detection has attracted increasing attentions in computer vision. Although most traditional saliency models can effectively detect the salient objects in natural images, it is still a burning problem in low contrast images, for low lightness and few color information limit the applicability of these models. Different from conventional models, which are not robust on weak light environments, the proposed method uses the particle swarm optimization (PSO) algorithm to estimate the image saliency. First, the covariance feature is used to compute the local saliency of each superpixel region. Then, the PSO search is executed to measure the image saliency in a global perspective. Finally, the graph model is constructed to optimize the saliency value. As the proposed model incorporates both local and global cues, the generated salient objects have well-defined boundaries and uniform inner regions. Experimental results show that the proposed salient object detection model yields better results than eleven state-of-the-art saliency models on low contrast images.

P549 *Dynamic Phasor Modeling of a Hybrid AC/DC Microgrid [#17555]*

Jin Xu, Keyou Wang and Guojie Li, Shanghai Jiao Tong University, China

The dynamic phasor (DP) model of a hybrid AC/DC microgird is proposed in this paper. This hybrid microgrid consists of an interlinking converter (ILC), wind turbine (WT) system, photovoltaic (PV) system and energy storage (ES) system, and can operate under either grid-connected mode or autonomous mode. A comprehensive definition of the dynamic phasor is given to make the devel-oped model more compact and the physical meaning more clear. The developed microgrid model is validated by comparing with a detailed model considering switch operations in Matlab/Simulink. By comparison, the DP model turns out to consume much less time and have a satisfactory accuracy under various disturb-ances.

P550 *Targets detection based on the prejudging and prediction mechanism [#17723]*

Xuemei Sun, Jianrong Cao, Chengdong Li, Ya Tian and Shusheng Zhao, Shandong Jianzhu University, China

The moving target detection is important to video supervision, video content analysis, object identification, and so on. However, some factors such as light, weather, shadow, the falling leaves and objects temporarily stumbled into the video may interrupt the real-time target extraction. In the paper, a new method based on a prejudging and prediction algorithm is proposed to reduce noise, improve the accuracy of segmentation, and decrease the regular computation cost. Six parts are introduced in the paper. In the second part, background subtraction method is simply

described for target extraction. In the third part, after comparing two background models, the multi-dimension GMM is chosen and an improved multi-dimension GMM based on the prejudging and prediction algorithm is described in the fourth part. Some experiments are carried out and the experimental results are shown in the fifth part. Experimental results show that the method proposed in the paper could decrease the computation cost, reduce stumbled object noise and improve the accuracy of detection.

P551 *A Method of Pedestrian Re-identification Based on Multiple Saliency Features [#17170]*

Cailing Wang, Yechao Xu, Guangwei Gao, Song Tang and Xiaoyuan Jing, Nanjing University of Posts and Telecommunications, China

In the field of video surveillance, a person that has already appeared in the video sequence can be recognized by video watchers across multiple cameras. Researchers call this kind of problem that on how to search the pedestrian target in sequences of multiple surveillance videos as pedestrian re- identification. The appearance of pedestrians usually varies greatly in different cameras, as the pedestrians in the sequences of surveillance video may be affected by the changes of the visual angles, the postures and the light. According to these problems, a method of pedestrian re-identification based on multiple salient features is proposed. The traditional method of pedestrian re-identification based on salient features characterizes the weight through the divergence between different samples. However, the result of the calculation of the traditional way is not stable enough and it may change with the rich diversity of samples. Therefore, this paper introduces a method based on the cellular automata to calculate the inherently salient characteristics of pedestrian images. In order to make full use of the advantages of the above methods, this paper uses multi-layer cellular automata to merge them together to achieve better results in the experiment. The experimental results show that the proposed algorithm has better performance in CAVIAR4REID and iLIDS databases than the existing algorithms.

P552 *Locality-constrained Iterative Matrix Regression for Robust Face Hallucination [#17107]*

Guangwei Gao, Huijuan Pang, Cailing Wang, Zuoyong Li and Dong Yue, Nanjing University of Posts and Telecommunications, China; Minjiang University, China

The performance of traditional face recognition approaches is sharply reduced when encountered with a low-resolution (LR) probe face image. The basic idea of a face super-resolution (SR) is to desire a high-resolution (HR) face image from an observed LR one with the help of a set of training examples. In this paper, we propose a locality-constrained iterative matrix regression (LCIMR) model for face hallucination task and use the alternating direction method of multipliers to solve it. LCIMR attempts to directly use the image matrix to compute the representation coefficients to maintain the essential structural information. A locality constraint is also enforced to preserve the locality and the sparsity simultaneously. Moreover, LCIMR iteratively updates the locality similarities and reconstruction weights based on the result (the hallucinated HR patch) from previous iteration, giving rise to improved performance. Experimental results on the benchmark FEI face database show the superiority of the proposed method over some state-of-the-art algorithms.

P553 *Structure-Preserved Face Cartoonization [#17324]*

Chenhao Gao, Bin Sheng and Ruimin Shen, Shanghai Jiao Tong University, China

Face cartoon synthesis has been proved to show wide range of uses in lots of fields, for example, instant message communication, suspects identity and online entertainment. In this paper, we propose a new dense descriptor based model to synthesize a face cartoon from a face photo which displays a great outcome.We generate two kinds of stylized face cartoons, one is called cartoon portraits and the other is called cartoon sketch.By integrating the two kinds of cartoons using guided filter, our results preserve the detail information of the input photo and generate good cartoon artistic style.

P554 *An Image Quality Evaluation Method Based on Joint Deep Learning [#17164]*

Jiachen Yang, Bin Jiang, Yinghao Zhu, Chunqi Ji and Wen Lu, Tianjin University, China; Xidian University, China

The image quality plays a very important role in image processing. In this paper, we propose an image quality evaluation method based on joint deep learning (JDL). Specifically, deep belief networks(DBNs) and convolutional neural network (CNNs) will be used together. Both the features extracted by human and features extracted by machine will be used to evaluate the quality of the images. For DBNs framework, the image features in both spatial domain and transform domain will be extracted. Then, it will be used to efficiently calculate and finally obtain image quality, Q1. For CNNs, the framework will calculate the image quality without features extracted by machine, which can be defined as Q2. At last, joint framework will give the final assessment result. Experiments show that our method is very consistent with the actual subjective assessment result.

P555 *Weakly-supervised Dual Generative Adversarial Networks for Makeup-removal [#17714]*

Xuedong Hou, Yun Li and Tao Li, Nanjing University of Posts and Telecommunications, China

With the improvement of face recognition precision, face recognition system is used in many fields. However, the face recognition system sometimes cannot recognize the makeup face. In this paper, a new image-to-image translation algorithm based on generative adversarial networks and dual learning is proposed to remove the makeup. Especially, the proposed algorithm is weakly supervised and it combines the paired and unpaired image-to-image translation model. The dual model is firstly trained using a small number of paired data, then the performance of the model is improved by large number of unpaired data. The proposed weakly-supervised image-to-image translation algorithm is applied into makeup-removal task, and the experimental results demonstrate its higher performance than other algorithms.

P556 *Exploiting Non-visible Relationship in Link Prediction Based on Asymmetric Local Random Walk [#17506]*

Chunlong Fan, Dong Li, Yiping Teng, Dongwan Fan and Guohui Ding, Shenyang Aerospace University, China

Link prediction is an important aspect of complex network evolution analysis. In the existing link prediction algorithms, the sparseness and scale of the target network have a great influence on the prediction results, and the link prediction algorithm based on local random walk is better in solving this problem. However, the existing local random walk link prediction algorithm simplifiy the definition of random walk process between nodes as symmetrical relationship, and ignore the influence of non- visible factors on the relationship of information diffusion between nodes. In this paper, for the first time, we introduce asymmetry and non-visible relationship of the network to the link prediction problem. Exploiting the unequal diffusion weights in different directions resulted from different degrees, we propose an asymmetric local random walk (ALRW) algorithm. In addition, with non-visible relationship to calculate of the similarity index, we propose a grounded asymmetric local random walk (GALRW) algorithm on the basis of ALRW. Compared with existing advanced link prediction algorithms, thorough experiments on typical datasets show that GALRW achieves better performance in prediction accuracy.

P557 *Ciphertext Retrieval Technology of Homomorphic Encryption based on Cloud Pretreatment [#17654]*

Changqing Gong, Yun Xiao, Mengfei Li, Shoufei Han, Na Lin and Zhenzhou Guo, Shenyang Aerospace University, China

Ciphertext retrieval in cloud computing environments requires both security and retrieval efficiency. This paper proposes a Ciphertext Retrieval based on Cloud Pretreatment (CRBCP) based on cloud preprocessing. The scheme divides the cloud into the file server and the

index server. Firstly, the program uploads the ciphertext document set to the file server and index server. A lot of preprocessing work is done in the index server and generate an inverted index table. Then, the program uploads the ciphertext retrieval item to the index server. Term Frequency-Inverse Document Frequency (TF-IDF) is used the to get the weight vector of the ciphertext document and the ciphertext retrieval item. Finally, the index server calculates the similarity and returns the result to the client. The simulation results show that the efficiency of encryption and decryption time in the algorithm is obviously higher than that of DjikGentryHaleviVaikuntanathan (DGHV) and Based Vector space model and Homomorphism ciphertext retrieval scheme (BVH). The overall efficiency of ciphertext retrieval in the program is superior than others. In the protection of user data privacy and security under the premise, CRBCP scheme preprocesses the ciphertext in the index server. This will not only greatly improve the efficiency of ciphertext retrieval and reduce the computational pressure on the client, but also fully embody the concept and advantages of cloud computing.

P558 *UAV Path Planning Based on Adaptive Weighted Pigeon-inspired Optimization Algorithm [#17672]*

Na Lin, Siming Huang, Changqing Gong, Liang Zhao and Jiacheng Tang, Shenyang Aerospace University, China

In the complex environment,using traditional pigeon-inspired optimization algorithm for the UAV route planning leads local optimum and slow convergence speed and unstable problem. This paper introduces an adaptive weighted pigeon- inspired optimization algorithm. The adaptive weight coefficient is applied to calculate the speed and position of the individuals in the population which enhances the quality and efficiency of route planning. The simulation results show that the adaptive weighted pigeon-inspired optimization algorithm provides a shorter route distance, a lower threat cost consumption and the algorithm running time while comparing with pigeon-inspired optimization algorithm and particle swarm optimization. After the spline smoothing, the UAV route is flyable.

P559 *Correlation Filters with Adaptive Memories and Fusion for Visual Tracking [#17290]*

Cheng Peng, Fanghui Liu, Haiyan Yang, Jie Yang and Nikola Kasabov, Shanghai Jiao Tong University, China; Auckland University of Technology, New Zealand

Correlation filter-based trackers (CFTs) with multiple features have recently achieved competitive performance. However, such conventional CFTs simply combine these features via a fixed weight. Likewise, these trackers also utilize a fixed learning rate to update their models, which makes CFTs easily drift especially when the target suffers heavy occlusions. To tackle these issues, we propose a dynamic decision fusion strategy to automatically learn the weight from the corresponding response map, and accordingly, models are adaptively updated based on a reliability metric. Moreover, a novel kernelized scale estimation scheme is proposed by exploiting the nonlinear relationship over targets of different sizes. Qualitative and quantitative comparisons on the benchmark have demonstrated that the proposed approach significantly outperforms other state-of-the-art trackers.

P560 *Patterns versus Characters in Subword-aware Neural Language Modeling [#17592]*

Takhanov Rustem and Assylbekov Zhenisbek, Nazarbayev University, Kazakhstan

Words in some natural languages can have a composite structure. Elements of this structure include the root (that could also be composite), prefixes and suffixes with which various nuances and relations to other words can be expressed. Thus, in order to build a proper word representation one must take into account its internal structure. From a corpus of texts we extract a set of frequent subwords and from the latter set we select patterns, i.e. subwords which encapsulate information on character n-gram regularities. The selection is made using the pattern-based Conditional Random Field model [23,19] with l_1 regularization. Further, for every word we construct a new sequence over an alphabet of patterns. The new alphabet's symbols confine a local statistical context stronger than the characters, therefore they allow better epresentations in ${\mathbb{R}}^n$ and are better building blocks for word representation. In the task of subword-aware language modeling, pattern-based models outperform character-based analogues by 2-20 perplexity points. Also, a recurrent neural network in which a word is represented as a sum of embeddings of its patterns is on par with a competitive and significantly more sophisticated character- based convolutional architecture.

P561 *Adaptive Fireworks Algorithm based on Two-master Sub-population and New Selection Strategy [#17685]*

Xiguang Li, Shoufei Han, Liang Zhao and Changqing Gong, Shenyang Aerospace University, China

Adaptive Fireworks Algorithm (AFWA) is an effective algorithm for solving optimization problems. However, AFWA is easy to fall into local optimal solutions prematurely and it also provides a slow convergence rate. In order to improve these problems, the purpose of this paper is to apply two-master sub- population(TMS) and new selection strategy to AFWA with the goal of further boosting performance and achieving global optimization. Our simulation compares the proposed algorithm(TMSFWA) with the FWA-Based algorithms and other swarm intelligence algorithms. The results show that the proposed algorithm achieves better overall performance on the standard test functions.

P562 *Multimodal Fusion with Global and Local Features for Text Classification [#17157]*

Cheng Xu, Yue Wu and Zongtian Liu, Shanghai University, China

Text classification is a crucial task in natural language processing. Due to the characteristics of text structure, achieving the best result remains an ongoing challenge. In this paper, we propose an ensemble model which outperforms the state-of- the-art. We first utilize rule-based n-gram approach to extend corpus. Then two different features, global dependencies of word and local semantic feature, are extracted by gated recurrent unit and global average pooling model respectively. In order to take advantage of the complementarity of the global and local features, a decision-level fusion is applied to fuse those different kinds of features. We evaluate the quality of our model on various public datasets, including sentiment analysis, ontology classification and text categorization. Experimental results shows that our model can effectively learnt representations for language modeling, and achieve the best accuracy of text categorization.

P563 *Image Segmentation with Pyramid Dilated Convolution based on ResNet and U-Net [#17778]*

Qiao Zhang, Zhipeng Cui, Xiaoguang Niu, Shijie Geng and Yu Qiao, Shanghai Jiao Tong University, China

Various deep convolutional neural networks (CNNs) have been applied in the task of medical image segmentation. A lot of CNNs have been proved to get better performance than the traditional algorithms. Deep residual network (ResNet) has drastically improved the performance by a trainable deep structure. In this paper, we proposed a new end-to-end network based on ResNet and U-Net. Our CNN effectively combine the features from shallow and deep layers through multi-path information confusion. In order to exploit global context features and enlarge receptive field in deep layer without losing resolution, we designed a new structure called Pyramid Dilated Convolution Unit. Unlike traditional CNNs, our network replaces the pooling layer with convolutional layer, which may reduce information loss to some extent. We also introduced the LeakyReLU instead of ReLU along the down- sampling path to increase the expressiveness of our model. Experiment shows that our proposed method can successfully extract features for ultrasound image segmentation.

P564 *Cognitive Load Recognition Using Multi-Threshold United Complex Network [#17788]*

Jian Shang and Qingshan Liu, Huazhong University of Science and Technology, China

Finding effective representations from electroencephalogram (EEG) data is challenging. Complex network (CN) analysis has been proved to be one of the efficient way in the EEG time series analysis, such as modeling the

cognitive events of human beings. But most of the network analysis is just using the time domain statistical features and often has a fixed threshold for the network's connectivity. Herein, based on our previous work with an adaptive threshold, we propose a novel approach using a set of thresholds which fit to the data distribution to construct connections between different EEG channels to generate a multi-channel network. Inspired by the multi-frame method of video processing, we also divide the EEG data of one trial into several frames without overlap. The final classification is based on the multi- threshold and multi-frame network structural features. The results on the cognitive load classification dataset demonstrate that the proposed approach is more efficient than the deep learning method, and reduce the mean classification error to 8.1\%.

Friday, November 17, 4:00PM-6:00PM

FriB1 Reinforcement learning

Friday, November 17, 4:00PM-6:00PM, Room: Kaixuan 7, Chairs: Ruizhuo Song and V. N. Muralidhara

4:00PM *Adaptive Dynamic Programming for Direct Current Servo Motor [#17106]*

Liao Zhu and Ruizhuo Song, University of Science and Technology Beijing, China

In this paper, a control method for continuous time Direct Current (DC) servo motor, is presented based on adaptive dynamic programming. The core of this paper is the application of adaptive dynamic programming (ADP) to control the DC servo motor system. The program includes three main steps: (i) The mathematical model of DC servo motor system is established, and the feasibility of solving the problem with ADP is analyzed; (ii) On the basis of introducing the theory of ADP, we propose a solution to the problem; (iii) The simulation of the DC servo motor system is carried out. The contribution of this paper is that ADP, which is one of the most important methods in the field of optimal control, is used to solve the traditional problem. Finally, simulation study is conducted to verify the effectiveness of the presented algorithm.

4:15PM *An Event-Triggered Heuristic Dynamic Programming Algorithm for Discrete-Time Nonlinear Systems [#17395]*

Ziyang Wang, Qinglai Wei and Derong Liu, University of Science and Technology Beijing, China; Institute of Automation, Chinese Academy of Sciences, China; Guangdong University of Technology, China

Event-triggered control means the control law of the systems will only be updated when the triggering condition is met, so that the computational burden is reduced. In this paper, a new event-triggering condition of the heuristic dynamic programming (HDP) algorithm is developed for discrete-time nonlinear systems. Two neural networks are constructed to estimate the value function and the control law. Besides, the Lyapunov stability of systems under the algorithm is proven. Finally, an example is presented to show the effectiveness of the algorithm.

4:30PM *Implicit Incremental Natural Actor Critic [#17425]*

Ryo Iwaki and Minoru Asada, Osaka University, Japan

The natural policy gradient (NPG) method is a promising approach to find a locally optimal policy parameter. The NPG method has been demonstrated remarkable successes in many fields, including the large scale applications. On the other hand, the estimation of the NPG itself requires a enormous amount of samples. Furthermore, incremental estimation of the NPG is computationally unstable. In this work, we propose a new incremental and stable algorthm for the NPG estimation. The proposed algorithm is based on the idea of implicit temporal differences, and we call the proposed one implicit incremental natural actor critic (I2NAC). Theoretical analysis indicates the stability of I2NAC and the instability of conventional incremental NPG methods. Numerical experiment shows that I2NAC is less sensitive to the value of step sizes.

4:45PM *Influence of the Chaotic Property on Reinforcement Learning using a Chaotic Neural Network [#17483]*

Yuki Goto and Katsunari Shibata, Oita University, Japan

Aiming for the emergence of higher complicated dynamic function such as "thinking", our group has set up a hypothesis that internal chaotic dynamics in an agent's chaotic neural network grows from "exploration" to "thinking" through reinforcement learning, and proposed a new learning method for that. However, even after learning in a simple obstacle avoidance task, the agent sometimes moved irregularly and collided with the obstacle. By reducing the scale of the recurrent connection weights, which is expected to have a deep relation to the chaotic property, the problem was reduced. Then in this paper, the learning performance depending on the recurrent weight scale is observed. The scale has an appropriate value as can be seen in FORCE learning in reservoir computing.

5:00PM *Average Reward Reinforcement Learning for Semi-Markov Decision Processes [#17557]*

Jiayuan Yang, Yanjie Li, Haoyao Chen and Jiangang Li, Harbin Institute of Technology Shenzhen Graduate School, China

In this paper, we study new reinforcement learning (RL) algorithms for Semi-Markov decision processes (SMDPs) with an average reward criterion. Based on the discrete- time type Bellman optimality equation, we use incremental value iteration (IVI), stochastic shortest path (SSP) value iteration and bisection algorithms to derive novel RL algorithms in a straightforward way. These algorithms use IVI, SSP and dichotomy to directly estimate the optimal average reward to solve the instability of average reward RL, respectively. Furthermore, a simulation experiment is used to compare the convergence among these algorithms.

5:15PM *Large-Scale Bandit Approaches for Recommender Systems [#17417]*

Qian Zhou, Xiaofang Zhang, Jin Xu and Bin Liang, Soochow University, China

Recommender systems have been successfully applied to many application areas to predict users' preference. However, these systems face the exploration-exploitation dilemma when making a recommendation, since they need to exploit items which raise users' interest and explore new items to improve satisfaction simultaneously. In this paper, we deal with this dilemma through Multi-Armed Bandit (MAB) approaches, especially for large-scale recommender systems that have vast or infinite items. We propose two large-scale bandit approaches under the situations that there is no available priori information. The continuous exploration in our approaches can address the cold start problem in recommender systems. Furthermore, our context-free approaches are based on users' click behavior without the dependence on side information. We theoretically prove that our approaches can converge to optimal item recommendations in the long run. Experimental results indicate that our approaches are able to provide more accurate recommendations than some classic bandit approaches in terms of click-through rates, with less calculation time.

5:30PM *Policy Gradient Reinforcement Learning for I/O Reordering on Storage Servers [#17130]*

Kumar Dheenadayalan, Gopalakrishnan Srinivasaraghavan and V.N. Muralidhara, Indian Institute of Information Technology, India

Deep customization of storage architectures to the applications they support is often undesirable --- nature of application data is dynamic, applications are replaced far more often than storage systems are and usage patterns change dynamically with time. A continuously learning software intervention that dynamically adapts to the changing workload pattern would be the easiest way to bridge this 'gap'. We do believe that the overhead induced by the software intervention would be negligible for large-scale storage systems. Reinforcement Learning offers a way to dynamically learn from a continuous data stream and take appropriate actions towards optimizing a future goal. We adapt policy gradient reinforcement learning to learn a policy that maximizes I/O throughput. A set of discrete actions consisting of switches between scheduling schemes is considered to dynamically re-order client-specific I/O operations. Results reveal that I/O reordering policy learned using reinforcement learning results in significant improvement in the overall I/O throughput.

5:45PM *Neuro-control of Nonlinear Systems with Unknown Input Constraints [#17745]*

Bo Zhao, Xinliang Liu, Derong Liu and Yuanchun Li, Institute of Automation, Chinese Academy of Sciences, China; Cyberspace Administration of China, China; Guangdong University of Technology, China; Changchun University of Technology, China

This paper establishes an adaptive dynamic programming algorithm based neuro control scheme for nonlinear systems with unknown input constraints. The control strategy consists of an online nominal optimal control and a neural network (NN) based saturation compensator. For nominal systems without input constraints, we develop a critic NN to solve the Hamilton-Jacobi-Bellman equation. Hereafter, the online approximate nominal optimal control policy can be derived directly. Then, considering the unknown input constraints as saturation nonlinearity, NN based feed-forward compensator is employed. The ultimate uniform bounded stability of the closed-loop system is analyzed via Lyapunov's direct method. Finally, simulation on a torsional pendulum system is provided to verify the effectiveness of the proposed control scheme.

FriB2 Computational intelligence 4

Friday, November 17, 4:00PM-6:00PM, Room: Zhujiang 2, Chairs: SongYun Xie and Raja Fdhila

4:00PM *Measuring Word Semantic Similarity Based on Transferred Vectors [#17599]*

Changliang Li, Teng Ma, Yujun Zhou, Jian Cheng and Bo Xu, Institute of Automation Chinese Academy of Sciences, China

Semantic similarity between words has now become a popular research problem to tackle in natural language processing (NLP) field. Word embedding have been demonstrated progress in measuring word similarity recently. However, limited to the distributional hypothesis, basic embedding methods generally have draw-backs in nature. One of the limitations is that word embeddings are usually by predicting a target word in its local context, leading to only limited information being captured. In this paper, we propose a novel transferred vectors approach to compute word semantic similarity. Transferred vectors are obtained via a reason-able combination of the source word and its nearest neighbors on semantic level. We conduct experiments on popular both English and Chinese benchmarks for measuring word similarity. The experiment results demonstrate that our method outperforms previous state-of-the-art by a large margin.

4:15PM *A portable system of visual fatigue evaluation for stereoscopic display [#17803]*

Yue Bai, SongYun Xie, JunDong Cho and Ghulam Hussian, Northwestern Polytechnical University, China; Sungkyunkwan University, Korea (South)

Stereoscopic display is contributing to realistic three dimensional (3D) effect which has been widely prevalent and successfully commercialized. However, visual fatigue is still an unsolved issue for these applications and has negative effects on viewers. In this paper, we proposed a method based on analysis of the production theory of 3D display and measurement of biological signals to evaluate visual fatigue. Given that two types of methods have a complementary relationship, we designed a Fuzzy Fusion of Visual Fatigue (FFVF) model using vergence-accommodation conflict (VAC) and electroencephalogram (EEG) signal. By utilizing the fuzzy theory as a fusion method to multiple features, our proposed FFVF model shows a high Pearson correlation value of 0.9676 with questionnaire results while maintaining high stability. This kind of portable human-friendly 3D viewing evaluation technology can be widely deployed.

4:30PM *Origami Folding Sequence Generation Using Discrete Particle Swarm Optimization [#17442]*

Ha Duong Bui, Sungmoon Jeong, Nak Young Chong and Matthew Mason, Japan Advanced Institute of Science and Technology, Japan; Carnegie Mellon University, United States

This paper proposes a novel approach to automating origami or paper folding. The folding problem is formulated as a combinatorial optimization problem to automatically find feasible folding sequences toward the desired shape from a generic crease pattern, minimizing the dissimilarity between the current and desired origami shapes. Specifically, we present a discrete particle swarm optimization algorithm, which can take advantage of the classical particle swarm optimization algorithm in a discrete folding action space. Through extensive numerical experiments, we have shown that the proposed approach can generate an optimum origami folding sequence by iteratively minimizing the Hausdorff distance, a dissimilarity metric between two geometric shapes. Moreover, an in-house origami simulator is newly developed to visualize the sequence of origami folding.

4:45PM *Emergency Materials Scheduling in Disaster Relief based on a Memetic Algorithm [#17758]*

Yongwei Qin and Jing Liu, Xidian University, China

In the case of large-scale natural disaster, it is very important to determine emergency materials scheduling quickly and efficiently from multiple emergency logistics centers as supply points supplying to multiple disasters affected points. In order to improve the efficiency of supplying organization and reduce casualties and economic losses, a mathematical model is first constructed in this paper to minimize the total emergency cost including emergency response system cost and the loss caused by untimely rescue. Then, a memetic algorithm (MA) using natural coding is proposed to solve the problem, and the experimental results show that the performance of this algorithm is much better than that of genetic algorithm (GA). At the same time, the proposed model and algorithm provide robust support for decision makers when quick responses are necessary for disaster relief activities.

5:00PM *Dynamic Multi Objective Particle Swarm Optimization based on a New Environment Change Detection Strategy [#17824]*

Ahlem Aboud, Raja Fdhila and Adel M Alimi, University of Sfax, Tunisia

The dynamic of real-world optimization problems raises new challenges to the traditional particle swarm optimization (PSO).Responding to these

challenges, the dynamic optimization has received considerable attention over the past decade. This paper introduces a new dynamic multi-objective optimization based particle swarm optimization (Dynamic-MOPSO).The main idea of this paper is to solve such dynamic problem based on a new environment change detection strategy using the advantage of the particle swarm optimization. In this way, our approach has been developed not just to obtain the optimal solution, but also to have a capability to detect the environment changes. Thereby, Dynamic-MOPSO ensures the balance between the exploration and the exploitation in dynamic research space. Our approach is tested through the most popularized dynamic benchmark's functions to evaluate its performance as a good method.

5:15PM *Multi Objective Particle Swarm Optimization based Cooperative Agents with Automated Negotiation [#17826]*

Najwa Kouka, Raja Fdhila and Adel M Alimi, University of Sfax, Tunisia

This paper investigates a new hybridization of multi-objective particle swarm optimization (MOPSO) and cooperative agents (MOPSO-CA) to handle the problem of stagnation encounters in MOPSO, which leads solutions to trap in local optima. The proposed approach involves a new distribution strategy based on the idea of having a set of a sub-population, each of which is processed by one agent. The number of the sub-population and agents are adjusted dynamically through the Pareto ranking. This method allocates a dynamic number of sub-population as required to improve diversity in the search space. Additionally, agents are used for better management for the exploitation within a sub-population, and for exploration among sub- populations. Furthermore, we investigate the automated negotiation within agents in order to share the best knowledge. To validate our approach, several benchmarks are performed. The results show that the introduced variant ensures the trade-off between the exploitation and exploration with respect to the comparative algorithms.

5:30PM *An AI-Based Hybrid Model for Wind Speed Forecasting [#17687]*

Haiyan Lu, Jiani Heng and Chen Wang, University of Technology Sydney, Australia; Dongbei University of Finance and Economics, China; Lanzhou University, China

Forecasting of wind speed plays an important role in wind power prediction for management of wind energy. Due to intermittent nature of wind, accurately forecasting of wind speed has been a long standing research chal-lenge. Artificial neural networks (ANNs) is one of promising approaches to predict wind speed. However, since the results of ANN-based models are strongly dependent on the initial weights and thresholds values which are usually randomly generated, the stability of forecasting results is not always satisfactory. This paper presents a new hybrid model for short term forecasting of wind speed with high accuracy and strong stability by optimizing the parameters in a generalized regression neural network(GRNN) using a multi-objective firefly algorithm (MOFA). To evaluate the effectiveness of this hybrid algorithm, we apply it for short-term forecasting of wind speed from four wind power stations in Penglai, China, along with four typical ANN-based models, which are back propagation neural network (BPNN), radical basis function neural network (RBFNN), wavelet neural network (WNN) and GRNN. The comparison results clearly show that this hybrid model can significantly reduce the impact of randomness of initialization on the forecasting results and achieve good accuracy and stability.

5:45PM *Towards a Brain-inspired Developmental Neural Network by Adaptive Synaptic Pruning [#17280]*

Feifei Zhao, Tielin Zhang, Yi Zeng and Bo Xu, Institute of Automation, Chinese Academy of Sciences, China

It is widely accepted that appropriate network topology should be empirically predefined before training a specific neural network learning task. However, in most cases, these carefully designed networks are easily falling into two kinds of dilemmas: 1) When the data is not enough to train the network well, it will get an underfitting result. 2) When networks have learned too much patterns, they are likely to lead to an overfitting result and have a poor performance on processing new data or transferring to other tasks. Inspired by the synaptic pruning characteristics of the human brain, we propose a brain-inspired developmental neural network (BDNN) algorithm by adaptive synaptic pruning (BDNN-sp) which could get rid of the overfitting and underfitting. The BDNN-sp algorithm adaptively modulates network topology by pruning useless neurons dynamically. In addition, the evolutional optimization method makes the network stop on an appropriate network topology with the best consideration of accuracy and adaptability. Experimental results indicate that the proposed algorithm could automatically find the optimal network topology and the network complexity could adaptively increase along with the increase of task complexity. Compared to the traditional topology-predefined networks, trained BDNN-sp has the similar accuracy but better transfer learning abilities.

FriB3 Data mining 3

Friday, November 17, 4:00PM-6:00PM, Room: Zhujiang 3, Chairs: Rhee Man Kil and Shukai Duan

4:00PM *A Hybrid Approach for Recovering Information Propagational Direction [#17512]*

Xiang-Rui Peng, Ling Huang and Chang-Dong Wang, Sun Yat-sen University, China

With the rapid development of network technology, people are communicating with each other through a variety of network access, such as computer, mobile phone, tablet, etc., for the sharing of information and interactive behavior. The flow of information is directional, but this directionality is usually hidden. In recent years, link prediction technology has been developed very rapidly in social network analysis. The active and passive of the relationship, in social network, could be identified via undirected relationship network structure. However, this approach only focuses on the topological structure while ignoring the information shared between individuals, which is not suitable for study in terms of information propagation. To solve this problem, we propose a hybrid approach termed DRHM to recover the information sharing direction in networks. It combines not only topology structure but also node content. Since the algorithm is based on edge structure, it is equally applicable to large-scale data set. The experiment has demonstrated that our algorithm performs well in information propagational network.

4:15PM *Make Users and Preferred Items Closer: Recommendation Based on Distance Metric Learning [#17570]*

Junliang Yu, Min Gao, Wenge Rong, Yuqi Song, Qianqi Fang and Qingyu Xiong, Chongqing University, China; Beihang University, China

Recommender systems can help to relieve the dilemma called information overload. Collaborative filtering is a primary approach based on collective historical ratings to recommend items to users. One of the most competitive collaborative filtering algorithm is matrix factorization. In this paper, we proposed an alternative method. It aims to make users be spatially close to items they like and be far away from items they dislike, by connecting matrix factorization and distance metric learning. The metric and latent factors are trained simultaneously and then used to generate reliable recommendations. The experiments conducted on the real-world datasets have shown that, compared with methods only based on factorization, our method has advantage in terms of accuracy.

4:30PM *Anomaly Detection for Categorical Observations using Latent Gaussian Process [#17590]*

Fengmao Lv, Guowu Yang, Jinzhao Wu, Chuan Liu and Yuhong Yang, University of Electronic Science and Technology of China, China; Guangxi Univesity for Nationalities, China; University of Minnesota, United States

Anomaly detection is an important problem in many applications, ranging from medical informatics to network security. Various distribution-based techniques have been proposed to tackle this issue, which try to learn the probabilistic distribution of conventional behaviors and consider the observations with low densities as anomalies. For categorical observations, multinomial or dirichlet compound multinomial distributions were adopted as effective statistical models for conventional samples. However, when faced with small-scale data set containing multivariate categorical samples, these models will suffer from the curse of dimensionality and fail to capture the statistical properties of conventional behavior, since only a small proportion of possible categorical configurations will exist in the training data. As an effective bayesian non- parametric technique, categorical latent Gaussian process is able to model small- scale categorical data through learning a continuous latent space for multivariate categorical samples with Gaussian process. Therefore, on the basis of categorical latent Gaussian process, we propose an anomaly detection technique for multivariate categorical observations. In our method, categorical latent Gaussian process is adopted to capture the probabilistic distributions of conventional categorical samples. Experimental results on categorical data set show that our method can effectively detect anomalous categorical observations and achieve better detection performance compared with other anomaly detection techniques.

4:45PM *Predicting Taxi Passenger Demands Based on the Temporal and Spatial Information [#17750]*

Sang Ho Kang, Han Bin Bae, Rhee Man Kil and Hee Yong Youn, Sungkyunkwan University, Korea (South)

This paper presents a new method of predicting taxi passenger demands in the central city areas of Seoul and New York based on the temporal and spatial information on predicted values. For the efficiency of the city's taxi system, investigating the taxi passenger demands is required mainly in the large scaled cities. From this context, this paper proposes a prediction model of combining the conditional transition distribution and the neighboring information on taxi passenger demands. As a result, the proposed method provides higher prediction performances than other methods of homogeneous prediction models.

5:00PM *Combining the Global and Local Estimation Models for Predicting PM10 Concentrations [#17751]*

Han Bin Bae, Tae Hyun Kim, Rhee Man Kil and Hee Yong Youn, Sungkyunkwan University, Korea (South)

This paper presents a new way of predicting timely air pollution measure such as the PM$_{10}$ concentration in Seoul based on a new method of combining the global and local estimation models. In the proposed method, the structure of nonlinear dynamics of generating air pollution data series is analyzed by investigating the attractors in the phase space and this structure is used to build the prediction model. Then, the global estimation model such as the network with Gaussian kernel functions is trained for the air pollution series data. Furthermore, the local estimation model which will recover the errors of the global estimation model using the on-line adaptation method, is also dopted. As a result, the proposed prediction model combining the global and local estimation models provides robust performances of predicting PM$_{10}$ concentrations.

5:15PM *Periodic Associated Sensor Patterns Mining from Wireless Sensor Networks [#17549]*

Md Mamunur Rashid, Joarder Kamruzzaman, Iqbal Gondal and Rafiul Hassan, Monash University, Australia; Federation University, Australia; King Fahd University of Petroleum and Minerals, Saudi Arabia

Mining interesting knowledge from the massive amount of data gathered in wireless sensor networks is a challenging task. Works reported in literature all-confidence measure based associated sensor patterns can captures association-like co-occurrences and the strong temporal correlations implied by such co-occurrences in the sensor data. However, when the user given all-confidence threshold is low, a huge amount of patterns are generated and mining these patterns may not be space and time efficient. Temporal periodicity of pattern appearance can be regarded as an important criterion for measuring the interestingness of associated patterns in WSNs. Associated sensor patterns that occur after regular intervals is called periodic associated sensor patterns. Even though mining periodic associated sensor patterns from sensor data stream is extremely important in many real-time applications, no such algorithm has been proposed yet. In this paper, we propose a compact tree structure called Periodic Associated Sensor Pattern-tree (PASP-tree) and an efficient mining approach for finding periodic associated sensor patterns (PASPs) from WSNs. Extensive performance analyses show that our technique is time and memory efficient in finding periodic associated sensor patterns.

5:30PM *PUD: Social Spammer Detection Based on PU Learning [#17366]*

Yuqi Song, Min Gao, Junliang Yu, Wentao Li, Junhao Wen and Qingyu Xiong, Chongqing University, China; University of Technology Sydney, Australia

Social networks act as the communication channels for people to share various information online. However, spammers who generate spam information reduce the satisfaction of common users. Numerous notable studies have been done to detect social spammers, and these methods can be categorized into three types: unsupervised, supervised and semi-supervised methods. While the performance of supervised and semi-supervised methods is superior in terms of detection accuracy, these methods usually suffer from the dilemma of imbalanced data since the labeled normal users are far more than spammers in real situations. To address the problem, we propose a novel method only relying on normal users to detect spammers. Firstly, a classifier is built from a part of normal and unlabeled samples to pick out reliable spammers from unlabeled samples. Secondly, our well-trained detector, which is based on the given normal users and predicted spammers, can distinguish between normal users and spammers. Experiments conducted on real-world datasets show that the proposed method is competitive with supervised methods.

5:45PM *Hierarchical Hybrid Attention Networks for Chinese Conversation Topic Classification [#17341]*

Yujun Zhou, Changliang Li, Bo Xu, Jiaming Xu, Jie Cao and Bo Xu, Institute of Automation, Chinese Academy of Sciences, China

Topic classification is useful for applications such as forensics analysis and cyber-crime investigation. To improve the overall performance on the task of Chinese conversation topic classification, we propose a hierarchical neural network with automatic semantic features selection, which is a hierarchical architecture that depicts the structure of conversations. The model firstly incorporates speaker information into the character- and word-level attentions and generates sentence representation, then uses attention-based BLSTM to construct the conversation representation. Experimental results on three datasets demonstrate that our model achieves better performance than multiple baselines. It indicates that the proposed architecture can capture the informative and salient features related to the meaning of a conversation for topic classification. And we release the dataset of this paper that can be obtained from https://github.com/njoe9/H-HANs.

FriB4 Pattern recognition 2

Friday, November 17, 4:00PM-6:00PM, Room: Zhujiang 5, Chairs: Chih-Cheng Hung and Hongyi Li

4:00PM *Bi-MOCK: A Multi-objective Evolutionary Algorithm for Bi-clustering with Automatic Determination of the Number of Bi-clusters. [#17593]*

Meriem Bousselmi, Slim Bechikh, Chih-Cheng Hung and Lamjed Ben Said, University of Tunis, Tunisia; Kennesaw State University, United States

Bi-clustering is one of the main tasks in data mining with many possible applications in bioinformatics, pattern recognition, text mining, just to cite a few. It refers to simultaneously partitioning a data matrix based on both rows and columns. One of the main issues in bi-clustering is the difficulty to find the number of bi-clusters, which is usually pre-specified by the human user. During the last decade, a new algorithm, called MOCK, has appeared and shown its performance in data clustering where the number of clusters is determined automatically. Motivated by the interesting results of MOCK, we propose in this paper a new algorithm, called Bi-MOCK, which could be seen as an extension of MOCK for bi-clustering. Like MOCK, Bi-MOCK uses the concept of multi-objective optimization and is able to find automatically the number of bi-clusters thanks to a newly proposed variable string length encoding scheme. The performance of our proposed algorithm is assessed on a set of real gene expression datasets. The comparative experiments show the merits and the outperformance of Bi-MOCK with respect to some existing recent works.

4:15PM *CNN based Transfer Learning for Scene Script Identification [#17853]*

Maroua Tounsi, Ikram Moalla, Adel M Alimi and Frank Lebourgeois, University of Sfax, Tunisia; Institut National des Sciences Appliquees de Lyon, France

Identifying scripts in natural images is an important step in document analysis. Recently, Convolutional Neural Network (CNN) has achieved great success in image classification tasks, due to its strong capacity and invariance to translation and distortions. A problem with training a new CNN is that it requires a large amount of labelled images and extensive computation resources. Transfer learning from pre-trained models proves to ease the application of CNN and even boost the performance in some circumstances. In this paper, we use transfer learning and fine-tuning in document analysis. Indeed, we deal with the scene script identification quantitatively by comparing the performances of transfer learning and learning from scratch. We evaluate two CNN architectures trained on natural images: AlexNet and VGG-16. Experimental results on several benchmark datasets namely, SIW-13, MLe2e and CVSI2015, demonstrate that our approach outperforms previous approaches and full training.

4:30PM *A Self Organizing Map based Multi-objective Framework for Automatic Evolution of Clusters [#17577]*

Naveen Saini, Shubham Chourasia, Sriparna Saha and Pushpak Bhattacharyya, Indian Institute of Technology Patna, India; Sikkim Manipal Institute of Technology Sikkim, India

The current paper reports about the development of an automatic clustering technique which builds upon the search capability of a self-organizing multi-objective differential evolutionary approach. The algorithm utilizes new search operators which are developed after considering the neighbor-hood relationships of solutions of a population extracted using a self organizing map (SOM). Variable number of cluster centers are encoded in different solutions of the population which are evolved using the new search operators of differential evolution to automatically determine the number of clusters. Two cluster validity indices capturing different goodness measures of partitioning are used as objective functions. The effectiveness of the proposed framework namely, self organizing map based multi-objective (MO) clustering technique (SMEA_clust) is shown for automatically partitioning four artificial and four real-life data sets in comparison with a multi- objective differential evolution based clustering technique (similar to our proposed approach but without using SOM concept), two recent multi-objective clustering based techniques, VAMOSA and MOCK. Results are further validated using statistical significance tests.

4:45PM *Neuronal Classifier for Both Rate and Timing-Based Spike Patterns [#17175]*

Qiang Yu, Longbiao Wang and Jianwu Dang, Tianjin University, China

Spikes play an essential role in information transmission and neural computation, but how neurons learn them remains unclear. Most learning rules depend on either the rate- or timing-based code, but rare one is suitable for both. In this paper, we present an efficient multi-spike learning rule which is suitable to train neurons to classify both rate- and timing-based spike patterns. With our learning rule, neurons can be trained to fire different numbers of output spikes in response to their input patterns, and therefore single neurons are capable for multi-category classification.

5:00PM *Experimental Study on the Effects of Watermarking Techniques on EEG-based Application System Performance [#17838]*

Trung Duy Pham, Dat Tran and Wanli Ma, University of Canberra, Australia

Watermarking has been suggested as a means to improve security of e-Health systems or to add additional functionalities to such system. All watermarking methods alter the host signal to some extent, though the acceptability of this modification varies with the watermarking scheme and depends on a particular application. However, the effect of watermarking methods on Electroencephalogram (EEG)-based applications has not been investigated. In this paper, we propose a robust EEG watermarking scheme and experimentally investigate the impact of applying the proposed method on the recognition performance of some EEG-based application systems such as emotion recognition and user authentication. We have found that the proposed EEG watermarking scheme results in a small degradation of performance.

5:15PM *Adaptively Weighted Facial Expression Recognition by Feature Fusion Under Intense Illumination Condition [#17061]*

Yuechuan Sun and Jun Yu, University of Science and Technology of China, China

Accurate and robust facial expression recognition under complex environment is a challenging task. In this paper, we propose an adaptively weighted facial expression recognition approach to overcome the intense illumination difficulty by fusing diverse illumination invariant appearance features. First, a novel neural-network- based adaptive weight assignment strategy is designed to eliminate the adverse illumination variations efficiently and effectively. Then, a feature fusion strategy is developed to combine two of the most successful illumination invariant appearance descriptors, namely Gabor and Local Binary Patterns (LBP), for giving comprehensive and robust description of facial expressions. Extensive experiments demonstrate the superiority of the proposed approach on the common used CK+ dataset, especially the adaptive weight assignment for the significant improvement of recognition accuracy under extreme and intense illumination conditions.

5:30PM *A Deep Model Combining Structural Features and Context Cues for Action Recognition in Static Images [#17397]*

Xinxin Wang, Kan Li and Yang Li, Beijing Institute of Technology, China

In this paper, we present a deep model for the task of action recognition in static images, which combines body structural information and context cues to build a more accurate classifier. Moreover, to construct more semantic and robust body structural features, we propose a new body descriptor, named limb angle discriptor(LAD), which uses the relative angles between the limbs in 2D skeleton. We evaluate our method on the

PASCAL VOC 2012 Action dataset and compare it with the published results. The result shows that our method achieves 90.6% mean AP, outperforming the previous state-of-art approaches in the field.

5:45PM *Face Hallucination and Recognition Using Kernel Canonical Correlation Analysis [#17865]*

Zhao Zhang, Yunhao Yuan, Yun Li, Bin Li and Jipeng Qiang, Yangzhou University, China

Canonical correlation analysis (CCA) is a classical but powerful tool for image super-resolution tasks. Since CCA in essence is a linear projection learning method, it usually fails to uncover the nonlinear relationships between high- resolution (HR) and low-resolution (LR) facial image features. In order to solve this issue, we propose a new face hallucination and recognition algorithm based on kernel CCA, where the nonlinear correlation between HR and LR face features can be well depicted by implicit high-dimensional nonlinear mappings determined by specific kernels. First, our proposed method respectively extracts the principal component features from high-resolution and low-resolution facial images for computational efficiency and noise removal. Then, it makes use of kernel CCA to learn the nonlinear consistency of HR and LR facial features. The proposed approach is compared with existing face hallucination algorithms. A number of experimental results on LR face recognition have demonstrated the effectiveness and robustness of our proposed method.

FriB5 Machine learning and deep learning

Friday, November 17, 4:00PM-6:00PM, Room: Zhujiang 7, Chairs: James Lo and Sheraz Ahmed

4:00PM *FCN and Unit-linking PCNN Based Image Saliency Detection [#17201]*

Lecheng Zhou and Xiaodong Gu, Fudan University, China

Detecting salient regions of an image can significantly increase the efficiency of follow-up processing, and thus improve the performance of the whole system. In this paper, we proposed a novel model of image saliency detection, which combines pulse coupled neural network (PCNN) with a fully convolutional neural network (FCN).In our proposed model, an image is firstly fed into a unit-linking PCNN, and the segmentation result, providing topological properties of the objects, serves as an input channel of the FCN. Guided by the topological features, the deep neural network then provides a coarse saliency map. Finally, we use the segmentation result to refine the boundaries of the salient objects to generate a fine saliency map. Furthermore, in this model various techniques are introduced to the PCNN to refine the segmentation result, preserving structural integrity between different objects. Experimental results on several benchmarks show that our model outperforms other state-of-the-art approaches without retuning on different datasets.

4:15PM *Relation Classification via CNN, Segmented Max-Pooling, and SDP-BLSTM [#17552]*

Pengfei Wang, Zhipeng Xie and Junfeng Hu, Fudan University, China

Relation classification is the task of classifying the semantic relation between two marked entities in a sentence. This paper proposes a novel neural model for this task. It first does convolution on input sentence to get local features of words in local context windows, and then designs a novel segmented max-pooling to reduce the temporal dimension from the length of sentence to the length of shortest dependency path (SDP) between two marked entities, and finally, a SDP- BLSTM network is applied to produce the final fixed-size vector representation of the relation instance, which is fed to a two-layer feed-forward network for classification. Experiments on the SemEval-2010 Task 8 dataset show that our model achieves competitive performance when compared with several start-of-the- art models.

4:30PM *Binary Stochastic Representation for Large Multi-class Classification [#17561]*

Thomas Gerald, Nicolas Baskiotis and Ludovic Denoyer, LIP6/UPMC, France

Classification with a large number of classes is a key problem in machine learning and corresponds to many real-world applications like tagging of images or textual documents in social networks. If one-vs-all methods usually reach top performance in this context, these approaches suffer of a high inference complexity, linear w.r.t the number of categories. Different models based on the notion of binary codes have been proposed to overcome this limitation, achieving in a sublinear inference complexity. But they a priori need to decide which binary code to associate to which category before learning using more or less complex heuristics. We propose a new end-to-end model which aims at simultaneously learning to associate binary codes with categories, but also learning to map inputs to binary codes. This approach called Deep Stochastic Neural Codes (DSNC) keeps the sublinear inference complexity but do not need any "a priori" tuning. Experimental results on different datasets show the effectiveness of the approach w.r.t baseline methods.

4:45PM *Solving the Local-Minimum Problem in Training Deep Learning Machines [#17589]*

James Lo, Yichuan Gui and Yun Peng, University of Maryland Baltimore County, United States

The local-minimum problem in training deep learning machines (DLMs) has plagued their development. This paper proposes a method to directly solve the problem. Our method is based on convexification of the sum squared error (SSE) criterion through transforming the SSE into a risk averting error (RAE) criterion. To alleviate numerical difficulties, a normalized RAE (NRAE) is employed. The convexity region of the SSE expands as its risk sensitivity index (RSI) increases. Making the best use of the convexity region, our method starts training with a very large RSI, gradually reduces it, and switches to the RAE as soon as the RAE is numerically feasible. After training converges, the resultant DLM is ex-pected to be inside the attraction basin of a global minimum of the SSE. Numerical results are provided to show the effectiveness of the proposed method.

5:00PM *Deep Learning Model for Sentiment Analysis in Multi-Lingual Corpus [#17402]*

Lisa Medrouk and Anna Pappa, University Paris 8, France

While most text classification studies focus on monolingual documents, in this article, we propose an empirical study of poly-lingual text sentiment classification model, based on Convolutional Networks (ConvNets). The novel approach consists on feeding the deep neural network with one input of multi-text source, composed by reviews all written in different languages, without any code-switching indication, or language translation. We construct a multi-lingual opinion corpus combining three languages: English French and Greek all from Restaurants `Reviews`. Despite the limited contextual information due to relatively compact text content, no prior knowledge is used. The neural networks exploit n-gram level information, and the experimental results achieve high accuracy for sentiment polarity prediction, both positive and negative, which lead us to deduce that ConvNets features extraction is language independent.

5:15PM *Learning Joint Multimodal Representation Based on Multi-fusion Deep Neural Networks [#17228]*

Zepeng Gu, Bo Lang, Tongyu Yue and Lei Huang, Beihang University, China

Recently, learning joint representation of multimodal data has received more and more attentions. Multimodal features are concept-level compositive features which are more effective than those single-modality features. Most existing methods only mine interactions between modalities on the top of their networks for one time to learn multimodal representation. In this paper, we propose a multi-fusion deep learning framework which learns multimodal features richer in semantic. The framework sets multiple fusing points in different level of feature spaces, and then integrates and passes the fusing information step by step from the low level to higher levels. Moreover, we propose a multi-channel decoding network with alternate fine-tuning strategy to fully mine the modality-specific information

and cross-modality correlations. We are also the first to introduce deep learning features into multimodal deep learning, alleviating the semantic and statistical property differences between modalities to learn better features. Extensive experiments on real-world datasets demonstrate that, our proposed method achieves superior performance compared with the state-of-the-art methods.

5:30PM *DeepBIBX: Deep Learning for Image Based Bibliographic Data Extraction [#17873]*

Akansha Bhardwaj, Dominik Mercier, Sheraz Ahmed and Andreas Dengel, University of Fribourg, Switzerland; German Research Center for Artificial Intelligence, Germany

Extraction of structured bibliographic data from document images of non-native- digital academic content is a challenging problem that finds its application in the automation of cataloging systems in libraries and reference linking domain. The existing approaches discard the visual cues and focus on converting the document image to text and further identifying citation strings using trained segmentation models. Apart from the large training data, which these existing methods require, they are also language dependent. This paper presents a novel approach (DeepBIBX) which targets this problem from a computer vision perspective and uses deep learning to semantically segment the individual citation strings in a document image. DeepBIBX is based on deep Fully Convolutional Networks and uses transfer learning to extract bibliographic references from document images. Unlike existing approaches which use textual content to semantically segment bibliographic references, DeepBIBX utilises image based contextual information, which makes it applicable to documents of any language. To gauge the performance of the presented approach, a dataset consisting of 286 document images containing 5090 bibliographic references is collected. Evaluation results reveals that the DeepBIBX outperforms state-of-the-art method (ParsCit, 71.7%) for bibliographic references extraction and achieved an accuracy of 84.9% in comparison to 71.7%. Furthermore, in terms of pixel classification task, DeepBIBX achieved a precision and a recall rate of 96.2%, 94.4% respectively.

5:45PM *Comparing Hybrid NN-HMM and RNN for Temporal Modeling in Gesture Recognition [#17511]*

Nicolas Granger and Mounim El Yacoubi, Telecom SudParis, France

This paper provides an extended comparison of two temporal models for gesture recognition, namely Hybrid Neural Network-Hidden Markov Models (NN-HMM) and Recurrent Neural Networks (RNN) which have lately claimed the state-the-art performances. Experiments were conducted on both models in the same body of work, with similar representation learning capacity and comparable computational costs. For both solutions, we have integrated recent contributions to the model architectures and training techniques. We show that, for this task, Hybrid NN-HMM models remain competitive with Recurrent Neural Networks in a standard setting. For both models, we analyze the influence of the training objective function on the final evaluation metric. We further tested the influence of temporal convolution to improve context modeling, a technique which was recently reported to improve the accuracy of gesture recognition.

FriB6 Computational finance

Friday, November 17, 4:00PM-6:00PM, Room: Kaixuan 3, Chairs: Mahesan Niranjan and Kaizhu Huang

4:00PM *Non-Negative Matrix Factorization with Exogenous Inputs for Modeling Financial Data [#17519]*

Steven Squires, Luis Montesdeoca, Adam Prugel-Bennett and Mahesan Niranjan, University of Southampton, United Kingdom

Nonnegative matrix factorization (NMF) is an effective dimensionality reduction technique that extracts useful latent spaces in positive value data matrices. Constraining the factors to be positive values, and via additional regularizations, sparse representations, sometimes interpretable as part-based representations have been derived in a wide range of applications. Here we propose a model suitable for the analysis of multi-variate financial time series data in which the variation in data is explained by latent subspace factors and contributions from a set of observed macro-economic variables. The macro-economic variables being external inputs, the model is termed XNMF (eXogenous inputs NMF). We derive a multiplicative update algorithm to learn the factorisation and empirically demonstrate that it converges to useful solutions on real data and prove that it is guaranteed to monotonically reduce the objective function. On share prices from the FTSE 100 index time series, we show that the proposed model is effective in clustering stocks in similar trading sectors together via the latent representations learned.

4:15PM *Measuring Self-monitoring Using Facebook Online Data Based on Snyder's Psychological Theories [#17335]*

Ying Liu, Yongfeng Huang and Xuanmei Qin, Beijing University of Posts and Telecommunications, China; Tsinghua University, China

Measuring psychological concept self-monitoring (SM) is useful for understanding how people consciously employ impression management strategies in social interactions. Recently, researchers have attempted to utilize the online user data to measure users' SM value. However, in earlier researches, self-monitoring individuals' specific behavioral and psychological characteristics haven' t been sufficiently considered in the process of features extraction. In this paper, motivated by psychologist Snyder' s SM psychological theories, we propose to extract the behavior character of self-monitoring individuals in social network at the macro-level to measure SM. Besides, some other SM relevant features, situational factors, implicit topic words in status updates and demographics are also extracted. Furthermore, a new SM measuring method is presented by exploiting various kinds of users' online data. The experimental results on a benchmark dataset show that all these features are effective and our SM measuring method can outperform many baseline methods.

4:30PM *Dynamic Bidding Strategy Based on Probabilistic Feedback in Display Advertising [#17162]*

Yuzhu Wu, Shumin Pan, Qianwen Zhang and Jinkui Xie, East China Normal University, China

Bidding strategy is an issue of fundamental importance to Demand Side Platform(DSP) in real-time bidding(RTB). Bidding strategies employed by the Demand Siders may have significant impacts on their own benefits. In this paper, we design a dynamic bidding strategy based on probabilistic feedback, called PFDBS, which is different from previous work that is mainly focused on fixed strategies or continuous feedback strategies. Our dynamic bidding strategy is more in accordance with environment of Internet advertising to solve the instability problem. If evaluated valid, we will retain the current strategy, otherwise, we present an approach to amend strategy combined with previous feedback. The experiments on real-world RTB dataset demonstrate that our method has the best performance on Key Performance Indicator(KPI) compared to other popular strategies, meanwhile, the consumption trend of overall budget is the most consistent with real market situation.

4:45PM *Dempster-Shafer Fusion of Semi-supervised Learning Methods for Predicting Defaults in Social Lending [#17766]*

Aleum Kim and Sung-Bae Cho, Yonsei University, Korea (South)

In social lending, it is hard to know whether borrowers will repay well or not. Most researchers use supervised learning for default prediction, but labeling data by hand is time-consuming. Moreover, labeling results of semi-supervised learning methods are not the same each other. In this paper, we propose a fusion method of label propagation and transductive

SVM based on Dempster-Shafer theory for precisely labeling unlabeled data to improve the performance. We remove few unlabeled data with lower reliabilities in labeling results and fusion of the two results based on Dempster-Shafer theory. We have conducted experiments with supervised learning method trained with labeled unlabeled data. As a result, the proposed method produced the best accuracies, 6.15% higher than the result trained with labeled data only, and 1.3% higher than the conventional methods.

5:00PM *Robust Portfolio Risk Minimization Using the Graphical Lasso [#17771]*

Tristan Millington and Mahesan Niranjan, University of Southampton, United Kingdom

We apply the statistical technique of graphical lasso for inverse covariance estimation of asset price returns in Markowitz portfolio optimisation. Graphical lasso induces sparsity in the inverse covariance matrix, thereby capturing conditional independences between different assets. We show empirical results that not only the resulting minimum risk portfolio is robust, in that the variation in expected returns is reduced when a fraction of the data is assumed missing, but also enables the construction of a financial network in which groups of assets belonging to the same financial sector are linked.

5:15PM *Deep Candlestick Mining [#17373]*

Andrew Mann and Denise Gorse, University College London, United Kingdom

A data mining process we name Deep Candlestick Mining (DCM) is developed using Randomised Decision Trees, Long Short Term Memory Recurrent Neural Networks and k-means++, and is shown to discover candlestick patterns significantly outperforming traditional ones. A test for the predictive ability of novel versus traditional candlestick patterns is devised using all significant candlestick patterns within the traditional or deep mined categories. The deep mined candlestick system demonstrates a remarkable ability to outperform the traditional system by 75.2% and 92.6% on the German Bund 10-year futures contract and EURUSD hourly data.

5:30PM *Data Augmentation Based Stock Trend Prediction Using Self-organising Map [#17725]*

Jiayi Zhang, Wenge Rong, Qiubin Liang, Haonan Sun and Zhang Xiong, Beihang University, China

Stock trend prediction has been of great interest for both investment benefits and research purposes. Unlike image processing or natural language processing, where the amount of data could easily reach a million order of magnitude, the application of artificial intelligent models is however limited in the domain of stock prediction because of insufficient amount of stock price data. This article seeks to ameliorate the stock prediction task from a different angle and provides a novel method to enlarge the training data by firstly clustering different stocks according to their retracement probability density function, and then combine all the day-wise information of the same stock cluster as enlarged training data, which is then fed into a recurrent neural network to make stock trend prediction. Experimental results show that this data augmentation technique suits for deep learning methods and notably improves the stock trend prediction task.

5:45PM *Stacked Denoising Autoencoder-based Stock Market Trend Prediction via K-Nearest Neighbour Data Selection [#17317]*

Haonan Sun, Wenge Rong, Jiayi Zhang, Qiubin Liang and Zhang Xiong, Beihang University, China

In financial applications, stock-market trend prediction has long been a popular subject. In this research, we develop a new predictive model to improve the accuracy by enhancing the denoising process which includes a training set selection based on four K-nearest neighbour (KNN) classifiers to generate a more representative training set and a denoising autoencoder-based deep architecture as kernel predictor. Considering the good agreement between closing price trends and daily extreme price movements, we forecast extreme price movements as an indirect channel for realizing accurate price-trend prediction. The experimental results demonstrate the effectiveness of the proposed method in terms of its accuracy compared with traditional machine-learning models in four principal Chinese stock indexes and nine leading individual stocks from nine different major industry sectors.

FriB7 Neuromorphic hardware & Speech processing

Friday, November 17, 4:00PM-6:00PM, Room: Kaixuan 5, Chairs: Hisanao Akima and Yifei Pu

4:00PM *Language Identification Using Deep Convolutional Recurrent Neural Networks [#17364]*

Christian Bartz, Tom Herold, Haojin Yang and Christoph Meinel, Hasso Plattner Institute, Germany

Language Identification (LID) systems are used to classify the spoken language from a given audio sample and are typically the first step for many spoken language processing tasks, such as Automatic Speech Recognition (ASR) systems. Without automatic language detec- tion, speech utterances cannot be parsed correctly and grammar rules cannot be applied, causing subsequent speech recognition steps to fail. We propose a LID system that solves the problem in the image domain, rather than the audio domain. We use a hybrid Convolutional Recur- rent Neural Network (CRNN) that operates on spectrogram images of the provided audio snippets. In extensive experiments we show, that our model is applicable to a range of noisy scenarios and can easily be extended to previously unknown languages, while maintaining its classi- fication accuracy. We release our code and a large scale training set for LID systems to the community.

4:15PM *Weighted Robust Principal Component Analysis with Gammatone Auditory Filterbank for Singing Voice Separation [#17135]*

Feng Li and Masato Akagi, Japan Advanced Institute of Science and Technology, Japan

This paper presents a proposed extension of robust principal component analysis (RPCA) with weighting (WRPCA) based on gammatone auditory filterbank for singing voice separation. Although the conventional RPCA is an effective method to separate singing voice and music accompaniment, it makes some strong assumptions. For example, drums may lie in the sparse subspace instead of being low-rank, which decreases the separation performance in many real-world applications, especially for drums existing in the mixture music signal. Accordingly, the proposed WRPCA method utilizes different weighted values between sparse (singing voice) and low-rank matrices (music accompaniment). In addition, we developed an extended RPCA on cochleagram using an alternative time- frequency (T-F) representation based on gammatone auditory filterbank. We also applied IBM/IRM estimation to improve the separation results. Evaluation results show that WRPCA achieves better separation performance than the conventional RPCA, especially for the IBM estimation method.

4:30PM *Complexity Reduction of Neural Network Model for Local Motion Detection in Motion Stereo Vision [#17403]*

Hisanao Akima, Susumu Kawakami, Jordi Madrenas, Satoshi Moriya, Masafumi Yano, Koji Nakajima, Masao Sakuraba and Shigeo Sato, Tohoku University, Japan; Universitat Politecnica de Catalunya, Spain

Spatial perception, in which objects' motion and positional relationship are recognized, is necessary for applications such as a walking robot and an autonomous car.One of the demanding features of spatial perception in real world applications is robustness. Neural network-based approaches, in which perception results are obtained by voting among a large number of neuronal activities, seem to be promising. We focused on a neural network model for motion stereo vision proposed by Kawakami et al. In this model, local motion in each small region of the visual field, which comprises optical flow, is detected by hierarchical neural network.

Implementation of this model into a VLSI is required for real-time operation with low power consumption. In this study, we reduced the computational complexity of this model and showed cell responses of the reduced model by numerical simulation.

4:45PM *A Hardware Oriented Dropout Algorithm for Efficient FPGA Implementation [#17760]*
Yoeng Jye Yeoh, Hakaru Tamukoh and Takashi Morie, Kyushu Institute of Technology, Japan

This paper proposes a hardware oriented dropout algorithm for efficient Field Programmable Gate Array (FPGA) implementation. Dropout is one of the regularization technique that is commonly used in neural networks such as Multi-Layer Perceptrons (MLPs), Convolutional Neural Networks (CNNs) and others. In order to generate a dropout mask to randomly drop the neurons during training phase, random number generators (RNGs) are usually used in software implementation. However, RNGs consume considerable FPGA resources for hardware implementation. The proposed method is able to minimize the resources required for FPGA implementation of dropout by performing a simple rotation operation to a predefined dropout mask. We apply the proposed method to MLPs and CNNs, and evaluate them on MNIST and CIFAR-10 classification. In addition, we employ the proposed method in GoogLeNet training using own dataset to construct a vision system for domestic robots. Experimental results show that the proposed method achieves the same regularized effect as the ordinary dropout algorithm. Logic synthesis results show that the proposed method significantly reduces FPGA resource consumption compared with the ordinary RNGs based approaches.

5:00PM *A Novel Design Method of Burst Mechanisms of a Piece-Wise Constant Neuron Model based on Bifurcation Analysis [#17472]*
Chiaki Matsuda and Hiroyuki Torikai, Kyoto Sangyo University, Japan

A piece-wise constant (PWC) neuron model is an electronic circuit neuron model having a PWC vector field. In this paper, a PWC neuron model with a novel controlled voltage source is presented. Due to the nonlinearity of the voltage source, the presented model exhibits various bifurcations. Among such bifurcations, fundamental bifurcations related to burst behaviors are analyzed in this paper. Then, using the bifurcation analyses results, a novel design method of the vector field of the PWC neuron model is presented. It is shown that the presented design method enables the PWC neuron model to reproduce typical occurrence mechanisms of burst behaviors of neurons. Furthermore, the PWC neuron model is implemented as a breadboard prototype and occurrence of a typical burst behavior is validated by a real circuit experiment.

5:15PM *Implementation of Desired Digital Spike Maps in the Digital Spiking Neurons [#17674]*
Hiroaki Uchida and Toshimichi Saito, HOSEI University, Japan

This paper considers implementation of desired digital spike maps (DSmaps) in the digital spiking neurons (DSNs). The DSmap is defined on a set of points and can describe various spike-trains. The DSN is constructed by two shift registers and a wiring. Depending on the wiring pattern, the DSN can generate various spike-trains. We present a simple formula that clarifies relation between the DSmaps and DSNs. Using the formula, desired DSmaps can be implemented in DSNs. We then present a simple ring-coupled system of the DSNs and demonstrate multi- phase synchronization of periodic spike-trains in Verilog simulation. This coupled system will be developed into large-scale networks of DSNs.

5:30PM *A Novel Hardware-Efficient CPG Model based on Nonlinear Dynamics of Asynchronous Cellular Automaton [#17478]*
Kentaro Takeda and Hiroyuki Torikai, Kyoto Sangyo University, Japan

A novel hardware-efficient central pattern generator (CPG) model based on the nonlinear dynamics of an asynchronous cellular automaton is presented. It is shown that the presented model can generate multi-phase synchronized periodic signals, which are suitable for controlling a snake robot. Then, the presented model is implemented on a field programmable gate array (FPGA) and is connected to a snake robot hardware. It is shown by real machine experiments that the presented model can realize rhythmic spinal locomotions of the snake robot. Moreover, it is shown that the presented model consumes much fewer hardware resources (FPGA slices) than a standard simple CPG model.

5:45PM *An Efficient Hardware Architecture for Multilayer Spiking Neural Networks [#17574]*
Yuling Luo, Lei Wan, Junxiu Liu, Jinlei Zhang and Yi Cao, Guangxi Normal University, China; University of Surrey, United Kingdom

Spiking Neural Network (SNN) is the most recent computational model that can emulate the behaviors of biological neuron system. This paper highlights and discusses an efficient hardware architecture for the hardware SNNs, which includes a layer-level tile architecture (LTA) for the neurons and synapses, and a novel routing architecture (NRA) for the interconnections between the neuron nodes. In addition, a visualization performance monitoring platform is designed, which is used as functional verification and performance monitoring for the SNN hardware system. Experimental results demonstrate that the proposed architecture is feasible and capable of scaling to large hardware multilayer SNNs.

FriB8 Emotion and reward & Bioinformatics

Friday, November 17, 4:00PM-6:00PM, Room: Kaixuan 6, Chairs: Chu Kiong Loo and Xue Yan

4:00PM *Effect of Parameter Tuning at Distinguishing between Real and Posed Smiles from Observers' Physiological Features [#17879]*
Md Zakir Hossain and Tamas Gedeon, Australian National University, Australia

To find the genuineness of a human behavior / emotion is an important research topic in affective and human centered computing. This paper uses a feature level fusion technique of three peripheral physiological features from observers, namely pupillary response (PR), blood volume pulse (BVP), and galvanic skin response (GSR). The observers' task is to distinguish between real and posed smiles when watching twenty smilers' videos (half being real smiles and half are posed smiles). A number of temporal features are extracted from the recorded physiological signals after a few processing steps and fused before computing classification performance by k-nearest neighbor (KNN), support vector machine (SVM), and neural network (NN) classifiers. Many factors can affect the results of smile classification, and depend upon the architecture of the classifiers. In this study, we varied the K values of KNN, the scaling factors of SVM, and the numbers of hidden nodes of NN with other parameters unchanged. Our final experimental results from a robust leave-one-everything-out process indicate that parameter tuning is a vital factor to find a high classifi-cation accuracy, and that feature level fusion can indicate when more parameter tuning is needed.

4:15PM *Efficient Human Stress Detection System based on Frontal Alpha Asymmetry [#17479]*
Asma Baghdadi, Yassine Aribi and Adel M Alimi, ReGIM-Lab, Tunisia

EEG signals reflect the inner emotional state of a person and regarding its wealth in temporal resolution, it can be used profitably to measure mental stress. Emotional states recognition is a growing research field inasmuch to its importance in Human-machine applications in all domains, in particular psychology and psychiatry. The main goal of this study is to provide a simple method for stress detection based on Frontal Alpha Asymmetry for trials selection and time, time-frequency domain features. This approach was tested on prevalent DEAP database, and provided us with two subdatasets to be processed and classified thereafter. From the variety of features produced in the literature we chose to test Hjorth parameters and Band Power as a time-frequency feature. To enhance the

classification performance, we tested the SVM classifier, K-NN and Fuzzy K-NN.

4:30PM *Can Eye Movement Improve Prediction Performance on Human Emotions toward Images Classification? [#17842]*

Kitsuchart Pasupa, Wisuwat Sunhem, Chu Kiong Loo and Yoshimitsu Kuroki, King Mongkut's Institute of Technology Ladkrabang, Thailand; University of Malaya, Malaysia; Kurume National College of Technology, Japan

Recently, image sentiment analysis has become more and more attractive to many researchers due to an increasing number of applications developed to understand images e.g. image retrieval systems and social networks. Many studies aim to improve the performance of the classifier by many approaches. This work aims to predict the emotional response of a person who is exposed to images. The prediction model makes use of eye movement data captured while users are looking at images to enhance the prediction performance. An image can stimulate different emotions in different users depending on where and how their eyes move on the image. Two image datasets were used, i.e. abstract images and images with context information, by using leave-one-user-out and leave-one-image-out cross-validation techniques. It was found that eye movement data is useful and able to improve the prediction performance only in leave-one-image-out cross-validation.

4:45PM *Multimodal Emotion Recognition Using Deep Neural Networks [#17817]*

Hao Tang, Wei Liu, Weilong Zheng and Baoliang Lu, Shanghai Jiao Tong University, China

The change of emotions is a temporal dependent process. In this paper, a Bimodal-LSTM model is introduced to take temporal information into account for emotion recognition with multimodal signals. We extend the implementation of denoising autoencoders and adopt the Bimodal Deep Denoising AutoEncoder modal. Both models are evaluated on a public dataset, SEED, using EEG features and eye movement features as inputs. Our experimental results indicate that the Bimodal-LSTM model outperforms other state-of-the-art methods with a mean accuracy of 93.97%. The Bimodal-LSTM model is also examined on DEAP dataset with EEG and peripheral physiological signals, and it achieves the state-of- the-art results with a mean accuracy of 83.53%.

5:00PM *Investigating Gender Differences of Brain Areas in Emotion Recognition Using LSTM Neural Network [#17818]*

Xue Yan, Weilong Zheng, Wei Liu and Baoliang Lu, Shanghai Jiao Tong University, China

In this paper, we investigate key brain areas of men and women using electroencephalography (EEG) data on recognising three emotions, namely happy, sad and neutral. Considering that emotion changes over time, Long Short-Term Memory (LSTM) neural network is adopted with its capacity of capturing time dependency. Our experimental results indicate that the neural patterns of different emotions have specific key brain areas for males and females, with females showing right lateralization and males being more left lateralized. Accordingly, two non-overlapping brain regions are selected for two genders. The classification accuracy for females (79.14%) using the right lateralized region is significantly higher than that for males (67.61%), and the left lateralized area educes a significantly higher classification accuracy for males (82.54%) than females (73.51%), especially for happy and sad emotions.

5:15PM *Prediction of Stroke Disease using Deep Learning Model [#17691]*

Pattanapong Chantamit-o-pas and Madhu Goyal, University of Technology Sydney, Australia

Many predictive techniques have been widely applied in clinical decision making such as predicting occurrence of a disease or diagnosis, evaluating prognosis or outcome of diseases and assisting clinicians to recommend treatment of diseases. However, the conventional predictive models or techniques are still not effective enough in capturing the underlying knowledge because it is incapable of simulating the complexity on feature representation of the medical problem domains. This research reports predictive analytical techniques for stroke diseases using deep learning model applied on heart disease dataset. The atrial fibrillation symptoms in heart patients are a major risk factor of stroke and share common variables to predict stroke. The outcomes of this research are more accurate than medical scoring systems currently in use for warning heart patients if they are likely to develop stroke.

5:30PM *Tuning Hyperparameters for Gene Interaction models in Genome-wide Association Studies [#17793]*

Suneetha Uppu and Aneesh Krishna, Curtin University, Australia

In genetic epidemiology, epistasis has been the subject of several researchers to understand the underlying causes of complex diseases. Identifying gene-gene and / or gene-environmental interactions are become more challenging due to multiple genetic and environmental factors acting together or independently. The limitations of current computational approaches motivated the development of a deep learning model in our recent study. The approach trained a multilayered feedforward neural network to discover interacting genes associated with the diseases. The models are evaluated under various simulated scenarios and compared with previous methods. The results showed significant improvements in predicting gene interactions over the traditional machine learning techniques. This study is further extended to maximize the predictive performance of the models by tuning the hyperparameters using Cartesian grid and random grid searching. Several experiments are conducted on real datasets to identify higher-order interacting genes responsible for the disease. The findings demonstrated randomly chosen trials are more efficient than trials chosen by grid search for optimizing hyperparameters. The optimal configuration of hyperparameter values improved the model performance without overfitting. The results illustrate top 30 gene interactions responsible for sporadic breast cancer and hypertension.

5:45PM *A Method of Integrating Spatial Proteomics and Protein-Protein Interaction Network Data [#17789]*

Steven Squires, Rob Ewing, Adam Prugel-Bennett and Mahesan Niranjan, University of Southampton, United Kingdom

The increase in quantity of spatial proteomics data requires a range of analytical techniques to effectively analyse the data. We provide a method of integrating spatial proteomics data together with protein-protein interaction (PPI) networks to enable the extraction of more information. A strong relationship between spatial proteomics and PPI network data was demonstrated. Then a method of converting the PPI network into vectors using spatial proteomics data was explained which allows the integration of the two datasets. The resulting vectors were tested using machine learning techniques and reasonable predictive accuracy was found.

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