The 12th International Workshop on Complex-systems for Future Technologies and Applications (IWCFTA 2019)

Program

11-13 October 2019·Nanjing·China

Sponsors

Jiangsu Provincial Key Laboratory of Networked Collective Intelligence, Southeast University
Technical Committee on Network Science and Engineering of Chinese Institute of Command and Control
City University of Hong Kong
Technical support: IEEE CASS (Nonlinear CAS Technical Committee)
Northeastern University

Conference site: Nanjing Zhongshan Hotel

Website: https://nci.seu.edu.cn/wome_23639/list.htm

Index

General Information

The 2019 IWCFTA will be the successor of the formerly successfully eleven sessions of "International Workshop on Chaos-Fractals Theories and Applications". In this year, the name changes to "International Workshop on Complex-systems for Future Technologies and Applications" with the same abbreviation. The 2019 IWCFTA will be the 12th International Workshop in the successful series of events organized consecutively in Chongqing (2018, 11th IWCFTA), Qinhuangdao (2017, 10th IWCFTA), Zhangzhou (2016, 9th IWCFTA), Harbin (2015, 8th IWCFTA) etc. (IWCFTA Home: http://chaos-fractal.cn). This series of conferences has been held annually since 2008, and now it has become a premier international workshop in the areas of complex systems and artificial intelligence.

The new workshop will cover topics beyond Chaos and Fractal Theory to general complex systems which are abundant in modern society. It will provide a high-level international forum for researchers and Ph. D. students who will present recent research results, address new challenges and discuss trends in the area of complex systems and interdisciplinary science. The aims of the conference are focused on discussing the most relevant methodologies and approaches to understanding, modelling, simulating, predicting, evaluating and mastering the Societal, Ecological, Biological and Engineered Complex Systems. Topics covered by the workshop include, but are not limited to:

1. Complex networks, self-organization, multi-agent systems
2. Chaos, fractal theory and its application, nonlinear dynamics, mathematical modeling and simulation
3. Information and communication technologies
4. Artificial intelligence, cognitive processes
5. Social networks, game theory, stock market and crises
6. Smart cities, urban planning, transport and energy
7. Biological networks, systems biology
8. Other applications of complex systems

The workshop is sponsored by Jiangsu Provincial Key Laboratory of Networked Collective Intelligence, School of Mathematics at the Southeast University and the Centre for Chaos and Complex Networks at the City University of Hong Kong.

Organizing Committee

Honorary Chairs

Leon O. Chua（University of California at Berkeley, USA）

Member of Academia Europaea,
IEEE Fellow

Guanrong (Ron) Chen（City University of Hong Kong, China）

Member of Academia Europaea,
Fellow of The World Academy of Sciences,
IEEE Fellow
Editor-in-Chief of International Journal of Bifurcation and Chaos

Zhiliang Zhu（Northeastern University, China）

General Chairs

Jinde Cao, Southeast University, China
C. K. Michael Tse, The Hong Kong Polytechnic University, China
Wenwu Yu, Southeast University, China
Xinghuo Yu, RMIT University, Australia

General Co-Chairs

Zengqiang Chen, Nankai University, China
Zhihong Guan, Huazhong University of Science and Technology, China
Guoping Jiang, Nanjing University of Posts and Telecommunications, China
Jinhu Lü, Beihang University, China
Xiaofan Wang, Shanghai University, China
Haikun Wei, Southeast University, China
Guanghui Wen, Southeast University, China

Program Chairs

Simone Baldi, Southeast University, China

Zengru Di, Beijing Normal University, China
Zhisheng Duan, Peking University, China
Xiang Li, Fudan University, China
Qingyun Wang, Beihang University, China
Zhigang Zeng, Huazhong University of Science and Technology, China

Program Co-Chairs

Junjie Fu, Southeast University, China
Jinling Liang, Southeast University, China
Qingshan Liu, Southeast University, China
Jianquan Lu, Southeast University, China
Wenjun Xiong, Southwestern University of Finance and Economics, China
Huaqing Li, Southwest University, China

Regional Chairs

Chun Lung Philip Chen, University of Macau, Macau China
Tingwen Huang, Texas A&M University at Qatar, Qatar
Juergen Kurths, Potsdam Institute for Climate Impact Research and Humboldt University Berlin, Institute of Physics, Germany
Wei Ren, University of California, Riverside, USA
Zidong Wang, Brunel University, UK
Wei-Xing Zheng, University of Western Sydney, Australia

Invited Session Chairs

Honggui Han, Beijing University of Technology, China
Wei He, University of Science and Technology Beijing, China
Tao Jia, Southwest University, China
Hongyi Li, Guangdong University of Technology, China
Chao Shen, Xi'an Jiaotong Univrsity, China
Aiguo Song, Southeast University, China
Jian Sun, Beijing Institute of Technology, China
Zhengguang Wu, Zhejiang University, China
Hai Yu, Northeastern University, China
Jinhui Zhang, Beijing Institute of Technology, China

Tong Zhang, South China University of Technology, China

Program Committee

Prof. Aziz-Alaoui M. A., University of Le Havre, France

Prof. Simone Baldi, Southeast University, China

Prof. Jinde Cao, Southeast University, China

Assoc. Prof. Nelson Chan, City University of Hong Kong, China

Prof. Fangyue Chen, Hangzhou Dianzi University, China

Prof. Zengqiang Chen, Nankai University, China

Prof. Qun Ding, Heilongjiang University, China

Prof. Shukai Duan, Southwest University, China

Prof. Zhisheng Duan, Peking University, China

Prof. Amed Elwakil, University of Sharjah, Emirates

Prof. Zhaosheng Feng, University of Texas--Pan American, USA

Prof. Chong Fu, Northeastern University, China

Prof. Xinchu Fu, Shanghai University, China

Prof. Geza Kolumban, Pázmány Péter Catholic University, Hungary

Prof. Cuncai Hua, Yunnan Normal University, China

Prof. Guoping Jiang, Nanjing University of Posts and Telecommunications, China

Prof. Francis C. M. Lau, The Hong Kong Polytechnic University, China

Prof. Chengqing Li, Xiangtan University, China

Prof.Huaqing Li, Southwest University, China

Prof. Yuxia Li, Shandong University of Science and Technology, China

Prof. Zhong Li, Fern University at Hagen, Germany

Prof. Xiaofeng Liao, Southwest University, China

Prof. Wei Lin, Fudan University, China

Prof. Jiemin Liu, Northeastern University at Qinhuangdao, China

Prof. Xiaoming Liu, Tianjin Polytechnic University, China

Prof. Guoyuan Qi, Tianjin Polytechnic University, China

Prof. Chuanjun Tian, Shenzhen University, China

Prof. Xiaojun Tong, Harbin University of Technology at Weihai, China

Prof. Guangyi Wang, Hangzhou Dianzi University, China

Prof. Lidong Wang, Dalian Nationalities University, China

Prof. Yuncai Wang, Taiyuan University of Technology, China

Prof. Guanghui Wen, Southeast University, China
Prof. Xiaofeng Wu, Minnan normal university, China
Prof. Qigui Yang, South China University of Technology, China
Prof. Xiaosong Yang, Huazhong University of Science and Technology, China
Prof. Simin Yu, Guangdong University of Technology, China
Prof. Xinghuo Yu, RMIT University, Australia
Prof. Wenwu Yu, Southeast University, China
Assoc. Prof. Hai Yu, Northeastern University, China
Prof. Huaguang Zhang, Northeastern University, China
Prof. Tianshou Zhou, Sun Yat-sen University, China

Organizing Chairs

Junjie Fu, Southeast University, China
Siyu Lv, Southeast University, China

Registration Chair

Duxin Chen, Southeast University, China
Yuezu Lv, Southeast University, China

Conference Secretariat

Peijun Wang, Anhui Normal University, China
Shaofu Yang, Southeast University, China
Wei Zhao, Southeast University, China
Lei Zhu, Southeast University, China

Program Overview

October 11 2019						
12:30-20:00			Registration (Hotel Hall Floor 1)			
18:00-19:30			Buffet (Yuhe Hall Floor 3)			
October 12 2019						
8:30-20:00			Registration (Hotel Hall Floor 1)			
Jinling Conference Hall (Floor 3)						
Time			Proceeding			
8:30-9:00			Opening Ceremony and Photo			
9:00-10:20			Keynote Speech			
10:20-10:40			Coffee break			
10:40-12:00			Keynote Speech			
12:00-13:00			Lunch Buffet (Yuhe Hall Floor 3)			
Time	Conference Room 201	Conference Room 206	Conference Room 307	Conference Room 308	Conference Room 312	Conference Room 309
13:30-16:00	Invited Session 1 (Process Control)	Invited Session 3 (Networked Control)	Invited Session 5 (Big Data and Patter Recognition)	Invited Session 6 (Complex Networks and MAS)	Invited Session 7 (Chaotic Dynamics and Applications)	Invited Session 8 (Nonlinear Systems and Applications)
16:00-16:30	Coffee Break					
16:30-17:50	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6
18:00-20:00	VIP Dinner (Zijin Hall Floor 1)/Buffet (Yuhe Hall Floor 3)					
October 13 2019						
Jinling Conference Hall (Floor 3)						
Time			Proceeding			
9:00-10:20			Keynote Speech			
10:20-10:40			Coffee break			
10:40-12:00			Keynote Speech			
12:00-13:00			Lunch Buffet (Yuhe Hall Floor 3)			
Time	Conference Room 201	Conference Room 206	Conference Room 307	Conference Room 308	Conference Room 312	Conference Room 309
13:30-16:00	Invited Session 2 (Robotics)	Invited Session 4 (Nonlinear Dynamics and Control)	Invited Session 11 (Distributed Control and Optimization with Applications)	Invited Session 12 (Hybrid Dynamics and Networks with Applications)	Invited Session 13 (Artificial Neural Networks Theories and Applications)	13:00-16:10 Invited Session 9 (Complex Networks) & 10 (Network Collaboration and Applications)
18:00-20:00	Dinner (Yuhe Hall Floor 3)					

Program Schedule

<table>
<tr><td colspan="6">October 11 2019</td></tr>
<tr><td>12:30-20:00</td><td colspan="5">Registration (Hotel Hall Floor 1)</td></tr>
<tr><td colspan="6">October 12 2019</td></tr>
<tr><td rowspan="8">8:30-12:00</td><td colspan="5">Jinling Conference Hall (Floor 3)</td></tr>
<tr><td>Chair</td><td>Time</td><td>Speaker</td><td>Organization</td><td>Title</td></tr>
<tr><td>Wenwu Yu</td><td>8:30-9:00</td><td colspan="3">Opening Ceremony and Photo</td></tr>
<tr><td>Guanrong Chen</td><td>9:00-9:40</td><td>Prof. Xinghuo Yu</td><td>RMIT University, Australia</td><td>Dealing with Complexity in Cyber-Physical-Social Systems with Simplexity</td></tr>
<tr><td>Xinghuo Yu</td><td>9:40-10:20</td><td>Prof. Yang Shi</td><td>University of Victoria, Canada</td><td>Distributed Model Predictive Control for Cyber-Physical Systems</td></tr>
<tr><td colspan="2">10:20-10:40</td><td colspan="3">Coffee break</td></tr>
<tr><td>C.K. Michael Tse</td><td>10:40-11:20</td><td>Prof. Zhongsheng Hou</td><td>Qingdao University, China</td><td>PID and Its Puzzles-MFAC and Progress</td></tr>
<tr><td>L. Philip Chen</td><td>11:20-12:00</td><td>Prof. Wei Ren</td><td>University of California, Riverside, USA</td><td>Distributed Dynamic State Estimation in Sensor Networks: Consistency, Confidence, and Convergence</td></tr>
<tr><td>12:00-13:30</td><td colspan="5">Lunch Buffet (Yuhe Hall Floor 3)</td></tr>
<tr><td rowspan="8">13:30-17:50</td><td colspan="5">Conference Room 201</td></tr>
<tr><td rowspan="7">Invited Session 1 Process Control</td><td colspan="4">Honggui Han, Beijing University of Technology, China (Chair)</td></tr>
<tr><td>Time</td><td>Speaker</td><td>Organization</td><td>Title</td></tr>
<tr><td>13:30-13:55</td><td>Prof. Jun Zhao</td><td>Dalian University of Technology, China</td><td>Data and Knowledge Driven Industrial Energy Prediction and Scheduling</td></tr>
<tr><td>13:55-14:20</td><td>Prof. Chunhui Zhao</td><td>Zhejiang University, China</td><td>Data-driven Wide-Range Non-Stationary Process Monitoring</td></tr>
<tr><td>14:20-14:45</td><td>Xiaoli Luan</td><td>Jiangnan University, China</td><td>Fault Detection Based on NIR for Crude Oil Desalting Process</td></tr>
<tr><td>14:45-15:10</td><td>Prof. Cailian Chen</td><td>Shanghai Jiao Tong University, China</td><td>Ultra-Reliable and Low-Latency Transmission for Sensing and Control in Industrial Network Systems</td></tr>
<tr><td>15:10-15:35</td><td>Prof. Honggui</td><td>Beijing University of</td><td>Multiobjective Cooperative</td></tr>
</table>

			Han	Technology, China	Optimal Control for Municipal Wastewater Treatment Process
	16:00-16:30 Coffee Break				
	Session 1	Junjie Fu, Southeast University, China (Chair)			
		16:30-16:50	Yunzhu Shen, Yongxiang Zhang	University of Jinan	Coexisting Strange Non-chaOtic Attractors in a Multistable System
		16:50-17:10	Zhen Xu, Yunzhu Shen, Yongxiang Zhang	University of Jinan	Infinite Number of Fractal Nonchaotic Attractors with Intermittency in A Piecewise Map
		17:10-17:30	Guanghan Liu, Enzeng Dong, Shen Li	Tianjin University of Technology	Mechanism Analysis of Hamiltonian Conservative Chaotic Systems Based on 4D Euler Equations
		17:30-17:50	Philippe Faradja, Guoyuan Qi	Tiangong University	Multistability and Hidden Chaos in the Brushless DC Motor System
13:30-17:50	Conference Room 206				
	Invited Session 3 Networked Control	Jian Sun, Beijing Institute of Technology, China (Chair) Jinhui Zhang, Beijing Institute of Technology, China (Chair)			
		Time	Speaker	Organization	Title
		13:30-13:55	Prof. Zhongqi Sun	Beijing Institute of Technology, China	Event-based MPC with Adaptive Horizon for Nonlinear Systems
		13:55-14:20	Prof. Yuanqing Wu	Guangdong University of Technology, China	Intelligent Control of Autonomous Unmanned System
		14:20-14:45	Prof. Huaicheng Yan	East China University of Science and Technology, China	Event-triggered H-infinity Control and Filtering of Networked Systems with Limited Information
		14:45-15:10	Prof. Hongjiu Yang	Tianjin University, China	Studying on Networked Control System with Actuator Saturated
		15:10-15:35	Prof. Jun Yang	Southeast University,	Event-triggered Disturbance Rejection Control for

				China	Networked Control Systems
		15:35-16:00	Prof. Bo Shen	Donghua University, China	Event-Triggered Filtering or Control for Network Systems
	16:00-16:30 Coffee Break				
	Session2	Yuezu Lv, Southeast University, China (Chair)			
		16:30-16:50	Zhe Shi, Li Liu, Hang Xu, Bingjie Wang, and Jingxia Li	Taiyuan University of Technology	Chaotic Ground Penetrating Radar based on Compression Sensing for Underground Cavity Detection
		16:50-17:10	Xinpeng Chen, Jingxia Li, Yang Liu, Hang Xu, Li Liu, and Bingjie Wang	Taiyuan University of Technology	Locating Underground Pipe Using Chaotic Pulse Position Modulation Signal
		17:10-17:30	Michaël A. Van Wyk and AndreM. McDonald	School of Electrical and Information Engineering Chamber of Mines Building University of the Witwatersrand	Invariant Density and Power Spectrum Selection via the Inverse Frobenius-Perron Problem Solution using Monotization
		17:30-17:50	Xiaodong Jiao, Enzeng Dong , Ronghao Li , Hui Yu	Tianjin University of Technology	Research on a Novel High Dimension Dissipative Hyper-Chaotic System and Application
13:30-17:50	Conference Room 307				
	Invited Session 5 Big Data and Pattern Recognition	Tong Zhang, South China University of Technology, China (Chair) Duxin Chen, Southeast University, China (Chair)			
		Time	Speaker	Organization	Title
		13:30-13:55	Dr. Xian-Bing Meng	South China University of Technology	Reinforcement Learning Based Evolutionary Algorithm with Applications to Multi-Agent Systems
		13:55-14:20	Dr. Jiajing	Sun Yat-sen	Data Analysis and Fraud

			Wu	University, Guangzhou	Detection on Blockchain
		14:20-14:45	Dr. Yuan Zong	Southeast University	Micro-Expression Recognition Based on Group Sparse Learning
		14:45-15:10	Wenxiao Zhao	Key Laboratory of Systems and Control, Academy of Mathematics and Systems Science, Chinese Academy of Sciences	Recursive Identification for Hammerstein Systems with Diminishing Excitation Signals
		15:10-15:35	Prof. Hua Geng	Tsinghua University, China	Operation of Large-scale Renewable Energy Conversion System: from unit to Cluster
		15:35-16:00	Prof. Hai-Tao Zhang	Huazhong University of Science and Technology	The role of reverse edges on hierarchical networks
	16:00-16:30 Coffee Break				
	Session 3	Duxin Chen, Southeast University, China (Chair)			
		16:30-16:50	Li Zhang, Sanjeeva Balasuriya, and Shu Tang Liu	Shandong university of political science and law	PDE, Fractal Theory and Urban Growth Models
		16:50-17:10	Yuanyuan Sun, Zhixing Lu, and Jiahao Liang	Dalian University of Technology	Symmetry Analysis of Julia Sets Based on Group Theory Julia
		17:10-17:30	Ruixin Xie, Hang Xu, Liqiang Li, Bingjie Wang, Li Liu, and Jingxia Li	Taiyuan University of Technology	A Hybrid Chaotic Radar System for Intrusion Detection

<table>
<tr><td></td><td></td><td>17:30-17:50</td><td>Chengjie Chen, Han Bao, Mo Chen, Quan Xu and Bocheng Bao</td><td>Changzhou University</td><td>Non-ideal Memristor Synapse-Coupled Bi-Neuron Hopfield Neural Network: Numerical Simulations and Breadboard Experiments</td></tr>
<tr><td rowspan="11">13:30-17:50</td><td colspan="5">Conference Room 308</td></tr>
<tr><td rowspan="6">Invited Session 6 Complex Networks and MAS</td><td colspan="4">Guanghui Wen, Southeast University, China (Chair)</td></tr>
<tr><td>Time</td><td>Speaker</td><td>Organization</td><td>Title</td></tr>
<tr><td>13:30-13:55</td><td>Prof. Wangli He</td><td>East China University</td><td>Consensus of Multi-agent Systems with Efficient Communication Schemes: Stochastic Sampling or Event-triggered strategies</td></tr>
<tr><td>13:55-14:20</td><td>Prof. Zhongkui Li</td><td>Peking University, China</td><td>Fully Distributed Event-triggered Cooperative Control</td></tr>
<tr><td>14:20-14:45</td><td>Prof. Zhiwei Liu</td><td>Huazhong University of Science and Technology, China</td><td>Trusted-Node Subsequence Reduction for Designing Resilient Consensus Algorithms</td></tr>
<tr><td>14:45-15:10</td><td>Prof. Haibo Du</td><td>Hefei University of Technology, China</td><td>Multi-agent Consensus Based on Non-Smooth Control Theory</td></tr>
<tr><td>15:10-15:35</td><td>Prof. Shanying Zhu</td><td>Shanghai Jiao Tong University, China</td><td>Distributed Economic Dispatch in Power Systems via Dual Splitting</td></tr>
<tr><td colspan="5">16:00-16:30 Coffee Break</td></tr>
<tr><td rowspan="3">Session 4</td><td colspan="4">Qingshan Liu, Southeast University, China (Chair)</td></tr>
<tr><td>16:30-16:50</td><td>Xiu Zhao, Jian Liu</td><td>Jinan University</td><td>Dynamics Analysis of Laser Complex Chaotic System and Its Self-synchronization</td></tr>
<tr><td>16:50-17:10</td><td>Lijun Pei, Dandan Weng, and Shuo Wang</td><td>Zhengzhou University</td><td>The Dynamics and Hopf Bifurcation of a Generalized Immune System – Cancerous Cells Interactions Model with Distributed Response Delay Based on Modified Frequency Domain Method</td></tr>
</table>

		17:10-17:30	Mo Chen, Xue Ren, Huagan Wu, Quan Xu and Bocheng Bao	Changzhou University	Periodically Varied Initial Boosting Behaviors in Memristive System with Cosine Memductance Nonlinearity
13:30-17:40	Conference Room 312				
	Invited Session 7 Chaotic Dynamics and Applications	Hai Yu, Northeastern University, China (Chair)			
		Time	Speaker	Organization	Title
		13:30-13:55	Prof. Chunbiao Li	Nanjing University of Information Science and Technology, China	Amplitude Control and Offset Boosting of Chaotic Signal
		13:55-14:20	Prof. Yuncai Wang	Tai Yuan University of Technology, China	Chaotic Applications: From Random Number Generator to Noise Generator
		14:20-14:45	Prof. Chengqing Li	Hunan University, China	Dynamic Analysis of Digital Chaotic Maps Via State-Mapping Networks
		14:45-15:10	Prof. Qigui Yang	South China University of Technology, China	Homoclinic/Heteroclinic Cycles and Chaos In 3D Three-Zone Piecewise Affine Systems
		15:10-15:35			
		15:35-16:00			
	16:00-16:30 Coffee Break				
	Session 5	Jianquan Lu, Southeast University, China (Chair)			
		16:30-16:50	Yingjuan Yang, Guoyuan Qi	Tiangong University	Transient Hidden Attractor of Plasma Chaotic System and Its Circuit Implementation
		16:50-17:10	Ting Gou, Guoyuan Qi	Tiangong University	Investigation of a Hamiltonian Conservative Chaotic System with Hidden nature and different Ha Miltonian energy level Coexistences

		17:10-17:30	Congcong Cheng, Guanghan Bai *, Yunan Zhang, Junyong Tao	National University of Defense Technology	Study on Network Topology of UAV Swarm Under Reconnaissance Mission
13:30-17:40	Conference Room 309				
		Hongyi Li, Guangdong University of Technology, China (Chair)			
	Invited Session 8 Nonlinear Systems and Applications	Time	Speaker	Organization	Title
		13:30-13:55	Prof. Qinglai Wei	The State Key Laboratory of Management and Control for Complex System, China	Discrete-Time Zero-Sum Games for Nonlinear Systems via Adaptive Dynamic Programming
		13:55-14:20	Prof. Qinmin Yang	Zhejiang University, China	Adaptive Transient Performance Enhancement Control and Its Applications In Microgrid
		14:20-14:45	Prof. Yongming Li	Liaoning University of Technology, China	Fuzzy Adaptive Control for A Class of Nonlinear Interconnected Large-Scale Systems
		14:45-15:10	Prof. Zhuo Wang	Beihang University, China	A Data-driven State Observation Method for Atomic Spin-exchange Relaxation-free Comagnetometer
		15:10-15:35	Prof. Tengfei Liu	Northeastern University, China	Robust Event-Triggered Control of Nonlinear Systems: Three Examples
	16:00-16:30 Coffee Break				
	Session 6	Jinling Liang, Southeast University, China (Chair)			
		16:30-16:50	Lin Xu, Guoyuan Qi	Tiangong University	Dynamical Analysis of The Hindmarsh Rose Neuron Model with Memristor Using Energy Method
		16:50-17:10	Quan Xu, Xiao Tan,	Changzhou University	Bursting/Spiking Behaviors and Bifurcations in Chay

			Dong Zhu, Han Bao, Yihua Hu, Senior Member, IEEE, and Bocheng Bao		Neuron Model and FPGA-Based Validations
		17:10-17:30	Zhuoheng He	Shanghai University	Some Systems of Coupled Sylvester-Type Quaternion Matrix Equations
18:00-20:00	VIP Dinner (Zijin Hall Floor 1)				
October 13 2019					
9:00-12:00	Jinling Conference Hall				
	Chair	Time	Speaker	Organization	Title
	Zengqiang Chen	9:00-9:40	Riccardo Meucci	Universita degli Studi Firenze, Italy	Chaotic Dynamics in Electronic and Photonic Devices
	Simone Baldi	9:40-10:20	Prof. Sajad Jafari	Amirkabir University of Technology, Tehran, Iran	Megastability: Definition and Its Relation with Multistability, Extreme Mutlistability, and Hidden Attractors
	10:20-10:40			Coffee break	
	Zhen Wang	10:40-11:20	Stefano Boccaetti	National Research Council of Italy (CNR), Italy	Collective Organization of Networked Phase Oscillators: from Explosive Synchronization to Bellerophon States
	Wenwu Yu	11:20-12:00	Simone Baldi	Southeast University, China	Controls in Smart Buildings: Experiences from European Projects
	Lunch Buffet (Yuhe Hall Floor 3)				
13:30-16:00	Conference Room 201				
	Invited Session 2 Robotics	Aiguo Song, Southeast University, China (Chair) Wei He, University of Science and Technology Beijing, China (Chair)			
		Time	Speaker	Organization	Title
		13:30-13:55	Prof. Wei He	University of Science and Technology Beijing, China	Intelligent Control of Bionic Flapping-Wing Robotic Aircraft
		13:55-14:20	Prof. Qing Shi	Beijing Institute of Technology, China	System Design and Motion Control of Miniature Robotic Rats

		14:20-14:45	Prof. Xuebo Zhang	Nankai University, China	Real-time and Complete Algorithms for Time-optimal motion planning of robots
		14:45-15:10	Prof. Bingzhao Gao	Jilin University, China	Calibration-Free Control System Development and Application in Automotive
		15:10-15:35	Prof. Long Cheng	University of Chinese Academy of Sciences, China	Intelligent Control for Piezoelectric Actuators
		15:35-16:00	Prof. Bin Xu	School of Automation, Northwestern Polytechnical University	Robust Adaptive Control of Hypersonic Flight Dynamics
13:30-16:00	Conference Room 206				
	Invited Session 4 Nonlinear Dynamics and Control	Zhengguang Wu, Zhejiang University, China (Chair)			
		Time	Speaker	Organization	Title
		13:30-13:55	Prof. Deyuan Meng	Beihang University, China	Iterative Learning Control for Nonlinear Systems
		13:55-14:20	Prof. Mou Chen	Nanjing University of Aeronautics and Astronautics, China	Multi-approximators Based Control and Application
		14:20-14:45	Prof. Zhaojing Wu	Yantai University, China	Random PWM Controls of Robots Driven by DC Motors
		14:45-15:10	Prof. Jian Chen	Zhejiang University, China	Identification of a Moving Object's Velocity and Range with a Static-Moving Camera System
		15:10-15:35	Prof. Chanying Li	Chinese Academy of Sciences, China	Feedback Limitations in Nonlinear Discrete-Time Control
		15:35-16:00			
13:00-16:10	Conference Room 309				
	Invited Session 9 Complex Networks	Tao Jia, Southwest University, China (Chair) Duxin Chen, Southeast University, China (Chair)			
		Time	Speaker	Organization	Title
		13:00-13:20	Prof. Tao	Southwest	The Upper Bound of Link

			Jia	University, China	Prediction by the AUC Measure
		13:20-13:40	Prof. Linyuan Lv	University of Electronic Science and Technology of China (UESTC), China	Characterizing Cycle Structure in Complex Networks
		13:40-14:00	Prof. Xin Lv	National University of Defense Technology (NUDT), China	Network Evolution of a Large Online MSM Dating Community: 2005 - 2018
		14:00-14:20	Prof. Gang Yan	Tongji University, China	Controllability and Predictability of Real Temporal Networks
		14:20-14:40	Prof. Zhen Wang	Northwestern Polytechnical University (NPU), China	Data Science and Collective Intelligence
	Invited Session 10 Network Collaboration and Applications	Qingshan Liu, Southeast University, China (Chair) Shaofu Yang, Southeast University, China (Chair)			
		14:50-15:10	Prof. Jianping He	Shanghai Jiao Tong University, China	Learning and Attack via External Observation for Multi-Robot Systems
		15:10-15:30	Prof. Huaqing Li	Southwest University, China	Communication and Computation Trade-off Distributed Optimization Algorithm and Its Applications
		15:30-15:50	Prof. Zhouhua Peng	Dalian Maritime University, China	Path-Guided Distributed Formation Control of Under-Actuated Autonomous Surface Vehicles
		15:50-16:10	Prof. Zai Yang	Xi'an Jiaotong University, China	Positive Semi definiteness of a Hadamard Product and Its Application in Array Signal Processing
Conference Room 307					
13:30-16:00	Invited Session 11 Distributed	Wenwu Yu, Southeast University, China (Chair) Junjie Fu, Southeast University, China (Chair)			
		Time	Speaker	Organization	Title

	Control and Optimization with Applications	13:30-13:55	Prof. Youfeng Su	Fuzhou University, China	Cooperative Output Regulation and its Application in Power Sharing Control of Microgrid
		13:55-14:20	Prof. Yuzhe Li	Northeastern University, China	Cyber-Physical Security in Remote State Estimation
		14:20-14:45	Prof. Yang Tang	East China University, China	Perception and Decision-Making of Autonomous Systems Driven by Artificial Intelligence
		14:45-15:10	Prof. Ziyang Meng	Tsinghua University, China	Vision-based Localization, Tracking and Coordinated Optimal Control of Unmanned Systems
		15:10-15:35	Prof. Junfeng Wu	Zhejiang University, China	Multi-hop Sensor Network Scheduling for Remote Estimation
		15:35-16:00	Prof. Nian Liu	North China Electrical Power University, China	Optimal Operation of Power Distribution and Consumption System: Cyber-Physical-Social System Perspective
	Conference Room 308				
13:30-16:00	Invited Session 12 Hybrid Dynamics and Networks with Applications	Jianquan Lu, Southeast University, China (Chair)			
		Time	Speaker	Organization	Title
		13:30-13:55	Prof. Zhiqiang Zuo	Tianjin University, China	Opinion Dynamics in Social Networks: Consensus Vs. Clusters
		13:55-14:20	Prof. Hao Yang	Nanjing University, China	Stability and Fault-Tolerant Control of Switched Systems and Its Applications
		14:20-14:45	Prof. Xiaodi Li	Shandong Normal University, China	Finite-Time Control of Impulsive Systems
		14:45-15:10	Prof. Zhongke Gao	Tianjin University, China	Multi-Source Information Fusion and Applications Based on Complex Network and Deep Learning
		15:10-15:35	Prof. Yang Liu	Zhejiang Normal University, China	On the Observability of Logical Networks
		15:35-16:00	Prof. Haitao Li	Shandong	Function Perturbation Impact on Stabilization of

<table>
<tr><td></td><td></td><td></td><td></td><td>Normal University, China</td><td>Logical Control Networks</td></tr>
<tr><td></td><td colspan="5">Conference Room 312</td></tr>
<tr><td rowspan="9">13:30-16:00</td><td rowspan="9">Invited Session 13 Artificial Neural Networks Theories and Applications</td><td colspan="4">Jinling Liang, Southeast University, China (Chair)</td></tr>
<tr><td>Time</td><td>Speaker</td><td>Organization</td><td>Title</td></tr>
<tr><td>13:30-13:55</td><td>Prof. Ping Guo</td><td>Beijing Normal University, China</td><td>Toward to AutoML with Pseudoinverse Learning Algorithm</td></tr>
<tr><td>13:55-14:20</td><td>Prof. Deshuang Huang</td><td>Tongji University, China</td><td>Motif Prediction and Analyses in DNA Sequences by Deep Neural Networks</td></tr>
<tr><td>14:20-14:45</td><td>Prof. Zhanshan Wang</td><td>Northeastern University, China</td><td>Stability Analysis of Neural Dynamical Networks with Time-Delays</td></tr>
<tr><td>14:45-15:10</td><td>Prof. Jian Wang</td><td>China University of Petroleum (East China), China</td><td>Group Sparse Neural Networks: Structure Optimization and Fault Tolerant Learning</td></tr>
<tr><td>15:10-15:35</td><td>Prof. Zenglin Xu</td><td>University of Electronic Science and Technology of China, China</td><td>Compressing Neural Networks with Tensor Networks</td></tr>
<tr><td>15:35-16:00</td><td>Prof. Nianyin Zeng</td><td>Xiamen University, China</td><td>A Novel Deep-Belief-Network-Based Particle Filter (DBN-PF) for Quantitative Analysis of Gold Immunochromatographic Strips</td></tr>
<tr><td>18:00-20:00</td><td colspan="5">Dinner(Yuhe Hall Floor 3)</td></tr>
</table>

Invited Lectures

Keynote Speeches

Lecture 1

Talk Title: Dealing with Complexity in Cyber-Physical-Social Systems with Simplexity

Speaker: Xinghuo Yu

Abstract: Cyber-Physical-Social Systems (CPSS) represent a broad range of future complex, multidisciplinary, physically and societally aware next-generation engineered systems that integrate embedded computing technologies (cyber part) into the physical world taking social and human considerations. A typical scenario is the future CPSS in Energy where smart grids integrate with social, economic and environmental models to form an energy eco-system that is vital to the future of industry, economy, society and the Nature. Such setting results in enormously increased complexity which requires an innovative way of thinking in dealing with modelling, control and optimisation with efficiency and effectiveness.

In this talk, we will first outline some recent developments in CPSS and their technological challenges. We will then discuss a potential 'simplexity' problem solving paradigm which advocates simple solutions for complex problems. The implications of adopting such paradigm in dealing with complexity in CPSS will be discussed, and some potential future methods inspired by the Nature will be speculated. A number of real-world cases, including some of our own research, will be used as case studies.

Biography: Prof. Xinghuo Yu is an Associate Deputy Vice-Chancellor and Distinguished Professor of Electrical and Electronic Engineering at Royal Melbourne Institute of Technology (RMIT University), Melbourne, Australia. He is also the President of IEEE Industrial Electronics Society, and a Chang Jiang Chair Professor with Southeast University.

He received BEng and MEng degrees from the University of Science and Technology of China, Hefei, China, in 1982 and 1984, and PhD degree from Southeast University, Nanjing, China in 1988, respectively. In 1989-1991, he was a Postdoctoral Fellow with University of Adelaide, Australia.

In 1991-2002, he was Central Queensland University, Australia, where, before he left, he was Chair Professor of Intelligent Systems. Since 2002, he has been with RMIT University, where he held several senior positions such as Associate Dean and Research Institute Director.
His main research areas include control systems, intelligent and complex systems, energy systems engineering. He received many awards and honors for his contributions, including 2018 M A Sargent Medal from Engineers Australia, 2018 Australasian AI Distinguished Research Contribution Award from Australian Computer Society, and 2013 Dr.-Ing. Eugene Mittelmann Achievement Award from IEEE Industrial Electronics Society. He was named a Highly Cited Researcher by Clarivate Analytics in 2015-2018. He is a Fellow of the IEEE, Engineers Australia, Australian Computer Society, and Australian Institute of Company Directors.

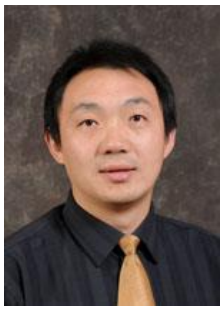
Lecture 2

Talk Title: Distributed Model Predictive Control for Cyber-Physical Systems

Speaker: Yang Shi

Abstract: Advanced control technologies for cyber-physical systems have received great attention in the control community due to its wide application areas. Network-induced limitations may be caused by the presence of a communication channel, or because of the efficient assignment of power and other limited resources. Cyber-physical systems represent a large class of smart systems that encompass cyber and physical components, seamlessly integrated and closely interacting to autonomously sense and manipulate the changing state of the physical system. These systems involve a high degree of complexity at numerous spatial and temporal scales and highly networked communications integrating computational and physical components. Model predictive control (MPC) is a promising paradigm for high-performance and cost-effective control of networked and distributed cyber-physical systems. This talk will firstly summarize the major application requirements and challenges to tackle and innovate in designing, implementing, deploying and operating cyber-physical systems. Further, distributed MPC design methods will be presented. Finally, the application of distribute MPC methods will be discussed.

Biography：Prof. Yang Shi received the Ph.D. degree in electrical and com-



puter engineering from the University of Alberta, Edmonton, AB, Canada, in 2005. From 2005 to 2009, he was an Assistant Professor and Associate Professor in the Department of Mechanical Engineering, University of Saskatchewan, Saskatoon, Saskatchewan, Canada. In 2009, he joined the University of Victoria, and now he is a Professor in the Department of Mechanical Engineering, University of Victoria, Victoria, British Columbia, Canada. His current research interests include networked and distributed systems, model predictive control (MPC), cyber-physical systems (CPS), robotics and mechatronics, navigation and control of autonomous systems (AUV and UAV), and energy system applications. Dr. Shi received the University of Saskatchewan Student Union Teaching Excellence Award in 2007. At the University of Victoria, he received the Faculty of Engineering Teaching Excellence in 2012, and the Craigdarroch Silver Medal for Excellence in Research in 2015. He received the JSPS Invitation Fellowship (short-term) in 2013 and the Humboldt Research Fellowship (for experienced researchers) in 2017. His co-authored paper was awarded the 2017 IEEE Transactions on Fuzzy Systems Outstanding Paper Award. He received the Humboldt Research Fellowship for Experienced Researchers in 2018. He is a currently member of the IEEE IES Administrative Committee, and Chair of IEEE IES Technical Committee on Industrial Cyber-Physical Systems. Currently, he is Co-Editor-in-Chief for IEEE Transactions on Industrial Electronics; he also serves as Associate Editor for Automatica, IEEE Trans. Control Systems Technology, IEEE/ASME Trans. Mechatrnonics, IEEE Trans. Cybernetics. He is a Fellow of EIC (Engineering Institute of Canada), IEEE, ASME and CSME, and a registered Professional Engineer in British Columbia, Canada.

Lecture 3

Talk Title：PID and Its Puzzles——MFAC and Progress

Speaker：Zhongsheng Hou

Abstract：Many practical processes generate and store a huge amount of process data, which contains all the valuable information of the process operations and the equipment. How to use these process data, both on-line and off-line, to directly determine the controller structure, tune the controller parameter, design the output prediction, make the performance assessment, etc., would have great significance when the process models are unavailable. Therefore, the establishment on the data driven control theory is an urgent and important issue

both for the theoretical development and field applications of the control theory. This talk includes four parts. The first is a brief survey on the existing problems of PID controller; The second is the dynamic linearization data modeling method for nonlinear systems; The third part will present the model free adaptive control (MFAC), including the indirect MFAC, the direct MFAC, and its progress; The final one is the MFAC application to a benchmark problem.

Biography：Prof. Zhongsheng Hou (SM'13) received the B.S. and M.S. de-

grees from Jilin University of Technology, Jilin, China, in 1983 and 1988, respectively, and the Ph.D. degree from Northeastern University, Shenyang, China, in 1994. From 1995 to 1997, he was a Postdoctoral Fellow with Harbin Institute of Technology, Harbin, China. From 2002 to 2003, he was a Visiting Scholar with Yale University, CT, USA. From 1997 to 2018, he was with Beijing Jiaotong University, Beijing, China, where he was a Distinguished Professor and the Founding Director of Advanced Control Systems Lab, and the Head of the Department of Automatic Control. He is currently a Chair Professor with the School of Automation, Qingdao University, Qingdao, China. His research interests are in the fields of data-driven control, model-free adaptive control, learning control, and intelligent transportation systems. Up to now, he has authored or co-authored more than 180 peer-reviewed journal papers and over 140 papers in prestigious conference proceedings. He has authored two monographs, Nonparametric Model and its Adaptive Control Theory, Science Press(in Chinese), 1999, and Model Free Adaptive Control: Theory and Applications, CRC Press, 2013.His pioneering work on model-free adaptive control has been verified in more than 160 different field applications, laboratory equipment and simulations with practical background, including wide-area power systems, lateral control of autonomous vehicles, temperature control of silicon rod. His works on data-driven learning and control has been supported by multiple projects supported by the National Natural Science Foundation of China (NSFC), including three Key Projects in 2009, 2015, and 2019, respectively, and a Major International Cooperation Project in 2012. Prof. Hou is the Founding Director of the Technical Committee on Data Driven Control, Learning and Optimization (DDCLO), Chinese Association of Automation (CAA), and is a Fellow of CAA. He is also an International Federation of Automatic Control Technical Committee Member of both "Adaptive and Learning Systems" and "Transportation Systems." Dr. Hou was the Guest Editor for two Special Sections on the topic of data-driven control of the IEEE TRANSACTIONS ON NEURAL NETWORKS in 2011, and the IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS in 2017.

Lecture 4

Talk Title: Distributed Dynamic State Estimation in Sensor Networks: Consistency, Confidence, and Convergence

Speaker: Wei Ren

Abstract: The problem of distributed dynamic state estimation using networked local agents with sensing and communication abilities, has become a popular research area in recent years due to its wide range of applications such as target tracking, region monitoring and area surveillance. Specifically, we consider the scenario where the local agents take local measurements and communicate with only their nearby neighbors to estimate the state of interest in a cooperative and fully distributed manner. A distributed hybrid information fusion (DHIF) algorithm is proposed in the scenario where the process model of the target and the sensing models of the local agents are linear and time varying. The proposed DHIF algorithm is shown to be fully distributed and hence scalable, to be run in an automated manner and hence adaptive to locally unknown changes in the network, to have agents communicate for only once during each sampling time interval and hence inexpensive in communication, and to be able to track the interested state with uniformly upper bounded estimate error covariance. It is also explored very mild conditions on general directed time-varying graphs and joint network observability/detectability to guarantee the stochastic stability of the proposed algorithm.

Biography: Prof. Wei Ren is currently a Professor with the Department of Electrical and Computer Engineering, University of California, Riverside. He received the Ph.D. degree in Electrical Engineering from Brigham Young University, Provo, UT, in 2004. Prior to joining UC Riverside, he was a faculty member at Utah State University. His research focuses on distributed control of multi-agent systems and autonomous control of unmanned vehicles. He was a recipient of the Antonio Ruberti Young Researcher Prize in 2017 and the National Science Foundation CAREER Award in 2008. He is currently an Associate Editor for Automatica. He is an IEEE Fellow.

Distinguished Lectures

Lecture 1

Talk Title: Chaotic Dynamics in Electronic and Photonic Devices

Speaker: Riccardo Meucci

Abstract: Deterministic chaos has had a large impact in physics and in many other fields in the last 40 years, although Henri Poincarè at the end of the 19th century pointed out its existence and foundation.
In the early 1980s at the National Institute of Optics we provided the first evidence of chaotic behavior in a CO2 laser applying a periodic forcing to the cavity loss parameter. In such a kind of laser, later classified as a class B laser, it is necessary to introduce a third degree of freedom to the two intrinsic ones, that is, population inversion and photon number of the single mode laser field. Immediately later other strategies were found to achieve chaos in class B lasers. The key role played by external periodic perturbations to different dynamical systems will be extensively discussed in the field of chaos control, another topic commonly investigated together with synchronization.
More recently, the attention has been focused on electronic oscillators like the Duffing's and the van der Pol's (van der Pol first introduced the concept of relaxation oscillator). These oscillators play an important role in electronics and neuroscience.

Biography: Riccardo Meucci received the M.S. degree in physics from the

University of Florence, Florence, Italy, in 1982, and the Ph.D. degree from the Graduate School in Optics, University of Florence, in 1987.He is currently a Research Director with the National Institute of Optics of the National Research Council, Florence, Italy, and a Contract Professor of optics with the University of Florence. His current research interests include chaotic instabilities in single-mode lasers, laser transients, dynamical models for the CO_2 laser, synchronization and control of chaos, spatiotemporal instabilities and delayed systems, and polarization instabilities.

Lecture 2

Talk Title: Megastability: Definition and Its Relation with Multistability, Extreme Mutlistability, and Hidden Attractors

Speaker: Sajad Jafari

Abstract: Multistability is one of the most important phenomena in dynamical systems. It occurs in many areas of science including physics, chemistry, biology, economics, and the nature. The attracting state of a multistable system depends on the initial conditions. Multistability can be undesirable, for example, in the design of a commercial device with specific characteristics where it must be avoided to stabilize the desired state in a noisy environment. On the other hand, multistability allows flexibility in the system performance without changing parameters, and that can be used with the right control strategies to induce a switching between different coexisting states. Sometimes, infinite attractors coexist in a dynamical system. When those infinite attractors are uncountable, the situation is called extreme multistability. However, when those infinite attractors are countable, the situation is called megastability. In this talk, we present some recent examples of megastable systems. We categorize them into two groups: megastable systems that are the result of infinite equilibrium points in the systems, and megastable systems that are not. We show that in the latter case, certainly infinite hidden attractors exist.

Biography: Sajad Jafari was born in Kermanshah, Iran, in 1983. He received

his BSc., M.S., and Ph.D. degrees in biomedical engineering in 2005, 2008, 2013 from biomedical engineering department, Amirkabir University of technology, Tehran, Iran. He is currently an assistant professor in there (since 2013). His research interests include artificial intelligence, optimization, pattern recognition and especially nonlinear and chaotic signals and systems.

Email: sajadjafari@aut.ac.ir, sajadjafari83@gmail.com

Lecture 3

Talk Title: Collective Organization of Networked Phase Oscillators: from Explosive Synchronization to Bellerophon States

Speaker: Stefano Boccaetti

Abstract: I will discuss the spontaneous emergence of collective dynamics in networked phase oscillators. As a first step, I will discuss how synchronization may emerge in a graph. Synchronization is a process in which dynamical systems adjust some properties of their trajectories (due to their interactions, or to a driving force) so that they eventually operate in a macroscopically coherent way. A common result is that the vast majority of transitions to synchronization are of the second-order type, continuous and reversible. However, as soon as networked units with complex architectures of interaction are taken into consideration, abrupt and irreversible phenomena may emerge, namely explosive synchronization, which rather remind first-order like transitions. In the second part of my talk, I will concentrate on a recently unveiled coherent state, the Bellerophon state, which is generically observed in the proximity of explosive synchronization at intermediate values of the coupling strength. Bellerophon states are multi-clustered states emerging in symmetric pairs. In these states, oscillators belonging to a given cluster are not locked in their instantaneous phases or frequencies, rather they display the same long-time average frequency (a sort of effective global frequency). Moreover, Bellerophon states feature quantum traits, in that such average frequencies are all odd multiples of a fundamental frequency.

Biography: Prof. Stefano Boccaetti now is a member of Academia Europaea

and a research Scientist at the Institute of Complex Systems, National Research Council of Italy (CNR), Italy. As one of the pioneers in the study of system synchronization, chaos control, and network science, as well as the founder of the European statistical society, he has received honorable doctorate degrees and professorships from several well-known universities in the world. He serves as a director of several centers for complex system study in Spain and Italy. During the past two decades, Prof. Boccaletti's mainly focused on complex network, nonlinear dynamics, system synchronization, chaos control, and applications of these research fields in interdisciplinary engineering, resulting in numerous creative achievements. From example, he has published more than 200 scientific papers, including Physics Reports, Physical Review Letters PNAS, Nature Communications, Science Advances. His citation number exceeds 23000 with H-index 58. Besides, his papers and achievements have been highlighted by Nature News and other famous academic media.

Lecture 4

Talk Title: Controls in Smart Buildings: Experiences from European Projects

Speaker: Simone Baldi

Abstract: In this talk I will discuss some research activities I joined within European and Dutch projects about smart buildings and energy efficient buildings. Some general overview on challenges and goals will be given, althogh not all information will be disclosed as these projects involved some industrial cooperation with Honeywell, Fraunhofer Institute for Building Physics, and Dutch Central Government Real Estate Agency.

Biography: Prof. Simone Baldi is professor of Southeast University. Prior to

this he was assistant professor at the Delft Center for Systems and Control, Delft University of Technology (TU Delft), postdoctoral fellow at the University of Cyprus (Prof. Petros Ioannou's group), and at the Information Technologies Institute, Greece (I.T.I.-CE.R.T.H, Prof. Elias Kosmatopoulos's group). He got his Ph.D. degree in Systems Engineering from University of Florence, Italy, in 2011, under the supervision of Prof. Edoardo Mosca. His research interests focus on adaptive and switching control, adaptive learning systems, artificial intelligence with its application in intelligent transportation systems, smart building, UAV formation etc. So far, more than 100 SCI and/or EI papers have been published, among them, more than 10 papers have been published in IEEE Transactions on Automatic Control and Automatica, the top journals in the field of automatic control, and more than 20 in top journals in the fields of smart energy, intelligent transportation and other application fields. He has been awarded outstanding reviewer for Applied Energy (2016), Automatica (2017), and IET Control Theory and Applications (2018). He serves in the IEEE technical committee on Systems Identification and Adaptive Control (since September 2016) and IFAC technical committee on Adaptive and Learning Systems (since September 2014); he has been guest editor on IET Control Theory and Applications and, since March 2019, he is a subject editor of the International Journal of Adaptive Control and Signal Processing. More info is available at his website: http://simonebaldi.my-board.org.

Invited Session 1 Process Control

Chair：Honggui Han, Beijing University of Technology, China

Lecture 1

Talk Title: Data and Knowledge Driven Industrial Energy Prediction and Scheduling

Speaker: Jun Zhao

Abstract: Industrial Energy Resource Saving is Capable of not only Improving the enterprise profits, but also carrying out the significant strategy meaning for our country. Given the fixed technical process and equipment, the optimization scheduling of the industrial energy system is the most important approach for such a goal. However, the most industrial energy systems exhibit a very complicated structure, which can hardly establish a mechanism-based model to describe such a system, and the existing manual scheduling method makes the decision-making process tardily. Aiming at such a challenge, a class of data-driven predictive scheduling methodology is proposed. In detail, considering the consistent modeling, the quantitative uncertainty description, and the semantic characteristics of the energy data, the short-term prediction model, the prediction interval one and the long-term model are respectively reported, and a rolling optimization technique with the procedures of prediction-scheduling-validation is proposed. The mentioned approaches have been successfully applied to a number of industrial enterprises in our country.

Biography：Prof. Jun Zhao received his Ph.D. degree from School of Control

Science and Engineering, Dalian University of Technology, China, in 2008. He worked as the associated professor in 2013-2015, and the full professor since the end of 2015 at Dalian University of Technology. He is now the director of Intelligent Control Institute with the School of Control Science and Engineering, DUT, China. He has authored or co-authored over 100 technical publications in refereed journals and conference proceedings. He serves as associate editors for several top tier journals including Control Engineering Practice, IEEE TNNLS, Information Sciences, etc. From 2015, he became a Technical Committee member (TC6.2) of IFAC MMM society. In 2018, he obtained the First Class Prizes of Science and Technology

Progress Award of CAA (Chinese Automation Association), and is now the scientist-in-chief of a National Key R&D Program of China. In addition, he was the recipient of Young Scholar of Yangtze River from Ministry of Education of China in 2016, and received the Excellent Young Scholar funding supported by National Natural Science Foundation of China in 2015. He is also the recipients of the Best Application Paper Award of WCICA2014, and the Zhang Zhongjun Best Paper Award of CPCC 2016.

Lecture 2

Talk Title: Data-driven Wide-Range Non-Stationary Process Monitoring

Speaker: Chunhui Zhao

Abstract: Modern industrial production often has wide-range nonstationary operating characteristics, such as batch manufacturing processes, wide-load power generation processes, etc. Due to its large-scale non-stationary operation characteristics, it raises new challenges to the safe and reliable operation of industrial processes and has become the focus of attention. Starting from the traditional batch process, this report will present the concept of a generalized batch process, analyze the specific characteristics of wide-range nonstationary industrial processes, and summarize the basic process monitoring techniques and the relevant research work in this field. It further analyzes the existing specific problems, and extend the traditional batch process analysis methods to industrial processes with wide-range non-stationary operation characteristics. Finally, the application of the proposed method in different fields will be briefly introduced.

Biography: Prof. Chunhui Zhao has been a Professor with the College of Control Science and Engineering, Zhejiang University, Hangzhou, China. Her research interests include statistical machine learning and data mining for industrial application. She has authored or coauthored more than 110 papers in peer-reviewed international journals. She has published 2 monographs and authorized 18 invention patents. She has hosted more than 10 scientific research projects, including the NSFC funds, provincial projects and corporate cooperation projects. She was the recipient of the National Top 100 Excellent Doctor Thesis Nomination Award, New Century Excellent Talents in University, China, and the National Science Fund for Excellent Young Scholars, respectively. She has also obtained the first Automation Society Young Women Scientist Award, the Process Control Youth Award, etc., and is now an IEEE senior member. She has served AE of three International Journals,

including Journal of Process Control, Control Engineering Practice and Neurocomputing, and two domestic journals, including Control and Decision, and Control Engineering.

Lecture 3

Talk Title: Fault Detection Based on NIR for Crude Oil Desalting Process

Speaker: Xiaoli Luan

Abstract: The fault detection problem of the oil desalting process is investigated in this presentation. Different from the traditional fault detection approaches based on measurable process variables, near-infrared (NIR) spectroscopy is applied to acquire the process fault information from the molecular vibrational signal. With the molecular spectra data, principal component analysis was explored to calculate the Hoteling T2 and squared prediction error, which act as fault indicators. Compared with the traditional fault detection approach based on measurable process variables, NIR spectra-based fault detection illustrates more sensitivity to early failure because of the fact that the changes in the molecular level can be identified earlier than the physical appearances on the process.

Biography: Prof. Xiaoli Luan received the B.Sc. degree in industrial automation

from Jiangnan University, China, in 2002; the M.Sc. degree in control theory and control engineering from Jiangnan University, China, in 2006; and the Ph.D. degree in control theory and control engineering from Jiangnan University, China, in 2010. Now she is a professor of the Institute of Automation, Jiangnan University. In 2016, she was a Visiting Professor with the University of Alberta, Canada. Her research interests include robust control and optimization of complex nonlinear systems.

Lecture 4

Talk Title: Ultra-Reliable and Low-Latency Transmission for Sensing and Control in Industrial Network Systems

Speaker: Cailian Chen

Abstract: Real-time and precise cooperative control of industrial systems relies

heavily on the reliable and timely sensing and control information interaction. Industrial Network Systems (INS) represent a class of systems integrating control, communication and computing techniques. INS enables us to quantify the interdependence and reflect evolution of physical systems and information systems. For the information exchange requirements for sensing and control in INS, this talk is concerned with the network architecture of network systems, ultra-reliable and low-latency wireless transmission and AI based scheduling techniques. The MicroRF-II Industrial Wireless Network Protocol Stack with Independent Intellectual Property will be introduced as well as the related experimental platform and demonstrative applications of wireless industrial monitoring systems.

Biography：Prof. Cailian Chen is currently a Full Professor of Department of

Automation, Shanghai Jiao Tong University, Shanghai, P. R. China. Her research interests include industrial wireless networks, computational intelligence and situation awareness, Internet of Vehicles. She has authored 3 research monographs and over 100 referred international journal papers. She is the inventor of more than 20 patents. Dr. Chen received the prestigious IEEE Transactions on Fuzzy Systems Outstanding Paper Award in 2008, and “Best Paper Award” of WCSP’17 and YAC’18. She won the Second Prize of National Natural Science Award from the State Council of China in 2018, First Prize of Natural Science Award from The Ministry of Education of China in 2006 and 2016, respectively, and First Prize of Technological Invention of Shanghai Municipal, China in 2017. She was honored “Changjiang Young Scholar” in 2015 and “Excellent Young Researcher” by NSF of China in 2016.

Prof. Chen has been actively involved in various professional services. She serves as Associate Editor of IEEE Transactions on Vehicular Technology, Peer-to-peer Networking and Applications (Springer). She also served as Guest Editor of IEEE Transactions on Vehicular Technology, TPC Chair of ISAS’19, Symposium TPC Co-chair of IEEE Globecom 2016 and VTC2016-fall, Workshop Co-chair of WiOpt’18.

Lecture 5

Talk Title： Multiobjective Cooperative Optimal Control for Municipal Wastewater Treatment Process

Speaker: Honggui Han

Abstract: Municipal wastewater treatment process is an effective way to protect the environment and realize the recycling utilization of water resources. However, since the municipal wastewater treatment process owns the characteristics of multiprocess, multiworking conditions and time-varying, the optimal control methods, based on the single scale, single level and single objective, cannot guarantee the optimal operation of whole system. Multiobjective cooperative optimal control can construct the performance indicators with different time scales and design the dynamic optimization method with multiple conflicting objectives for the municipal wastewater treatment process. And a multiobjective cooperative optimization control technology has been developed to achieve the multiobjective optimization of municipal wastewater treatment process between local and overall, short-term and long-term, benefit and safety. Then, the abnormal working conditions in municipal wastewater treatment plants has been reduced, and the operation efficiency of municipal wastewater treatment has been improved.

Biography: Prof. Honggui Han is a doctoral supervisor at Beijing University of

Technology. He is currently vice dean of department of artificial intelligence and automation. His main research interest is intelligent optimal control. He has been selected in the National Science Fund for Excellent Young Scholars, Excellent Young Scientists in Beijing Universities, China Association of Science and Technology Youth Talents Enrollment Project, China Association of Science and Technology Youth Talents Enrollment Project, et al. Prof. Han has published more than 60 academic papers, which have been cited more than 600 times. He has been authorized more than 30 U.S.A./China invention patents and more than 30 software copyrights. He was awarded a second prize of national science and technology, a first prize of science and technology of the ministry of education, a first prize of science and technology of Wu Wenjun's artificial intelligence, and a first prize for scientific and technological progress in the cooperative innovation achievements of industry, university and research institutes in China.

Invited Session 2 Robotics

Chair ： Aiguo Song, Southeast University, China

Wei He, University of Science and Technology Beijing, China

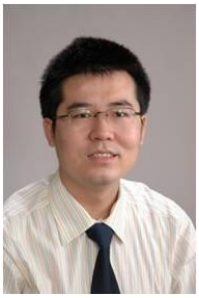
Lecture 1

Talk Title: Intelligent Control of Bionic Flapping-Wing Robotic Aircraft

Speaker: Wei He

Abstract: The bionic flapping-wing robotic aircraft is inspired by the flying ways of birds, which is regarded as a rigid-flexible coupling system. Our research focuses on the control system design of the aircraft, which makes the aircraft have great advantages such as high flexibility, low energy consumption and so on. However, flexible wings might produce the unexpected vibration and deformation under the influence of air flow. The vibration will degrade the flight performance, even shorten the lifespan of the aircraft. Therefore, designing an effective control method for suppressing vibrations of flexible wings is significant in practice. We have made several flapping-wing robotic aircraft for experiments. The control system is designed for vibration control and autonomous flying of the flapping-wing robotic aircraft.

Biography： Prof. Wei, He received his PhD from Department of Electrical &



Computer Engineering, the National University of Singapore (NUS), Singapore, in 2011, both his M.Eng. and B.Eng. degrees from South China University of Technology (SCUT), Guangzhou, China, in 2008 and 2006 respectively. He is currently working as the Full Professor at School of Automation and Electric Engineering, University of Science and Technology Beijing (USTB), China. He has co-authored 3 books published in Springer and published over 100 international journal and conference papers. He was awarded a Newton Advanced Fellowship from the Royal Society, UK in 2017. He was a recipient of the IEEE SMC Society Andrew P. Sage Best Transactions Paper Award in 2017. He is serving the Chair of IEEE SMC Society Beijing Capital Region Chapter. From 2018, he has been the chair of Technical Committee on Autonomous Bionic Robotic Aircraft (TC-ABRA), IEEE Systems, Man and Cybernetics Society. He is serving as the Associate Editor of IEEE

Transactions on Robotics, IEEE Transactions on Neural Networks and Learning Systems, IEEE Transactions on Control Systems Technology, IEEE Transactions on Systems, Man, and Cybernetics: Systems, and IEEE/CAA Journal of Automatica Sinica, and Editor of Journal of Intelligent & Robotic Systems. His current research interests include robotics, distributed parameter systems and intelligent control systems.

Lecture 2

Talk Title: System Design and Motion Control of Miniature Robotic Rats

Speaker: Qing Shi

Abstract: Rats have the characteristics of small size, diverse postures, strong adaptability and complex social behavior, which provides a good innovative idea for the research of biomimetic robots. This report focuses on the biomimetic modeling, optimization and evaluation, the biomimetic micro-sensing unit and the interaction modeling of the robotic rat. First, based on the biomimetic behavior mechanism, the parametric modeling and optimization of the robotic rat are carried out; second, an evaluation model for quantifying the similarity of motion is set up; third, a multi-dimensional perception system based on micro binocular vision and tentacle sensor is built; finally, a motor-behavioral model with multi-source stimulus and the interaction model between the robotic rat and experimental rats are established. At the same time, the report will show the results of the exploration from morphological and functional bionics to interactive bionics, and discuss how to design robotic robots from shape to spirit.

Biography: Prof. Qing Shi received the Ph.D. degree from Waseda University, Japan, in 2012. He had been a Research Associate at GCOE Global Robot Academia of Waseda University from 2009 to 2013. Since 2013 he has been a Full-time Lecturer, and now an Associate Professor at Beijing Institute of Technology. His research interests are focused on bio-inspired robotics, mechatronic systems, computer vision. Dr. Shi has published more than 40 international journal papers, and has received Best Journal Paper Award of Advanced Robotics (2015), and Best Cognitive Robotics Paper Finalist of ICRA 2014. He is currently the Associate Editor of IEEE Transactions on Medical Robotics and Bionics and ROBOMECH Journal, and the Secretary of IEEE Beijing Section Robotics and Automation Society Chapter. Additionally, he has served as Associate Editor of IROS2016, ICRA2017 and ICRA 2018, Guest Editor of IEEE Transactions on Nanotechnology and Applied Sciences, committee chairs (e.g., Program Co-Chair) for 10

international conferences like IEEE CBS 2017, HUMANOIDS 2018.

Lecture 3

Talk Title: Real-time and Complete Algorithms for Time-optimal motion planning of robots

Speaker: Xuebo Zhang

Abstract: Time-optimal motion planning is important to increase the work efficiency of autonomous robots while ensuring safety. However, it is very challenging because real-time performance and algorithm completeness are required and many complex constraints also need to be satisfied. In this talk, we divide the motion planning problem into path planning and trajectory planning along a known path. On the basis of such a decoupled framework, we further propose a real-time, complete, and time-optimal trajectory planning algorithm in the presence of torque, acceleration and velocity constraints. Furthermore, a flexible tradability mechanism between the motion efficiency and cruise motion ratio are proposed with guarantee of algorithm completeness.

Biography: Dr. Xuebo Zhang received the B.Eng. degree in Automation from

Tianjin University in 2002, China, and the Ph. D. degree in Control Theory and Control Engineering from Nankai University in 2011, China. From July 2011, he joined the Institute of Robotics and Automatic Information Systems (IRAIS), Nankai University. He is currently an Associate Professor, the deputy head of IRAIS and also the deputy head of Tianjin Key Laboratory of Intelligent Robotics (TJKLIR), Nankai University, China. His research interests include planning and control of autonomous robotic and mechatronic systems; intelligent perception including robot vision, visual sensor networks, SLAM, etc. He received some research and teaching awards such as First-class and Second-class Natural Science Award of Tianjin City and First-class Award for Teaching Achievements in Higher Education of Tianjin City. He received Nomination of Best Paper Awards in IEEE/ASME AIM 2017, IEEE ARM 2018 and IEEE RCAR 2018. He received the General Chairs' Recognition Award for Interactive papers in IEEE CDC 2009. He is currently an Associate Editor for ASME Journal of Dynamic Systems, Measurement and Control. He served as the organization chair of IEEE-CYBER 2018 and the program chair of IEEE RCAR 2019.

Lecture 4

Talk Title: Calibration-Free Control System Development and Application in Automotive

Speaker: Bingzhao Gao

Abstract: Various time-varying parameters, such as road slope, vehicle mass and ambient temperature, exist in the automotive powertrain system. In order to achieve high-level smoothness and comfort under the premise of ensuring high transmission efficiency, complicated control system needs to be developed and the parameter calibration workload is heavy. Thus, it is necessary to develop calibration-free control system with high efficiency. The optimal controller being able to reject fast time-varying disturbance for automatic transmission system and the eco-driving cruise controller with the prediction of road traffic information are presented, and the principle of calibration-free development process of advanced control system are illustrated, which are also verified by real-car tests under various traffic scenes.

Biography: Prof. Bingzhao Gao received the Ph.D. degree in Control Theory and Control Engineering from Jilin University, in 2009, and received the B.S. and M.S. degrees from Jilin University of Technology and Jilin University in 1998 and 2002 respectively. He is currently a professor of State Key Laboratory of Automotive Simulation and Control, Jilin University. He is the recipient of the National Science Fund for Excellent Young Scholars, and served as the secretary of Technical Committee on Vehicle Control and Intelligence of Chinese Association of Automation. He has published 2 books and more than 40 international journal papers. He has been authorized for 26 invention patents, including 2 US patents. His research achievements of electric vehicle powertrain system have been industrialized and mass-produced.

Lecture 5

Talk Title: Intelligent Control for Piezoelectric Actuators

Speaker: Long Cheng

Abstract: The piezoelectric actuator is one key component in the nano-positioning applications. However, there are several nonlinear characteristics (e.g.,

hysteresis, creeping and variation) in the dynamics of piezoelectric actuators, how to achieve the high performance control of piezoelectric actuators is a great challenge. This talk introduces several neural networks or fuzzy logic-based modelling approaches for the hysteresis nonlinearity, then the model-predictive based controllers have been proposed, which are experimentally verified to have the satisfactory control performance. Meanwhile, by using the stick-slip principle, the long-range high-accuracy positioning control of the piezoelectric actuator has been achieved as well. Finally, an automatic collection device for brain slices has been designed by the piezoelectric actuator and its working principle and verification experiment are to be introduced.

Biography：Prof. Long Cheng received the B.S. (Hons.) degree in control engineering from Nankai University, Tianjin, China, in 2004, and the Ph.D. (Hons.) degree in control theory and control engineering from the Institute of Automation, Chinese Academy of Sciences, Beijing, China, in 2009. He is currently a Full Professor with the Institute of Automation, Chinese Academy of Sciences. He is also an Adjunct Professor with the University of Chinese Academy of Sciences, Beijing, China. He has authored and co-authored more than 100 technical papers in peer-refereed journals and prestigious conference proceedings. His current research interests include the rehabilitation robot, intelligent control, and neural networks. Prof. Cheng was the recipient of the IEEE TRANSACTIONS ON NEURAL NETWORKS Outstanding Paper Award from the IEEE Computational Intelligence Society, the Aharon Katzir Young Investigator Award from the International Neural Networks Society, and the Young Researcher Award from the Asian Pacific Neural Networks Society. He is currently serving as an Associate Editor/Editorial Board Member for the IEEE TRANSACTIONS ON CYBERNETICS, Neural Processing Letters, Neurocomputing, International Journal of Systems Science, and Acta Automatica Sinica.

Lecture 6

Talk Title: Robust Adaptive Control of Hypersonic Flight Dynamics

Speaker: Bin Xu

Abstract: This talk addresses the control of hypersonic flight dynamics on the basis of intelligent learning and disturbance observer in presence of system uncertainty, time-varying disturbance and system constraint. The control

scheme using parameter estimation, composite learning, disturbance observer and Barrier Lyapunov Function will be discussed. The uniformly ultimate boundedness stability is analyzed via Lyapunov method. Through simulation verification, the proposed approach obtains better performance with higher accuracy for the hypersonic longitudinal dynamics.

Biography： Prof. Bin Xu is Professor with School of Automation, Northwestern

Polytechnical University. He received the B.S. degree in measurement and control from Northwestern Polytechnical University, China, 2006 and the Ph.D. degree in Computer Science from Tsinghua University, China, 2012. He visited ETH Zurich from Mar 2010 to Mar 2011 and from Feb 2012 to Jan 2013 he was Research Fellow with Nanyang Technological University. From Jul 2012 until now, he is working at School of Automation, Northwestern Polytechnical University. His research interests include computation intelligence, intelligent control and adaptive control with application to flight dynamics, robotic systems. He is currently associate editor of Neurocomputing, International Journal of Advanced Robotic Systems, and Chinese Journal of Aeronautics.

Invited Session 3 Networked Control

Chair: Jian Sun, Beijing Institute of Technology, China

Jinhui Zhang, Beijing Institute of Technology, China

Lecture 1

Talk Title: Event-based MPC with Adaptive Horizon for Nonlinear Systems

Speaker: Zhongqi Sun

Abstract: Model predictive control (MPC) has the advantages of explicitly handling input and state constraints and optimizing the performance. Generally, traditional MPC requires a quite heavy computation, especially for nonlinear systems, to solve an optimization control problem (OCP) at each step. This may prevent its application to fast systems such as unmanned ground vehicles, quadrotor and servo systems, etc. This motivated us to design event- or self-triggered MPC to reduce the frequency of solving the OCP. The event-based approach is able to alleviate the computation burden, but it only through the reduction in the frequency of solving the OCP. The computational complexity at each update remains high, because the prediction horizon is usually a fixed constant. Therefore, we develop event-based MPC with adaptive horizon schemes, which saves the computing resources in two ways: decreasing the frequency of solving the OCP and reducing the complexity of each OCP.

Biography: Prof. Zhongqi Sun was born in Hebei Province, China, in 1986.

He received the B.S. degree in Computer and Automation in 2010 from Hebei Polytechnic University, Hebei, China, and the Ph.D. degree in Control Science and Engineering in 2018 from Beijing Institute of Technology, Beijing, China. During September 2018 - August 2019, he was a postdoctoral researcher with the Faculty of Science and Engineering, University of Groningen, Netherlands. He is currently an assistant professor in the School of Automation of Beijing Institute of Technology. His research interests include multi-agent systems, model predictive control, machine learning and robotic systems.

Lecture 2

Talk Title: Intelligent Control of Autonomous Unmanned System

Speaker: Yuanqing Wu

Abstract: Unmanned intelligent vehicle is a high-tech integration of computer, sensing, information, communication, navigation, artificial intelligence and automatic control. The hardware design platform completes part modeling and virtual entity assembly through Solidworks 3D software, and then performs feasibility analysis on the vehicle body assembly, completes CAD part processing drawing and actual processing, assembly and testing. For parts with high processing difficulty and low strength requirements, 3D printers are used for printing to shorten the production cycle. Further, the development of the platform of intelligent vehicle requires a sensor measurement interface, an execution component control interface, a data visualization interface, an expansion interface, and a system communication interface. Then, a PCB circuit board and other hardware circuits of the motor drive portion and the main control portion are designed. Finally, utilization communication bus realizes information exchange between modules, which is convenient for maintenance and expansion. By integrating Zigbee communication, UWB positioning, inertial measurement, main control, motor drive, camera sensing, ultrasonic measurement and other modules, the platform can realize high-precision positioning in the room, real-time measurement and positioning information update vehicles coordination, formation control, ultrasonic obstacle avoidance, automatic heading calibration and real-time tracking of target objects.

Biography: Prof. Yuanqing Wu received the Ph.D. degree from the Department

of Control Science and Engineering, Zhejiang University, Hangzhou, China, in 2016. He is currently a Professor with the School of Automation, Guangdong University of Technology, Guangzhou, China. He was a Research Assistant with the School of Electrical and Electronic Engineering, Nanyang Technology University, Singapore, from 2014 to 2015. His research interests include nonlinear control systems, networked control systems, output regulation, and artificial intelligence.

Lecture 3

Talk Title: Event-triggered H-infinity Control and Filtering of Networked Systems with Limited Information

Speaker: Huaicheng Yan

Abstract: This talk will present fundamental theory, challenges and some recent results on the concept of control and estimation for networked systems with limited information. Specifically, the problems of H-infinity control, network-based control design, and observer-based control design, H-infinity filtering in the presence of network complexities and imperfections are discussed. The sampled data are transmitted through networks. In order to reduce network traffic load and save communication resources, some novel event-triggered sampling schemes are proposed, under which data are transmitted only when the proposed triggering condition is violated. Co-design of event-triggered and distributed controller/filters are derived to guarantee well H-infinity robustness to system noises considered above. Finally, some concluding remarks and future directions are provided.

Biography: Prof. Huaicheng Yan received the B.Sc. degree in automatic control from the Wuhan University of Technology, China, in 2001, and the Ph.D. degree in control theory and control engineering from the Huazhong University of Science and Technology, China, in 2007. From 2007 to 2009, he was a Post-Doctoral Fellow with the Chinese University of Hong Kong. In 2011, he was a Research Fellow with the University of Hong Kong. In 2012, he was a Research Fellow with the City University of Hong Kong. He is currently a Professor with the School of Information Science and Engineering, East China University of Science and Technology, Shanghai, China. He serves as Associate Editor of International Journal of Robotics and Automation, etc. He has authored/coauthored more than 90 SCI journal papers, including 50 Automatica and IEEE Transctions papers. His research interests include networked control systems, multi-agent systems, information fusion, smart grids and robotics.

Lecture 4

Talk Title: Studying on Networked Control System with Actuator Saturated

Speaker: Hongjiu Yang

Abstract: By control studying on pneumatic control systems, quadrotors, wheeled robots, underwater suspension, teleoperation, space vehicle formation and other control systems, it is shown that not only dynamic performance of a system is reduced because of actuator saturation, but also there exists instability for a closed-loop system for actuator saturation. Fast sampling will produce a large number of data for control systems, which will bring many problems on transmission in network channel. Under fast sampling, problems on actuator saturation are shown as follows: estimation for null controllable region, estimating the domain of attraction, methods for increasing the domain of attraction, performance analysis in the domain of attraction, analysis on the domain of attraction for some kinds of systems, application of systems subject to actuator saturation, and so on. In addition to the problems on actuator saturation, there are also other problems on networked control systems, such as data quantification, predictive control, network security, cloud control, and so on. Therefore, it is interesting for studying effective methods to deal with the problems on actuator saturation in networked control systems.

Biography: Prof. Hongjiu Yang was born in Qinhuangdao, Hebei, China, in

1981. He received the B.S. degree in mathematics and applied mathematics and the M.S. degree in applied mathematics from the Hebei University of Science and Technology, Shijiazhuang, China, in 2005 and 2008, respectively, and the Ph.D. degree in control science and engineering from the Beijing Institute of Technology, Beijing, China, in 2011. He is currently a professor with the School of Electrical and Information Engineering, Tianjin University, Tianjin, China. His current research interests include robust control/filter theory, delta operator systems, networked control systems, and active disturbance rejection control.

Lecture 5

Talk Title: Event-triggered Disturbance Rejection Control for Networked Control Systems

Speaker: Jun Yang

Abstract: Networked control system has been widely used in a wide range of applications (e.g., sensor network, smart grid, intelligent transportation systems,

etc.), However, the networked control systems are subject to the limited communication bandwidth. To handle this issue, event-triggered control was proposed and has been attracting plenty of attention in recent two decades. The underlying idea of event-triggered control is that the control tasks are executed only when there are necessary. Up to now, event-triggered control has been become one of important methods to save the communication resource. Meanwhile, various disturbances/uncertainties are inevitable in practical systems, which seriously deteriorate the closed-loop system performance, even make the systems unstable under the controllers designed for the nominal systems. Specially, for event-triggered control systems, it has shown that some well-known triggering mechanisms are not robust to arbitrary small disturbances in the sense that the required communication resources can grow without bounds. This talk is about how to design novel event-triggered active disturbance rejection control method to improve the robustness of networked control systems subject to disturbances/uncertainties while saving communication resource.

Biography：Prof. Jun Yang is a Professor in Department of Automation, Southeast University. He was selected as one of top-notch young talents under the National Ten Thousand People's Plan in 2018. He is a senior member of IEEE, the vice-chairman of Nanjing Branch of IEEE Industrial Electronics, member of Jiangsu Automation Society. He has been engaged in the research of nonlinear and disturbance rejection control theory, mechatronic control system and autonomous control technology. He held over 4 national scientific research projects, 6 provincial-level and enterprise cooperation projects, published more than 70 SCI papers, applied for more than 20 national invention patents and authorized more than 10. Cooperative research has been carried out with Manchester University, Loughborough University, RMIT University and West Sydney University. The research results have won one Natural Science Award of the Ministry of Education, Science and Technology Awards of Jiangsu Province, the Best Paper Award of the Institute of Engineering and Technology (IET), the Institute of Measurement and Control (IMC), the Japanese Association of Electrical and Electronic Engineers (IEEJ) and one of the 100 most influential international academic papers awards of China. Currently, he is an Associate Editor of Transactions of the Institute of Measurement and Control.

Lecture 6

Talk Title: Event-Triggered Filtering or Control for Network Systems

Speaker: Bo Shen

Abstract: Recently, event-triggered control and estimation schemes have been a popular research topic in the control community. Different from the traditional time-triggered scheme, in the event-triggered strategy, the controller or estimator is modulated only when a certain triggering condition is met, which can effectively reduce the unnecessary energy consumption. Energy saving is particularly important in those resource limited environments such as sensor networks, complex networks and neural networks. In these network systems, considerable processing and storage resources would have to be committed, and the corresponding resource allocation/saving becomes a critical issue. In this case, for the efficiency of energy utilization, it is important to introduce the event-triggering mechanism into the filtering or control problem for the network systems. In this talk, the event-triggered mechanism as well as the dynamic event-triggered mechanism is first introduced. Then, the recent results on the event-triggered filtering or control problem for sensor networks, complex networks and neural networks are presented. Finally, some conclusions are drawn and several possible related research directions are pointed out.

Biography: Prof. Bo Shen received his B.Sc. degree in mathematics from

Northwestern Polytechnical University, Xi'an, China, in 2003 and the Ph.D. degree in control theory and control engineering from Donghua University, Shanghai, China, in 2011. He is currently a Professor with the College of Information Science and Technology, Donghua University, Shanghai, China. From 2009 to 2010, he was a Research Assistant in the Department of Electrical and Electronic Engineering, the University of Hong Kong, Hong Kong. From 2010 to 2011, he was a Visiting PhD Student in the Department of Information Systems and Computing, Brunel University, U.K. From 2011 to 2013, he was a Research Fellow (Scientific co-worker) in the Institute for Automatic Control and Complex Systems, University of Duisburg-Essen, Germany. His research interests include nonlinear control and filtering, stochastic control and filtering, as well as complex networks and neural networks. He has published around 70 papers in refereed international journals.

Invited Session 4 Nonlinear Dynamics and Control

Chair： Zhengguang Wu, Zhejiang University, China

Lecture 1

Talk Title: Iterative Learning Control for Nonlinear Systems

Speaker: Deyuan Meng

Abstract: In this talk, we discuss fundamental convergence problems of iterative learning control for nonlinear systems. We first introduce brief reviews of ILC, including what ILC is, why it is required, and how it is technically formulated. Then we present analysis methods and convergence results of robust ILC for nonlinear systems, where we consider both global and local Lipschitz nonlinearities. We next provide simulation examples and experiment results on a hand rehabilitation robot to demonstrate the effectiveness for robust ILC of nonlinear systems. Finally, we give some concluding remarks about ILC for nonlinear systems.

Biography： Prof. Deyuan Meng received the B.S. degree in Mathematics and

Applied Mathematics from Ocean University of China (OUC), Qingdao, China, in June 2005, and the Ph.D. degree in Control Theory and Control Engineering from Beihang University (BUAA), Beijing, China, in July 2010. He is currently with the Seventh Research Division and School of Automation Science and Electrical Engineering at Beihang University. From November 2012 to November 2013, he was a visiting scholar with the Department of Electrical Engineering and Computer Science, Colorado School of Mines, Golden, CO, USA. His research interests include iterative learning control, multi-agent systems, and social opinion dynamics. He was a recipient of the “Best Paper Award” from the IEEE 7th Data Driven Control and Learning Systems Conference in 2018.

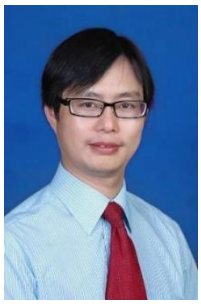
Lecture 2

Talk Title: Multi-approximators Based Control and Application

Speaker: Mou Chen

Abstract: In this talk, the related methods of multi-approximators based control are given for the uncertain nonlinear system. For the system uncertainty, unmeasured states, time-varying unknown disturbance and system fault of multi-input and multi-output uncertain nonlinear systems, the neural network was applied to approximate the nonlinear systems uncertainty, the nonlinear disturbance observer was used to estimate the time-varying unknown external disturbance, the nonlinear state observer was designed to estimate the unmeasured system states and the fault estimator was developed to estimate system fault. Several coupling designs were given for the heterogeneous approximations. The outputs of the different approximator are applied to the design of robust controller for uncertain nonlinear system, so as to ensure the closed-loop stability of uncertain nonlinear system under the influence of system uncertainty, time-varying external interference, unmeasured states and system fault, and to improve its control performance. At the same time, the application of multiple approximators cooperative control in robust flight control of aircraft was discussed.

Biography： Prof. Mou Chen is now a professor and vice Dean of the College



of Automation Engineering, Nanjing University of Aeronautics and Astronautics. He received the BSc degree and the PhD degree in Nanjing University of Aeronautics and Astronautics. He was awarded by the National Science Fund for Distinguished Young Scholars in 2018 and was elected to the Program for New Century Excellent Talents in University of Ministry of Education of China in 2011. He visited the Loughborough University, UK, from November 2007 to February 2008. He was a postdoctoral fellow in the National University of Singapore, Singapore, from June 2008 to September 2009. He was a senior research fellow in the University of Adelaide, Australia, from May 2014 to November 2014. He has actively served in the editorial boards of a number of international journals as an associate editor, including IEEE Transactions on Systems, Man, and Cybernetics: Systems, IEEE Access, Neurocomputing, International Journal of Advanced Robotic Systems, Chinese Journal of Aeronautics, SCIENCE CHINA Information Sciences, etc. He was a PI of 20 projects in the last five years, including the General Program of National Natural Science Foundation of China, and the Project for Jiangsu Natural Science Foundation of China, etc. He was awarded two Second Prize in China's State Natural Science Award (ranking second), one First Prize in Natural Science Award of Ministry of Education (ranking second), two Second Prize in National Defense Science and Technology Progress (ranking first), and applied over 20 invention patents. He has published one English monograph and one Chinese monograph. He was published over 100 academic papers, more than 90 papers were published or accepted by international journals among these papers.

Lecture 3

Talk Title: Random PWM Controls of Robots Driven by DC Motors

Speaker: Zhaojing Wu

Abstract: In this report, the problem of modeling and stochastic tracking is presented for robots driven by DC-motor with PWM amplifier. The main work consists of Five aspects. 1) Local stability of Random nonlinear system is invaginated. 2) Equivalence of a given continuous control and a PWM strategy is proved, which can be achieved by a physical circuit. 3). Equivalent control for robot with CD-motor is obtained by using vectorial backstepping method, and an observer of current is presented. 4). PWM controller of two levels is extended to the case of three levels by using H-bridge circuit. 5). Virtual reality simulations are presented to demonstrate the efficiency of proposed method.

Biography: Prof. Zhaojing Wu received the M.S. and Ph.D. degrees from Qufu

Normal University and Northeastern University, in 2003 and 2005, respectively. He is currently a Professor in the School of Mathematics and Information Science of Yantai University and Distinguished Professor of Taishan Scholar Program of Shandong Province. He was the outstanding reviewer for IEEE Transactions on Automatic Control in 2012 and best conference paper awarder of IEEE ICCSS 2016. His research interests include nonlinear control, adaptive control, stochastic stability analysis, stochastic dissipative systems, stochastic Hamiltonian systems, stochastic Lagrangian systems and applications on robotic control. He is the author of 18 papers (including 4 regular papers) published in IEEE Transactions on Automatic Control or Automatica.

Lecture 4

Talk Title: Identification of a Moving Object's Velocity and Range with a Static-Moving Camera System

Speaker: Jian Chen

Abstract: In this talk, a nonlinear observer strategy is introduced to asymptotically identify the velocity and range of the feature points on a moving object using a static-moving camera system. Specifically, the camera system consists of a static camera and a moving camera. The observers are developed in a sequential way. First, nonlinear observers are designed to identify the scaled velocity of the feature points and the angular velocity of the moving camera. Second, based on the estimated velocities, the range of the feature points is identified by a reduced order estimator. Homography-based techniques are used in the auxiliary state construction and the observer design. With the estimated scaled velocity and range, the motion and structure of the object can be obtained with respect to both cameras. The proposed approach does not require the motion constraint or apriori geometric knowledge of the moving object. Furthermore, Lyapunov-based analysis is used to prove that the estimators asymptotically identify the velocity and range of the feature points.

Biography: Prof. Jian Chen received the B. E. degree in measurement and control technology and instruments and the M.E. degree in control science and engineering from Zhejiang University, Hangzhou, China, in 1998 and 2001, respectively, and the Ph.D. degree in electrical engineering from Clemson University, Clemson, SC, USA, in 2005. He was a Research Fellow with the University of Michigan, Ann Arbor, MI, USA, from 2006 to 2008, where he was involved in fuel cell modeling and control. In 2013, he joined the Department of Control Science and Engineering, Zhejiang University, where he is currently a Professor with the College of Control Science and Engineering. He has been supported by the Chinese Recruitment Program of Global Youth Experts since 2013, and the Key Program of National Natural Science Foundation of China on Modeling and Control of Fuel Cell vehicles since 2015. He has published more than 110 peer reviewed papers and one monograph. His research interests include modeling and control of fuel cell vehicles, visual servo techniques, and nonlinear control.

Lecture 5

Talk Title: Feedback Limitations in Nonlinear Discrete-Time Control

Speaker: Chanying Li

Abstract: An interesting phenomenon occurs when one attempts to control systems with output nonlinearity growing faster than linearity, where similarities between the continuous- and discrete-time cases of adaptive control no longer

exist. It is generally known that a large class of continuous-time nonlinear parametric systems, regardless of how fast the growth rate is, can be globally stabilized by the nonlinear damping or back-stepping approach in adaptive control. However, fundamental difficulties arise for the discrete-time case. These difficulties are caused by the inherent limitations of the feedback principle in dealing with uncertainties, which means that systems with uncertainties beyond the feedback capability cannot be stabilized by any discrete-time feedback control law. This talk is aimed at the identification and control of discrete-time nonlinear parametric systems and trying to give an appropriate characterization of feedback limitations.

Biography: Prof. Chanying Li received the B.S. degree in Mathematics from

Sichuan University in 2002, and the M.S. and Ph.D. degrees in control theory from Academy of Mathematics and Systems Science, Chinese Academy of Sciences, in 2005 and 2008, respectively. She was a Postdoctoral Fellow at the Wayne State University from 2008 to 2009, and the University of Hong Kong from 2009 to 2011. She joined the Institute of Systems Science at Chinese Academy of Sciences in 2011, and is currently a professor at the Key Laboratory of Systems and Control, Chinese Academy of Sciences. Her current research interests include the maximum capability of feedback, adaptive nonlinear control, system identification and stochastic control systems.

Invited Session 5 Big Data and Pattern Recognition

Chair: Tong Zhang, South China University of Technology, China

Lecture 1

Talk Title: Reinforcement Learning Based Evolutionary Algorithm with Applications to Multi-Agent Systems
Speaker: Xian-Bing Meng
Abstract: As a bio-inspired algorithm, the crux of designing evolutionary algorithm is to formulate swarm intelligence. Two classic evolutionary algorithms, chicken swarm optimization and bird swarm algorithm are first used as examples to show how to extract swarm intelligence to design algorithms. Then, Reinforcement Learning based evolutionary algorithm is introduced as a framework of improving evolutionary algorithms. Finally, it will be discussed how to integrate evolutionary algorithm into multi-agent systems.

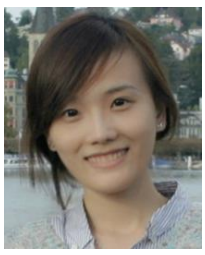
Biography：Dr. Xian-Bing Meng is a postdoctoral fellow with School of Com-

puter Science and Engineering, South China University of Technology. He received the Ph. D. degree from Central South University, and severed as a senior research assistant at City University of Hong Kong. His research interests mainly include evolutionary computation, fuzzy logic systems, broad learning and their applications.

Lecture 2

Talk Title: Data Analysis and Fraud Detection on Blockchain
Speaker: Jiajing Wu
Abstract: Blockchain technology is a emerging technology that has the potential to revolutionize many traditional industries. Since the creation of Bitcoin, which represents blockchain 1.0, blockchain technology has been attracting extensive attention and a great amount of user transaction data has been accumulated. Furthermore, the birth of Ethereum, which represents blockchain 2.0, further enriches data type in blockchain. While the popularity of blockchain technology bringing about a lot of technical innovation, it also leads to many new problems, such as user privacy disclosure and illegal financial activities. However, the public accessible of blockchain data provides unprecedented opportunity for researchers to understand and resolve these problems through blockchain data analysis. This talk will introduce some of our recent work on data analysis and fraud detection.

Biography：Dr. Jiajing Wu is an associate professor at the School of Data and



Computer Science, Sun Yat-sen University, Guangzhou, China. She received the Ph.D. degree in Electronic and Information Engineering from The Hong Kong Polytechnic University, Hong Kong, in 2014. She was a recipient of the Hong Kong PhD Fellowship Scheme during her Ph.D. study in Hong Kong. Her research interests include theory and applications of complex networks, data mining, blockchain, and cyber-physical networks. She is a member of IEEE, a member of IEEE Technical Committee on Nonlinear Circuits and Systems, and an Associate Editor of IEEE Transactions on Circuits and Systems-II: Express Briefs.

Lecture 3

Talk Title: Micro-Expression Recognition Based on Group Sparse Learning

Speaker: Yuan Zong
Abstract: Micro-expressions are subtle, repressed, and involuntary facial expressions and occur when people try to conceal their true emotions. Micro-expression recognition (MER) aims at accurately detecting this hidden emotion from the facial video clips. It has been one of the most attractive research issues among affective computing, pattern recognition, and computer vision. In this talk, we present a simple yet effective group sparse learning model and its several variants, which are motivated by the facial action coding system (FACS) theory, to deal with the MER problem. In addition, we would like to simply discuss the future directions of this challenging but interesting research topic.

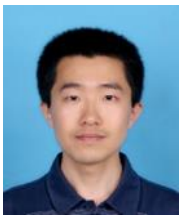
Biography：Dr. Yuan Zong received the B.Sc. and M.Sc. degrees from Nanjing

Normal University, Nanjing, China, in 2011 and 2014, respectively, and the Ph.D. degree in Biomedical Engineering from Southeast University, Nanjing, China in 2018. He is currently a Lecturer with the School of Biological Science and Medical Engineering, Southeast University. From 2016 to 2017, he worked as the Visiting Scholar with the Center for Machine Vision and Signal Analysis (CMVS), University of Oulu, Finland. His research interests include affective computing, pattern recognition, and computer vision, especially facial expression/micro-expression analysis. He has published over 30 papers in journals and conferences such as TIP/TCYB/TAFFC/IJCAI/ACM MM. Dr. Zong won the Video based Emotion Recognition First Runner-up Position of the EmotiW Challenge at ACM ICMI in 2019 and the Second Runner-up Position in 2016 and 2018, respectively.

Lecture 4

Talk Title: Recursive Identification for Hammerstein Systems with Diminishing Excitation Signals
Speaker: Wenxiao Zhao
Abstract: In this talk, we consider the identification of Hammerstein systems where the nonlinearity is described by a combination of basis functions with unknown coefficients. The extended least squares (ELS) algorithm is applied to estimate the unknown parameters in the system. Contrary to the classical excitation signals for identification of Hammerstein systems, i.e., the periodic inputs or stationary random signals, here we choose a sequence of diminishing excitation signals as the system inputs. We prove that the strong consistency of the ELS algorithm still holds true and the convergence rate is obtained as well. A numerical example is given to verify the performance of the identification method.

Biography：Wenxiao Zhao received the B.Sc. degree from Shandong Univer-



sity, China in 2003 and the Ph.D. degree in operation research and cybernetics from the Institute of Systems Science (ISS), Academy of Mathematics and Systems Science (AMSS), Chinese Academy of Sciences (CAS), China, in 2008. He is currently an Associate Professor with AMSS, CAS. His research interests are mainly in identification and adaptive control, particularly, in sparse parameter estimation for stochastic systems, recursive identification of nonlinear systems, distributed optimization, etc.

Lecture 5

Talk Title: Feedback Limitations in Nonlinear Discrete-Time Control

Speaker: Hua Geng

Abstract: In order to cope with the worsening environmental and energy crisis,

it has become an inevitable trend to replace fossil-based traditional (thermal) power generation with renewable energy such as wind power and photovoltaic power. Compared with traditional power generation, renewable energy generation has the characteristics of clustering, distribution and power electronic based, which brings many technical challenges in terms of control and optimization. This talk discusses the challenges towards safe and reliable operation of large-scale renewable energy cluster from the perspective of individual synchronization and cluster cooperation.

Biography：Prof. Hua Geng is currently a tenured associate professor in Au-

tomation Department and research professor in Energy Internet Research Institute, both of Tsinghua University. He received his Ph.D. degree in control theory and application from Tsinghua University, Beijing, China in 2008. From 2008 to 2010, he was a Postdoctoral Research Fellow with the Department of Electrical and Computer Engineering, Ryerson University, Toronto, ON, Canada. He joined Tsinghua University in June 2010. His current research interests include renewable energy conversion systems, Flexible AC transmission system (FACTS), micro-grid and digital control on power electronics. He is the Chief scientist of National Key R&D Program, principle investigator (PI) of the Excellent Youth Scholar project and one key project of National Science Foundation of China (NSFC). Dr. Geng has published more than 150 technical papers, authored a China Machine Press book, and holds more than 20 issued Chinese

patents. He was granted “Delta Young Scholar Award” by Delta Environmental and Educational Foundation in 2014 and “Young Professional Award” by China Power Supply Society (CPSS) in 2013. Dr. Geng is an IET Fellow, IEEE Senior Member, Honored Chair of the Youth Working Committee of CPSS, Standing Director of CPSS, Deputy Secretary-General of the Electrical Automation Technical Committee of the China Automation Society, etc. He serves as the expert of IEC international standards, editor of IEEE Trans. on Energy Conversion, IEEE Trans. on Sustainable Energy and IEEE Power Engineering Letters, associate editor of IEEE Trans. on Industry Applications, Control Engineering Practice, Journal of control, automation and electrical systems, Chinese Journal of Electrical Engineering and CPSS trans. on Power Electronics and Applications, etc.

Lecture 6

Talk Title: The role of reverse edges on hierarchical networks

Speaker: Hai-Tao Zhang

Abstract: Hierarchical networks widely exist in natural biological, industrial, and social networked systems. This brief explores the effects of adding a reverse edge, across a so-called stem, in a hierarchical network on consensus performance. In particular, it quantitatively reveals the effects in terms of the in-degrees of the surpassed stem nodes. The study further enriches the existing results on special chain and grid networks by accommodating more general network topologies. From the application perspective, this talk provides a guidance for an attacking (or conversely anti-attacking) strategy of injecting the most effective malicious reverse edge. It has other potential applications in regulating DAG network convergence performance with reverse edges.

Biography: Hai-Tao Zhang, Vice Dean of School of Artificial Intelligence and

Automation, Huazhong University of Science and Technology, Distinguished Professor of Central China Scholar, Young Scholar of Chang Jiang Scholars’ Award Program of Minister of Education, National Young Top Talent, and Winner of National Excellent Youth Fund. Born in 1977, he received his Bachelor and Ph.D. from University of Science and Technology of China in 2000 and 2005, respectively. In 2007, he was engaged in post-doctoral research at Cambridge University in England. He was promoted to Professor in 2010. He has visited University of California, University of Virginia and other academic institutions. His research interests include swarm intelligence, cooperative control

of autonomous USVs, etc. He has hosted more than 20 projects such as Joint Key Fund, Excellent Youth Fund and Major Research Plan of National Natural Science Foundation. He has published/been accepted 86 SCI journal papers, including 1 paper in Nature Communication, and 40 papers in Automatica and IEEE Trans./Mag. His collective motions' phase-transition work was selected as research highlights in Nature Physics in 2016. He has applied or authorized 38 patents of invention (including 2 American patents). He has won the first prize of Natural Science in Hubei Province, and the gold award of Genevan International Invention Exhibition. Prof. Zhang is an IEEE Senior Member who serves/have served as Editorial Board members of several International SCI Journals such as IEEE Trans. Circuits and Systems II, Asian Journal of Control.

Invited Session 6 Complex Networks and MAS

Chair: Guanghui Wen, Southeast University, China

Lecture 1

Talk Title: Consensus of Multi-agent Systems with Efficient Communication Schemes: Stochastic Sampling or Event-triggered strategies

Speaker: Wangli He

Abstract: This talk focuses on consensus of multi-agent systems with efficient communication schemes. Firstly, leader-following consensus with stochastic sampling is considered. A distributed consensus protocol with probabilistic sampling in two sampling periods is proposed. A general consensus criterion is derived for multi-agent systems under a directed graph. Then, a dimension-reduced condition is obtained for multi-agent systems under an undirected graph, which greatly facilitates its application to large-scale networked agents. Secondly, a dynamic event-triggered strategy is proposed to solve the consensus problem of multi-agent systems, in which an auxiliary parameter is introduced for each agent to regulate its threshold dynamically. A distributed adaptive consensus protocol is formed including the updating law of the coupling strength. It is proved that the triggering time sequences do not exhibit Zeno behavior. Examples are given to validate the effectiveness of theoretical results.

Biography: Dr. Wangli He received the B.S. degree in information and computing science and the Ph.D. degree in applied mathematics from Southeast University, Nanjing, China, in 2005 and 2010, respectively. She was a Post-Doctoral Research Fellow with the School of Information Science and Engineering, East China University of Science and Technology, Shanghai, China, and a Visiting Post-Doctoral Research Fellow with Central Queensland University, Rockhampton, Australia from 2010 to 2011. During 2013 to 2017, she held several visiting positions with University of Hong Kong, City University of Hong Kong, Potsdam Institute for Climate Research Institute and Tokyo Metropolitan University. She is currently a Professor with the School of Information Science and Engineering, East China University of Science and Technology. Her current research interests include cooperative control of multi-agent systems, networked nonlinear systems, security of cyber-physical systems. She is the Chair of Technical Committee on Networked-based Control Systems and Applications of IES. She was the Visiting Associate

Professor of Tokyo Metropolitan University (2015-2017). She was the recipient of Excellent Doctoral Thesis Award of Jiangsu Province in 2001, Young Elite Scientist of CAST in 2017, Young Rising Star Award of Shanghai Science and Technology Commission in 2018 and National Outstanding Youth Science Foundation in 2019.

Lecture 2

Talk Title: Fully Distributed Event-triggered Cooperative Control

Speaker: Zhongkui Li

Abstract: We consider the distributed event-triggered consensus problem for general linear multi-agent networks. A core task in the event-triggered consensus problem is to design distributed event-based protocols, consisting of the event-based control laws and the triggering functions. Based on the local sampled state or local output information, distributed adaptive event-triggered protocols are designed, which can ensure that consensus of the agents is achieved and the Zeno behavior is excluded by showing that the interval between any two triggering events is lower bounded by a strictly positive value. Our main contribution is that the proposed adaptive event-based protocols are fully distributed and scalable, which do not rely on any global information of the network graph and are independent of the network's scale. In these event-based protocols, continuous communications are not required for either control laws updating or triggering functions monitoring.

Biography: Prof. Zhongkui Li received the B.S. degree in space engineering

from the National University of Defense Technology, China, in 2005, and his Ph.D. degree in dynamics and control from Peking University, China, in 2010. Since 2013, he has been with the Department of Mechanics and Engineering Science, College of Engineering, Peking University, China, where he is currently an Associate Professor with tenure. Dr. Li is an author of a book Cooperative Control of Multi-Agent Systems: A Consensus Region Approach (CRC press, 2014) and has published a number of journal papers. His current research interests include cooperative control of multi-agent systems, networked control systems, autonomous unmanned systems. He serves as an associate editor for IEEE Trans. Automatic Control and Nonlinear Analysis: Hybrid Systems. Dr. Li was selected into the Changjiang Scholars Program (Young Scholar), Ministry of Education of China, in 2017, and the Clarivate Analytics Highly Cited Researchers in Engineering in 2018. He was the recipient of the State Natural Science Award of China (Second Prize) in 2015,

the Yang Jiachi Science and Technology Award in 2015, and the National Excellent Doctoral Thesis Award of China in 2012. His coauthored papers received the IET Control Theory & Applications Premium (Best Paper) Award in 2013, the IEEE CSS Beijing Chapter Young Author Prize in 2013, and the 2009-2011 Best Paper Award of Journal of Systems Science & Complexity in 2012.

Lecture 3

Talk Title: Trusted-Node Subsequence Reduction for Designing Resilient Consensus Algorithms

Speaker: Zhiwei Liu

Abstract: Existing resilient consensus algorithms are mainly developed based on the mean subsequence reduced (MSR) method, which requires the assumption that there exist at most f malicious agents (i.e., f-total model) and the exact information of f. However, such assumption and information are hard to satisfy and obtain in some practical multiagent networks (MANs). A novel method, called trusted-node subsequence reduction (TSR), is proposed for designing resilient consensus algorithm without using the assumption of f-total model. The main idea of the TSR method is to filter out the received information for each agent beyond a dynamic trust region, determined by the current relative state of the neighboring trusted nodes. Based on the TSR method, we design a sampled-data resilient consensus algorithm for double-integrator MANs. A necessary and sufficient graphic condition is obtained for resilient consensus of the considered MAN, which is easy to realize, even on a large scale. Finally, simulations are conducted to illustrate the effectiveness of the proposed algorithm.

Biography: Prof. Zhiwei Liu, Associate Professor, Huazhong University of Sci-

ence and Technology. In June 2004, he graduated from the School of Economics and Management of Southwest Jiaotong University. In June 2011, he graduated from the Department of Control Science and Engineering of Huazhong University of Science and Technology. July 2011 - February 2017 Postdoctoral, lecturer and associate professor of the Department of Automation, Wuhan University. February 2017-present Associate Professor, School of Artificial Intelligence and Automation, Huazhong University of Science and Technology. In recent years, he has hosted three projects of the National Natural Science Foundation of China, the Morning Light Project of Hubei Province, and the Young Scholars of Wuhan University. Zeng Jin has conducted collaborative research at the City University of Hong Kong and the Royal Melbourne Institute of Technology. The main research directions are:

control and optimization of distributed network systems, and smart grid control and optimization.

Lecture 4

Talk Title: Multi-agent Consensus Based on Non-Smooth Control Theory

Speaker: Haibo Du

Abstract: Non-smooth/finite-time control has attracted a lot of attention in recent years due to its advantages with faster convergence performance and better disturbance rejection ability. This report first introduces the background and significance of non-smooth control theory. Then some multi-agent consensus algorithms based on non-smooth control are given. Finally, some application cases of the proposed non-smooth consensus algorithm in UAV, robot and power electronics are shown.

Biography: Prof. Haibo Du is a professor at the School of Electrical and Automation Engineering of Hefei University of Technology. He worked on the problem of analysis and synthesis of non-smooth control theory. He has presided over 2 projects of the National Natural Science Foundation of China, 4 provincial and ministerial projects and 3 entrusted projects of enterprises. He published more than 60 SCI papers, among them 12 papers are in IEEE TAC or Automatica. The papers are cited SCI more than 1500 citations by others. 7 papers are ESI highly cited papers. His research results about non-smooth control have got the Natural Science Award (Second Class) of the Ministry of Education. One paper obtained the First Prize of Anhui Province Natural Science Excellent Academic Paper and one paper has been selected the Most Cited Automatica Articles. He applied 8 china national invention patents among them 4 patents were authorized. He visited the University of Texas at San Antonio, the Royal Melbourne Institute of Technology, and the University of Hong Kong for academic exchanges and cooperation. He is the guest editor of the International Journal of Advanced Robotic and other international SCI publications. He is IEEE Senior Member, a member of Society of Intelligent Aerospace Systems for Chinese Association for Artificial Intelligence, a member of Network Science and Engineering Professional Committee for Chinese Institute of Command and Control.

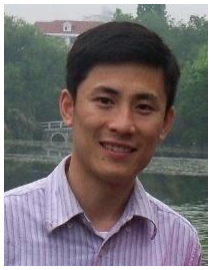
Lecture 5

Talk Title: Distributed Economic Dispatch in Power Systems via Dual Splitting

Speaker: Shanying Zhu

Abstract: Economic dispatch is a fundamental problem in power systems, whose goal is to seek a fair load sharing between generators in such a way that minimizes their total generated costs while satisfying their individual capacity constraints. Most existing methods are centralized while few works are devoted to solving the problem in a distributed manner. The problem becomes even more challenging when there is a (nonsmooth) regularization term in the cost function. A novel distributed algorithm to solve the economic problem based on duality analysis and splitting methods will be presented in this talk. This algorithm is not required to communicate sensitive gradient information while still achieving the optimum without sacrificing the performance. It is shown that the proposed algorithm converges at a nonergodic convergence rate of O(1/k) for general convex cost functions and a linear convergence rate for smooth and strongly convex cost functions, respectively. Extensions to solve the optimal energy management problem for multiple energy systems which are interconnected with each other via energy hubs will also be discussed.

Biography: Prof. Shanying Zhu is an associate professor in the Department



of Automation, Shanghai Jiaotong University. In 2013, he graduated from the Automation Department of Shanghai Jiaotong University and obtained a doctorate in engineering. From 2013 to 2015, he conducted postdoctoral research at Nanyang Technological University in Singapore and the Berkeley Singapore Education Alliance (BEARS). The main research areas are distributed estimation, optimization and application in the industry in wireless networks. More than 50 papers published in IEEE Transactions on Automatic Control, IEEE Transactions on Signal Processing, IEEE Transactions on Cybernetics, Automatica, Chinese Science and CDC, IFAC, ICASSP, GLOBECOM and other internationally renowned journals and conferences Co-published a monograph in English. Hosted/participated in several national natural science funds, national key research and development sub-projects. Received the first prize of the 2016 Ministry of Education Natural Science and the first prize of the 2017 Shanghai Technology Invention. He received NSFC Outstanding Youth Science Foundation Grant in 2019.

Invited Session 7 Chaotic Dynamics and Applications

Chair: Hai Yu, Northeastern University, China

Lecture 1

Talk Title: Amplitude Control and Offset Boosting of Chaotic Signal

Speaker: Chunbiao Li

Abstract: Chaotic signal is considered with great potential in radar and communication engineering for its inherent property of broadband frequency spectrum. However, there are two stumbling blocks in the way to chaos application: how to obtain the suitable amplitude or offset of chaotic signal? Because of the broadband property and the sensitivity to initial condition, it is a great challenge to design an amplifier or a polarity converter. Fortunately, differential-equation-based continuous chaotic system may share a structure-friendly mathematical form, which could be equipped with an independent knob to control the amplitude or offset directly without losing the fundamental property of chaos. This brings great convenience for chaos application, enabling us possible to ignore the chaotic signal conditioning before signal transmission and processing. In this talk, firstly various regimes of chaotic system with an independent amplitude controller are discussed combined with circuit realization. Secondly, chaotic systems with one or two independent offset controllers are introduced, after which infinitely many attractors are constructed when the offset boosting is based on the initial condition by a periodic function. Finally, the potential application of the proposed systems with easy amplitude/offset control will be briefly discussed.

Biography: Prof. Chunbiao Li is a professor in the School of Electronic & Information Engineering at Nanjing University of Information Science & Technology. He received his Master degree and Ph.D. degree from Nanjing University of Science and Technology in succession in 2004 and 2009. From 2010 to 2014 he was a postdoctoral fellow in school of information science and engineering at Southeast University. He was a visiting scholar in the department of physics at the University of Wisconsin-Madison in 2012 and 2013. His research interests are in the areas of nonlinear dynamics and chaos including nonlinear circuits, memristive systems and corresponding applications. He has been devoted to finding the multistability mechanism in dynamical system and the methodology for constructing chaotic

systems with amplitude control and offset boosting. He has received several awards for his teaching and research in Jiangsu Province.

Lecture 2

Talk Title: Chaotic Applications: From Random Number Generator to Noise Generator

Speaker: Prof. Yuncai Wang

Abstract: “Philosophers only interpret the world in different ways, but the problem is to change the world”, Chaos will be more attractive only it had more applications. In this presentation, the **Speaker** introduce two important chaotic applications in his group: How to build the fast random number generator and wideband millimeter wave noise generator utilizing chaotic laser diode.

Biography: Prof. Yuncai Wang received the B.Sc. in electronics from the Nankai University of Tianjin, China, in 1982, the M.Sc degree in Electronics, particles & vacuum physics in 1994, and the Ph.D degree in Optics from Xi’an Institute of Optics & Fine Mechanics, CAS, respectively. In 1986, he joined the Department of Physics & Optoelectronics Engineering, Taiyuan University of Technology as an Assistant Lecture, then a Lecture (1994), an Associate Professor (1998), and a Professor(2003). From 2000 to 2001, he was a visiting staff member at the Institute of Solid State Physics, Technology University of Berlin. In 2009, he was the visiting professor in Technology University, Darmstadt. Since 2019, he has been a professor with the School of Information Engineering, Guangdong University of Technology.

He is currently working on the applications of chaotic laser & chaotic chip, such as fast random number and millimeter wave noise generation, physical secure communications, sensor and detection using chaotic laser.

Dr. Wang is a senior member of Optical Society of China, the Vice Chairman of the Professional Committee of Optical-Mechanical-electronic Technology & System Integration, Instrument and Control Society, China, and the vice President of the Chaotic Secure communications Committee, Association for Cryptologic Research, China.

Lecture 3

Talk Title: Dynamic Analysis of Digital Chaotic Maps Via State-Mapping Networks

Speaker: Chengqing Li

Abstract: Complex dynamics of chaotic maps under an infinite-precision mathematical framework have been well known. The case in a finite-precision computer remains to be further explored. Previous work treated a digital chaotic map as a black box and gave different explanations according to the test results of the output. Using the Logistic map, Tent map, Cat map as typical examples, we disclose some dynamical properties of chaotic maps in fixed-point arithmetic by studying its corresponding state-mapping network, where every possible value is considered as a node and every possible mapping relation between a pair of nodes works as a directed edge. The scale-free property of the state network will be quantitatively proven. The obtained results can be extended to the scenario of floating-point arithmetic and to other chaotic maps. Understanding the real network structure of the state space of a chaotic map in the digital domain will help evaluate and improve the randomness of pseudo-random number sequences generated by chaotic maps.

Biography: Prof. Chengqing Li received his M.Sc. degree in applied mathematics from Zhejiang University, China in 2005 and his Ph.D. degree in electronic engineering from City University of Hong Kong in 2008. Thereafter, he worked as a Postdoctoral Fellow at The Hong Kong Polytechnic University till September 2010. Then, he worked at the College of Information Engineering, Xiangtan University, China. From April 2013 to July 2014, he worked at the University of Konstanz, Germany, under the support of the Alexander von Humboldt Foundation. Since April 2018, he has been working with the School of Computer Science and Electronic Engineering, Hunan University, China as a full professor. Prof. Li focuses on dynamics analysis of digital chaotic systems and their applications in multimedia security. He has published more than fifty papers on the focal subject in the past 15 years, receiving more than 2800 citations with h-index 29.

Lecture 4

Talk Title: Homoclinic/Heteroclinic Cycles and Chaos in 3D Three-Zone Piecewise Affine Systems

Speaker: Qigui Yang

Abstract: It is a great challenge to detect homoclinic/heteroclinic cycles and chaos in dynamical systems with multiple discontinuous boundaries. This paper takes the challenge to investigate the coexistence of homoclinic, heteroclinic and homoclinic/ heteroclinic cycles in a new class of three-dimensional three-zone piecewise affine systems. It develops a method to accurately predict the coexisting homoclinic, heteroclinic and homoclinic/heteroclinic cycles in such a system. Furthermore, this paper establishes some conditions for chaos to exist in the system, with rigorous mathematical proof of chaos emerged from the

coexistence of these homoclinic, heteroclinic and homoclinic/heteroclinic cycles. Finally, it presents numerical simulations to verify the theoretical results. Moreover, it is hoped that the investigation of the paper will shed some lights to more systematic studies of 3D Lorenz-type chaotic systems.

Biography: Prof. Qigui Yang is a professor of the second grade, Doctor of Science, Doctoral supervisor, teaching masters at South China University of Technology. He received his Master from Chongqing University, Ph.D. from Sun Yat-sen University, and the Postdoctoral from Tsinghua University. He has engaged in teaching and reaching the geometric theory of differential equations, the chaotic dynamical systems and stochastic dynamical systems and their applications. He is interested in studying the existence condition of chaotic complexity with simply systems and revealing the chaos mechanism and complex dynamical characteristics of chaotic systems. Also, he was awarded the first prize for ''Guangxi Scientific and Technological Progress Award'' (rank: 1/4), the second prize for ''Guangdong Higher Education Provincial Teaching Achievement Prize'' (rank: 2/5), and the excellent supervisor award in "Excellent Doctoral Dissertation of Guangdong Province" for three times consecutively. Up to now, he has published 119 papers in domestic and international professional journals including J. Differential Equations, Chaos, Int. J. Bifur. Chaos, Proc. Royal Soc. Edinburgh (A), of which 101 papers have been indexed in the SCI and positively cited over 1500. Moreover, he has hosted 4 projects from National Natural Science Foundation of China (NSFC) and 5 projects from provincial Natural Science Foundation on the topic of Chaos, and he also participated in the Major Research Instrumentation Program of NSFC, 3 other projects from NSFC and the Provincial Innovation Team Project. Besides, he has hosted 7 provincial teaching and research projects. In addition, he was engaged as an evaluation express for NSFC with both meeting and communication deciding. Until now, he has guided 4 postdoctoral, 18 graduated Ph.D. students (including 2 international students) and 33 graduated master students and is supervising 1 postdoctoral, 5 Ph.D. and 6 master candidates.

Invited Session 8 Nonlinear Systems and Applications

Chair： Hongyi Li, Guangdong University of Technology, China

Lecture 1

Talk Title: Discrete-Time Zero-Sum Games for Nonlinear Systems via Adaptive Dynamic Programming

Speaker: Qinglai Wei

Abstract: In this talk, the principle of ADP is discussed. A novel iterative zero-sum ADP algorithm is introduced for solving infinite horizon discrete-time two-player zero-sum games of nonlinear systems. The present iterative zero-sum ADP algorithm permits arbitrary positive semi-definite functions to initialize the upper and lower iterations. When the saddle-point equilibrium exists, both the upper and lower iterative value functions are proven to converge to the optimal solution of the zero-sum game, where the existence criteria of the saddle-point equilibrium are not required. If the saddle-point equilibrium does not exist, the upper and lower optimal performance index functions are obtained, respectively, where the upper and lower performance index functions are proven to be not equivalent. Finally, simulation results are shown to illustrate the performance of the present method.

Biography： Prof. Qinglai Wei, received the B.S. degree in Automation, and the

Ph.D. degree in control theory and control engineering, from the Northeastern University, Shenyang, China, in 2002 and 2009, respectively. From 2009-2011, he was a postdoctoral fellow with The State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, Beijing, China. He is currently a Professor of the institute and the associate director of The State Key Laboratory of Management and Control for Complex Systems. He has authored three books, and published over 70 international journal papers. His research interests include adaptive dynamic programming, neural-networks-based control, optimal control, nonlinear systems and their industrial applications.

Dr. Wei is an Associate Editor of IEEE Transaction on Systems Man, and Cybernetics: Systems since 2016, Information Sciences since 2016, Neurocomputing since 2016, Optimal Control Applications and Methods since 2016, Acta Automatica Sinica since 2015, and has been holding the same position for IEEE Transactions on Neural Networks and Learning Systems during 2014-2015. He

is the Secretary of IEEE Computational Intelligence Society (CIS) Beijing Chapter since 2015. He was Registration Chair of the 12th World Congress on Intelligent Control and Automation (WCICA2016). He was the Publication Chair of 5th International Conference on Information Science and Technology (ICIST 2015). He was the Finance Chair of the 4th International Conference on Intelligent Control and Information Processing (ICICIP 2013) and the Publicity Chair of the 2012 International Conference on Brain Inspired Cognitive Systems (BICS 2012). He was guest editors for several international journals. He was a recipient of Shuang-Chuang Talents in Jiangsu Province, China, in 2014. He was a recipient of the Outstanding Paper Award of Acta Automatica Sinica in 2011 and Zhang Siying Outstanding Paper Award of Chinese Control and Decision Conference (CCDC) in 2015. He was a recipient of Young Researcher Award of Asia Pacific Neural Network Society (APNNS) in 2016.

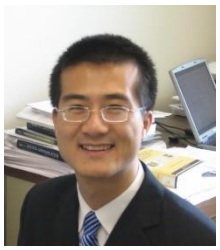
Lecture 2

Talk Title: Adaptive Transient Performance Enhancement Control and Its Applications in Microgrid

Speaker: Qinmin Yang

Abstract: A microgrid is a small power system consisting of distributed generation units, energy storage units, and loads, and has the characteristics include low inertia and large uncertainties. The traditional microgrid control strategies mainly consider steady-state performance, whereas transient performance is not quantitatively analyzed. Learning-based nonlinear control methods are also criticized by their uncertain performance during transient stage. To ensure the stable and efficiently operation of micro-grids, for example ship power systems (SPS), adaptive transient performance enhancement control is introduced in this talk. Various applications are also demonstrated.

Biography：Prof. Qinmin Yang received the Bachelor's degree in Electrical Engineering from Civil Aviation University of China, Tianjin, China in 2001, the Master of Science Degree in Control Science and Engineering from Institute of Automation, Chinese Academy of Sciences, Beijing, China in 2004, and the Ph.D. degree in Electrical Engineering from the University of Missouri-Rolla, MO USA, in 2007.



From 2007 to 2008, he was a Post-doctoral Research Associate at University of Missouri-Rolla. From 2008 to 2009, he was a system engineer with Caterpillar Inc. From 2009 to 2010, he was a Post-doctoral Research Associate at University of Connecticut. Since 2010, he has been with the State Key Laboratory

of Industrial Control Technology, the College of Control Science and Engineering, Zhejiang University, China, where he is currently a professor. He has also held visiting positions in University of Toronto and Lehigh University. He has been serving as an Associate Editor for IEEE Transactions on Systems, Man, and Cybernetics: Systems, Transactions of the Institute of Measurement and Control, and Automatica Sinica. His research interests include intelligent control, renewable energy systems, smart grid, and industrial big data.

Lecture 3

Talk Title: Fuzzy Adaptive Control for A Class of Nonlinear Interconnected Large-Scale Systems

Speaker: Yongming Li

Abstract: Practical control systems, such as aerospace systems, robot manipulators and chemistry reaction process, possess highly nonlinear, large-scale, uncertain, multivariable and strong coupling characteristics, making it extremely challenging to model accurately. As a result, the control theory and method based on precise mathematical model cannot solve the control problem for this kind of complex nonlinear system. Thanks to the fuzzy control approach that has been successfully used to handle uncertain nonlinear systems, which provides a possibility to deal with above-mentioned challenge. We propose an fuzzy adaptive control strategy for a class of interconnected nonlinear large scale systems. Specifically, the nonlinear systems considered consist of unmodeled uncertainties, unmeasured states, unknown interconnected terms, unknown control directions, and actuator faults. The developed control scheme guarantees that all closed loop signals are bounded and outputs of each subsystem converge to the neighborhood of origin whose size can be made as small as desired by appropriately selecting design parameters.

Biography： Prof. Yongming Li is a professor in the college of science, Liaoning University of Technology. He received the B.S. and the M.S. degrees in applied mathematics from Liaoning University of Technology, Jinzhou, China, in 2004and 2007, respectively. He received the Ph.D. degree in transportation information engineering and control from Dalian Maritime University, Dalian, China, in 2014. His research interests include adaptive control, fuzzy control, and neural networks control for nonlinear systems. He has published over 70 papers, and his recent awards include the Outstanding Paper Award of IEEE Transactions on Fuzzy Systems, the Best Paper Award of IEEE Transactions on Systems, Man and Cybernetics: Systems, a Second Prize of National Natural Science Award of Chinese Ministry of Education in 2015, and a Youth Science and Technology Award of Liaoning province in 2017.

Lecture 4

Talk Title: A Data-driven State Observation Method for Atomic Spin-exchange Relaxation-free Comagnetometer

Speaker: Zhuo Wang

Abstract: With the development of quantum mechanics, modern optics and atomic manipulation technique, the traditional electromechanical and optical sensing has gradually developed to quantum sensing based on intrinsic properties of atoms. Atomic spin-exchange relaxation-free (SERF) comagnetometer, which can sense inertial rotation using atomic spins, is one kind of quantum sensors with ultra-sensitivity. This talk is about the atomic dual-axis spin-exchange relaxation-free (SERF) comagnetometers. In our work, we first establish a state-space model of the atomic SERF comagnetometer system according to its linearized Bloch equations, by selecting the transverse polarizations of electron spin and nuclear spin as the state variables. However, the transverse nuclear spin polarizations cannot be directly measured, which means some of the system states cannot be directly observed. To solve this problem, a data-driven state observation (DDSO) method is developed to estimate the nuclear spin polarizations in real time. Simulation results based on practical system parameters illustrate the feasibility of the DDSO method. In the end, some comments are also given on the meaning and value of this DDSO method.

Biography： Prof. Zhuo Wang received the Ph.D. degree in electrical and computer engineering from University of Illinois at Chicago, Chicago, Illinois, USA, in 2013. He was a Postdoctoral Fellow with the Department of Electrical and Computer Engineering, University of Alberta, from 2013 to 2014. He worked as a Research Assistant Professor with the Fok Ying Tung Graduate School, Hong Kong University of Science and Technology, from 2014 to 2015. He was selected for the ``12th Recruitment Program for Young Professionals'' by the Organization Department of the CPC Central Committee, and the ``100 Talents Program'' by Beihang University, in 2015. He is currently a Professor and a Ph.D. Instructor with the Research Institute of Frontier Science, Beihang University, Beijing, China. Prof. Wang is currently a Vice Director of the 9th Chinese Association of Automation (CAA) Youth Work Committee; a Member of the Adaptive Dynamic Programming and Reinforcement Learning Technical Committee of IEEE Computational Intelligence Society; a Member of the Data Driven Control, Learning & Optimization Professional Committee of CAA; and is also a Member of the Fault Diagnosis & Safety for Technical Processes Professional Committee of CAA. He is an Associate Editor of IEEE Transactions on Systems, Man, and Cybernetics: Systems; an Associate Editor of Control Theory & Applications; and is also an Associate Editor of Pattern Recognition and Artificial Intelligence.

Lecture 5

Speaker: Tengfei Liu

Talk Title: Robust Event-Triggered Control of Nonlinear Systems: Three Examples

Abstract: This talk discusses the design of event triggered control schemes for nonlinear systems subject to both external disturbances and dynamic uncertainties. To avoid Zeno behavior, this paper proposes an event-triggering mechanism that uses not only the measured system state but also an estimation of the influence of the external disturbances and dynamic uncertainty. It is shown that the proposed event-triggering mechanism guarantees that the inter-sampling intervals are bounded blow by a positive constant, leading to the absence of Zeno phenomenon. Moreover, the closed-loop event-triggered system is input-to-state stable with the external disturbance as the input. Three examples are employed to show the basic idea.

Biography： Prof. Tengfei Liu received the B.E. degree in Automation and the

M.E. degree in Control Theory and Control Engineering from South China University of Technology, in 2005 and 2007, respectively. He received the Ph.D. degree in Engineering from the Australian National University in 2011. Tengfei Liu is a visiting assistant professor at Polytechnic Institute of New York University. His research interests include stability theory, robust nonlinear control, quantized control, distributed control and their applications in mechanical systems, power systems and transportation systems. Dr. Liu, with Z. Jiang and D. J. Hill, received the Guan Zhao-Zhi Best Paper Award at the 2011 Chinese Control Conference.

Invited Session 9 Complex Networks

Chair： Tao Jia, Southwest University, China
Duxin Chen, Southeast University, China

Lecture 1

Talk Title: The Upper Bound of Link Prediction by the AUC Measure

Speaker: Tao Jia

Abstract: Link prediction aims to predict missing links that are not directly visible but likely to exist. While this can be formulated as a binary classification problem solvable by machine learning algorithm, a class of “similarity based” methods are also widely considered. The similarity based approach considers the existing topology of the network and takes a certain topological feature to assign a similarity score between two nodes, which is proportional to the probability that they should be connected. The area under the receiver operating characteristic curve (AUC) is widely considered as the golden standard to quantify the quality of prediction, which can be interpreted as the chance that a true missing link has a higher score than the nonexistent one. Here we theoretically and empirically demonstrate that the performance of a family of link predictors, if measured by AUC, has an upper bound for a given network, which is determined by the topological feature selected for similarity calculation, and is rooted in the way that AUC is quantified. The upper bound predicts the performance of other predictors in the same family, allowing us to better choose features/predictors. It also gives rise to an issue of evaluation saturation, when the AUC gives a very tight upper and lower bound on the performance measure, which needs to be carefully treated. Given the popularity that the similarity based link prediction is applied in network science, our finding brings new insights on a series of important questions that were not emphasized previously.

Biography: Prof. Tao Jia obtained his Master in industrial and system engineering and Ph.D. in physics at Virginia Tech. He worked as the postdoctoral researcher at Northeastern University from 2011 to 2013 and at Rensselaer Polytechnic Institute from 2013 to 2015. In September 2015, he worked as the professor at Southwest University (China) and is now the Associate Dean of College of Computer and Information Science of Southwest University. Dr. Jia's research interest focuses on the computational and analytical understanding of complex systems, including complex networks, social systems, and biological systems. As the first author (and co-corresponding author), he has published on journals

such as Nature Human Behaviour, Nature Communications and Physical Review Letters. He is awarded the Chinese Government Award for Outstanding Self-Financed Students Abroad in 2011.

Lecture 2

Talk Title: Characterizing Cycle Structure in Complex Networks

Speaker: Linyuan Lv

Abstract: Compared with star structure, cycle structure is an important cause of the complexity of network structure, a necessary basis of feedback effect in network and an important condition of dynamic evolution. Today the star structure has been widely studied in network analysis, while the cycle structure has received rare attention. Here we propose the perspective on network research, namely the cycle structure, and show difference and relationship between star- and cycle structure in understanding network structure and dynamics. We define a new node characteristic, cycle ratio, which can be used to measure a node's importance of structure and dynamics. Numerical analyses suggest that the nodes with higher cycle ratio are more important to network connectivity and network pinning controllability. We hope that this paper can open a new direction of understanding both local and global structures of network and its dynamics.

Biography: Prof.Linyuan Lv, full professor of Institute of Fundamental and

Frontier Sciences at University of Electronic Science and Technology of China (UESTC), board member of *Network Science Society*. Main research interests include complex networks and information filtering, an interdisciplinary domain related to both statistical physics and information sciences. Published more than 70 research papers in peer-reviewed international journals and conferences, of which the majority are published in prestigious journals, like Physics Reports, PNAS, Nature Communications, etc. Nine papers are the ESI Top-1% highly cited papers. All publications get more than 3500 citations from the Web of Science, and more than 8000 citations from Google Scholar, H-index 32. Academic monograph link prediction won the first prize of excellent academic book award of the 4th China university press. Applied for twelve patents, five of which were licensed. In 2018, awarded *MIT Technology Review Innovator Under 35 China (MIT TR 35)*. The member of *China Society for Industrial and Applied Mathematics (CSIAM) Activity Group on Complex Network and System Control*, the member of *Chinese Information Processing Society of China Activity Group on Social Media Processing*, the board member of *Network Science and Engineering Committee*, associate editor of *International Journal of Modern Physics C*.

Lecture 3

Talk Title: Network Evolution of a Large Online MSM Dating Community: 2005 - 2018

Speaker: Xin Lv

Abstract: Due to multiple sexual partners and low condom use rate in MSM (men who have sex with men), the probability of HIV infection in MSM is much higher than that of the general population. In addition, MSM is likely to become the medium of HIV, prompting the virus to transmit to the general population. Therefore, it is of great significance to analyze the characteristics of online activities of MSM and to understand the evolution of their social networks, which is essential for establishing and improving the health management mechanism on the MSM population. In this study, we collect a comprehensive dataset, covering the period of January 2005 to June 2018, from the largest Chinese online community, Baidu Tieba. We build the online dating network for MSM-related people in the community of gay-bar, and analyze the network from both static and dynamic aspects. We find that the degree of the node shows a significant positive correlation with the sum of the weights of all edges it is connected to and that there is a geographic homophily in this online MSM dating network, indicating the same geographical location is an important factor on MSM's social relationship. We analyze the dynamic features of the MSM online dating network with time evolution, including the dynamics of the shortest-path length, clustering, assortativity, community, etc. It is found that most network measurements tend to be stable at the later stages of the evolution. In comparison with heterosexual networks, we find that the MSM dating network shows differences from many aspects.

Biography: Prof. Xin Lu is the professor at the National University of Defense

Technology (NUDT) in China. He is the co-founder and board member of the international non-government organization Flowminder Foundation (www.flowminder.org), which is focusing on the analysis of big data and providing them for free to organizations and relief agencies. Using large-scale mobile phone data, Dr. Lu and his colleges have collaborated closely with UN organizations and industry associations such as UNFPA, OCHA, UNU and GSMA etc., to analyze human mobility pattern and change of behaviors during disasters to enable improvement of disaster response and emergency management. Their work in the past years has stimulated a revolutionary movement in the research of mobile phone data and was published in Nature (Correspondence), Nature Microbiology, Physics Reports, PLOS Medicine, PNAS, Global Environmental Change, Journal of the Royal Statistical Society, Social Networks, etc. His research received a lot of

media attention and was reported in BBC, New York Times, NPR, etc. They were nominated for Global Mobile Awards 2012 and were listed *the 10 Breakthrough Technologies 2013* by MIT Technology Review. Flowminder has won the *Mobile in Emergency or Humanitarian Situations* Global Mobile Award (GLOMO 2016) at the Mobile World Congress 2016 for their groundbreaking advances made in the aftermath of the Nepal earthquake.

Lecture 4

Talk Title: Controllability and Predictability of Real Temporal Networks

Speaker: Gang Yan

Abstract: Links in most real networks often change over time. Such temporality of links encodes the ordering and causality of interactions between nodes and has profound effect on network dynamics and functions. Recent evidences recognize that link temporality of real networks is not completely random, yet it has been challenging to measure the regularity of temporal networks due to the entanglement of topological and temporal link patterns. Here we propose an entropy-rate based framework for quantifying the predictability of any temporal network. We validate our framework in various model networks, demonstrating that it indeed captures the intrinsic topological-temporal regularity while previous methods characterize only one aspect or only the regularity in link weight distributions. We apply the framework to a wide range of real networks and unveil the predictability profiles for different network categories. Interestingly, we find that a temporal network can be highly predictable even when both its topological and temporal regularities are very weak. Moreover, a recent discovery demonstrated that temporal networks are more controllable than their static counterparts in terms of control time, control energy and control path length. However, the underlying mechanism continues to elude us. Here we analytically and numerically investigate the controllability of temporal networks, finding that the (even tiny) change of link weights, not the order of snapshots, makes temporal networks more controllable. These findings deepen the understanding of temporality in complex systems.

Biography: Prof. Gang Yan is a full professor with School of Physics Science and Engineering at Tongji University, an adjunct professor with Shanghai Institute of Intelligence Science and Technology, and also with Center for Excellence in Brain Science and Intelligence Technology, Chinese Academy of Sciences. His research focuses on network science and its applications to brains, and has published 32 papers in international journals, including Nature, Nature Physics, Physical Review Letters, etc. He is a recipient of the Thousand Youth Talents Plan (2016), and an associate editor of IEEE Transactions on Network Science and Engineering.

Lecture 5

Talk Title: Data Science and Collective Intelligence

Speaker: Zhen Wang

Abstract: One of the most elusive scientific challenges for over 150 years has been to explain why cooperation survives despite being a seemingly inferior strategy from an evolutionary point of view. Over the years, various theoretical scenarios aimed at solving the evolutionary puzzle of cooperation have been proposed, eventually identifying several cooperation-promoting mechanisms: kin selection, direct reciprocity, indirect reciprocity, network reciprocity, and group selection. We report the results of repeated Prisoner's Dilemma experiments with anonymous and onymous pairwise interactions among individuals. We find that onymity significantly increases the frequency of cooperation and the median payoff per round relative to anonymity. Furthermore, we also show that the correlation between players' ranks and the usage of strategies (cooperation, defection, or punishment) underwent a fundamental shift, whereby more prosocial actions are rewarded with a better ranking under onymity. Our findings prove that reducing anonymity is a valid promoter of cooperation, leading to higher payoffs for cooperators and thus suppressing an incentive—anonymity—that would ultimately favor defection.

Biography: Prof. Zhen Wang is a Distinguished Professor at Northwestern Polytechnical University (NPU), China, selected for this position via the *National 1000 Young Talents Plan*. At NPU, he founded a Net-DataSci Lab, became its director, as well as an Associate Director of Research Center of Intelligence Control and Information Technology. Additionally, he is a honorary/guest/chair professor at several overseas universities, a long-term committee member of several national academy societies. Alongcomplex systems, network science, human behavior and cognition, Prof. Wang has published more than 100 papers and books, including Physics Reports, PNAS, Nature Communications, Science Advances, IEEE Transactions on Information Forensics and Security, IEEE Transactions on Automatic Control, IEEE Transactions on Knowledge and Data Engineering, and other IEEE Transactions journals. His total citation is over 10000, with H-index 47 and i-10-index 104. His researches were highlighted in Nature, Science, PNAS, etc., broadly reported by well-known academic media such as Science, Nature News, LiveScience, Science Daily, Phys. Org, EurekAlert, Yahoo! News, etc. Based on his research, Prof. Wang obtained Highly Cited Researcher (powered by Web of Science), MIT Technology Review (China) Innovators Under 35, CIPS Science and Technology Award, Natural Science Award of Ministry of Education, etc. He was/is a senior admin (e.g., chapter or symposium chairs)

of conferences for 70+ times, a committee member around 60 times. Besides, he was invited to give dedicated talks at 60+ international academic conferences (e.g., SIAM, ICIAM, etc.).

Invited Session 10 Network Collaboration and Applications

Chair ： Qingshan Liu, Southeast University, China

Shaofu Yang, Southeast University, China

Lecture 1

Talk Title: Learning and Attack via External Observation for Multi-Robot Systems

Speaker: Jianping He

Abstract: In this talk, we propose a statistical learning framework for multi-robot systems to infer the underlying interaction relations and control rules by observing trajectories of interacting robots. A correlation algorithm adopted in Vector Auto-Regression (VAR) is designed and a transfer matrix estimator involving regression mechanism is proposed to infer the underlying topology (static or dynamic) of the robot system. Then, we design a learning-based intelligent attack scheme against the obstacle avoidance of formation control. With this scheme, the attacker can i) learn the detection area and the goal position of an agent through trial and observation; ii) regress the obstacle-avoidance mechanism using support vector regress (SVR) method. Experiments are provided to verify the feasibility and effectiveness of the proposed algorithms.

Biography: Prof. Jianping He (M’15) is currently an associate professor in the

Department of Automation at Shanghai Jiao Tong University. He received the Ph.D. degree in control science and engineering from Zhejiang University, Hangzhou, China, in 2013, and had been a research fellow in the Department of Electrical and Computer Engineering at University of Victoria, Canada, from Dec. 2013 to Mar. 2017. His research interests mainly include the distributed learning, control and optimization, security and privacy in network systems. Dr. He serves as an Associate Editor for the IEEE Open Journal of Vehicular Technology and KSII Trans. Internet and Information Systems. He was also a Guest Editor of the IEEE TAC, International Journal of Robust and Nonlinear Control, etc. He was the winner of Outstanding Thesis Award, Chinese Association of Automation, 2015. He received the best paper award from IEEE WCSP’17, the best conference papers award from IEEE PESGM’17, and the finalist best student paper award from IEEE ICCA’17. He is the recipient of China National Recruitment Program of 1000 Talented Young Scholars.

Lecture 2

Talk Title: Communication and Computation Trade-off Distributed Optimization Algorithm and Its Applications

Speaker: Huaqing Li

Abstract: In distributed optimization, nodes cooperate to minimize a global objective function that is the sum (or average) of per-node local objective functions. Algorithms interleave local computations with communication among all the nodes. This talk will introduce the application backgrounds of distributed optimization, give an overview of the state-of-art distributed algorithms based on the structure of communication networks and the performance of convergence, and discuss how to implement distributed algorithms with fewer communications and computations while keep good convergence properties. Our recent work on an improved distributed primal-dual algorithm will be presented, where multiple primal updates are executed at each iteration. To avoid computational complexity, a local unbiased stochastic substitute of gradient is evaluated once per iteration and is used for all primal updates in that iteration at each node. This talk will focus on the trade-off between communication/computation and convergence performance of the proposed algorithm, and how the trade-off is involved in such implementations. Numerical tests on a classification problem using regularized logistic regression show the good performance and the advantage of the algorithm for solving large scale distributed statistical learning problems.

Biography: Prof. Huaqing Li is a currently a Professor at College of Electronic and Information Engineering, Southwest University, China. He received the Ph.D. degree in Computer Science and Technology from Chongqing University in 2013. He was a Postdoctoral Researcher at School of Electrical and Information Engineering, The University of Sydney from Sept. 2014 to Sept. 2015, and at School of Electrical and Electronic Engineering, Nanyang Technological University from Nov. 2015 to Nov. 2016. His main research interests include nonlinear dynamics and control, multi-agent systems, and distributed optimization. He was elected in Chongqing High-Level Personnel Special Support Program-Youth Top-notch Talent in 2018. He serves as a Regional Editor for Neural Computing & Applications and an Editorial Board Member for IEEE Access.

Lecture 3

Talk Title: Path-guided Distributed Formation Control of Under-Actuated Autonomous Surface Vehicles

Speaker: Zhouhua Peng

Abstract: Autonomous surface vehicles play an important role in studying, observing, protecting, and exploiting oceans. The collaboration capability is one of the key metrics to weight the intelligence of marine vehicles, and how to achieve a desired formation is central focus of current study among researchers. In this talk, some recent advances on coordinated control of marine vehicles are surveyed. Then, a distributed time-varying formation controller with capability of collision avoidance and connectivity maintenance for a swarm of under-actuated autonomous surface vehicles guided by a parameterized path will be introduced. Finally, simulation and experiment results are presented to substantiate the efficacy of the proposed coordination method.

Biography: Prof. Zhouhua Peng received the B.E. degree in electrical engineering and automation, the M.E. degree in power electronics and power drives, and the Ph.D. degree in control theory and control engineering from Dalian Maritime University, Dalian, China, in 2005, 2008 and 2011, respectively. He held the postdoctoral position in the School of Control Science and Engineering, Dalian University of Technology, China, and the Hong Kong Scholar position in the Department of Computer Science, City University of Hong Kong, Hong Kong. Currently, he is a Professor with the School of Marine Electrical Engineering, Dalian Maritime University, China.

Dr. Peng was a recipient of the Science and Technology Award from Liaoning Province(2013,2017),the Youth Science and Technology Award from China Institute of Navigation, the Award of Hong Kong Scholar, the Natural Science Academic Achievement Award from Liaoning Province, the Science and Technology Achievement Award from Department of Transportation, the Excellent Doctoral Dissertation Nomination Award from Liaoning Province, the Significant Academic Progress Award from Dalian Maritime University. He also won the honor of the BaiQianWan Talent in Liaoning Province, the Youth Science and Technology Talent in Ministry of Transport of China, the Science and Technology Star in Dalian, the Distinguished Young Teacher in Dalian, the Outstanding Youth in Dalian. Dr. Peng has authored/coauthored more than 160 papers in refereed journals and conferences. His research interests are guidance, control, and coordination of autonomous surface vehicles.

Lecture 4

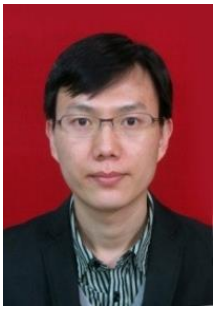
Talk Title: Positive Semidefiniteness of a Hadamard Product and Its Application in Array Signal Processing

Speaker: Zai Yang

Abstract: Two problems will be considered in this talk: 1) In array signal processing, how many antennas are sufficient to ensure the source resolvability? 2) In mathematics, under what conditions the Hadamard product of two positive semidefinite matrices is positive definite? We relate these two problems by

providing a new Hadamard product perspective for the source resolvability. We give sufficient conditions for the second problem showing that both positive semidefinite matrices can be singular to ensure the positive definiteness of their Hadamard product. We apply this result to the first problem and show that fewer antennas than previously thought are sufficient to resolve the sources.

Biography: Prof. Zai Yang is currently in the School of Mathematics and Statistics, Xi'an Jiaotong University, China. He received the B.Sc. degree in mathematics and M.Sc. degree in applied mathematics from Sun Yat-sen (Zhongshan) University, China, in 2007 and 2009 respectively, and the Ph.D degree in electrical and electronic engineering from Nanyang Technological University (NTU), Singapore, in 2014. He has published over 30 peer-reviewed papers on the IEEE T-IT, IEEE T-SP and other journals and conferences. He is an IEEE Senior Member and serving on the editorial board of Signal Processing (Elsevier). His research interests include compressed sensing and optimization theory and their applications in signal and information processing, big data analytics, and machine learning.



Invited Session 11 Distributed Control and Optimization with Applications

Chair ： Wenwu Yu, Southeast University, China

Junjie Fu, Southeast University, China

Lecture 1

Talk Title: Cooperative Output Regulation and its Application in Power Sharing Control of Microgrid

Speaker: Youfeng Su

Abstract: In this talk, we present a distributed observer control framework for the cooperative output regulation problem of leader-follower multi-agent systems. With the aid of certainty equivalence principle, it is shown that the cooperative output regulation problem can be solved by a distributed controller composed of a distributed observer of the leader system and a centralized controller of the follower systems. As an application, we further show that the power sharing control problem of a grid-connected AC microgrid can be reformulated and

hence solved as the cooperative output regulation problem of an interconnected leader-follower multi-agent system. It is interesting to see that the proposed design is able to handle microgrids where the system parameters of the dispatchable distributed generators are subject to arbitrarily large uncertainties.

Biography： Prof. Youfeng Su received the B.S. degree in 2005 and the M.S.

degree in 2008, both from East China Normal University, Shanghai, P. R. China, and the Ph.D. degree in 2012 from The Chinese University of Hong Kong, Hong Kong, P. R. China. From May 2012 to June 2013, he was a Postdoctoral Fellow at The Chinese University of Hong Kong. In July 2013, he joined the College of Mathematics and Computer Science, Fuzhou University, Fuzhou, P. R. China, where he has been a professor since July 2014. His research interests include output regulation, nonlinear control, cooperative control, multi-agent systems, and switched/hybrid systems. Dr. Su received the CUHK Young Scholars Thesis Award from the Chinese University of Hong Kong in 2013. He was selected to the national “1000-Youth Talent Program” of China and the “100 Talent Program” of Fujian Province both in 2015. He was a recipient of Outstanding Youth Science Fund Award of Fujian Province in 2016. He is a Subject Editor of International Journal of Robust and Nonlinear Control, Associated Editor of Journal of Systems Science and Mathematical Sciences, Member of the Conference Editorial Board of IEEE Control Systems Society

Lecture 2

Talk Title: Cyber-Physical Security in Remote State Estimation

Speaker: Yuzhe Li

Abstract: Cyber-Physical Systems (CPS) have attracted considerable interest from both academic and industrial communities in the past few years. Using wireless sensors for remote state estimation is a key component in CPS, and have advantages such as low cost, easy installation, and self-power. However, due to the inherent open characteristics of wireless communication, and the increasing penetration of CPS to safety-critical infrastructures of the society, cyber-physical security issues arise naturally and are of fundamental importance to ensure the safe operation of CPS. In this talk, our recent results about the cyber-physical security in remote state estimation will be introduced.

Biography: Prof. Yuzhe Li is currently a Professor in the State Key Laboratory

of Synthetical Automation for Process Industries, Northeastern University, Shenyang, China. He received the B.S. degree in Mechanics from Peking University, China in 2011 and the Ph.D. degree in Electronic and Computer Engineering from the Hong Kong University of Science and Technology (HKUST) in 2015. Between June 2013 and August 2013, he was a visiting scholar in the University of Newcastle, Australia. From September 2015 to September 2017, he was a Postdoctoral Fellow at the Department of Electrical and Computer Engineering, University of Alberta, Canada. His research interests include cyber-physical systems security, sensor power control and networked state estimation. He is a recipient of the National 1000-Talent Recruitment Program (Young Scholars).

Lecture 3

Talk Title: Perception and Decision-Making of Autonomous Systems Driven by Artificial Intelligence

Speaker: Yang Tang

Abstract: In recent years, artificial intelligence has been widely applied in the area of intelligent transportation, smart medical care, and smart manufacturing. This report considers the depth estimation, pose estimation, pedestrian recognition and optimization in the perception and decision-making of autonomous systems, and introduces the relevant developments and results in the above areas related to artificial intelligence.

Biography: Prof. Yang Tang received the B.S. and Ph.D. degrees in electrical

engineering from Donghua University, Shanghai, China, in 2006 and 2010, respectively. From 2008 to 2010, he was a Research Associate with The Hong Kong Polytechnic University, Hong Kong. From 2011 to 2015, he was a Post-Doctoral Researcher with the Humboldt University of Berlin, Berlin, Germany, and with the Potsdam Institute for Climate Impact Research, Potsdam, Germany. Since 2015, he has been a Professor with the East China University of Science and Technology, Shanghai. His current research interests include distributed estimation/control/optimization, cyber-physical systems, hybrid dynamical systems, and artificial intelligence and their applications. Prof. Tang was a recipient of the Alexander von Humboldt Fellowship and the ISI Highly Cited Researchers Award by Clarivate Analytics in 2017 and 2018. He is a Senior Board Member of Scientific reports, an Associate Editor of the Journal of the Franklin Institute, Neurocomputing, and a Leading Guest Editor of the Journal of the Franklin Institute and CHAOS.

Lecture 4

Talk Title: Vision-based Localization, Tracking and Coordinated Optimal Control of Unmanned Systems

Speaker: Ziyang Meng

Abstract: This talk starts from a brief introduction on the research background of coupled systems, and then delivers several recent research results. In particular, a visual-inertial odometer system is given with time-stamp synchronization, visual target tracking algorithm is proposed for a nano-scale drone, distributed coordinated optimal control method is studied for a group of dynamic systems, and set aggregation control are presented for multiple unmanned systems.

Biography: Prof. Ziyang Meng received his B.S. degree with honors from

Huazhong University of Science & Technology, Wuhan, China, in 2006, and Ph.D. degree from Tsinghua University, Beijing, China, in 2010. He was an exchange Ph.D. student at Utah State University, Logan, USA from Sept. 2008 to Sept. 2009. From 2010 to 2015, he held postdoc, researcher, and Humboldt research fellow positions at, respectively, Shanghai Jiao Tong University, Shanghai, China, KTH Royal Institute of Technology, Stockholm, Sweden, and Technical University of Munich, Munich, Germany. He joined Department of Precision Instrument, Tsinghua University, China as an associate professor since Sept. 2015. He was selected to the national “1000-Youth Talent Program” of China in 2015. His research interests include distributed control and optimization, spacecraft systems, and intelligent navigation technique. He serves as an associate editor of Systems & Control Letters.

Lecture 5

Talk Title: Multi-hop Sensor Network Scheduling for Remote Estimation

Speaker: Junfeng Wu

Abstract: In this talk, we consider a design problem of how a group of wireless sensors are selected and scheduled to transmit data efficiently over a multi-hop network subject to energy considerations, when the sensors are observing multiple independent discrete-time linear systems. Each time a set of sensors are selected to transmit their measurements towards a remote estimator. We formulate an optimization problem, minimizing a linear combination of the averaged estimation error and the averaged transmission energy consumption to obtain suitable network scheduling and estimation algorithms. Necessary conditions for network control optimality are derived so that the problem can be transformed into a Markov decision process problem. We show that under

some conditions there exists a periodic network schedule and how it can be computed numerically. Efficient algorithms to obtain suboptimal schedules are proposed to reduce the computational complexity of the original optimization problem.

Biography: Prof. Junfeng Wu received the B.Eng. degree from the Department of Automatic Control, Zhejiang University, Hangzhou, China, and the Ph.D. degree in electrical and computer engineering from Hong Kong University of Science and Technology, Hong Kong, in 2009, and 2013, respectively. From September to December 2013, he was a Research Associate in the Department of Electronic and Computer Engineering, Hong Kong University of Science and Technology. From January 2014 to June 2017, he was a Postdoctoral Researcher in the ACCESS (Autonomic Complex Communication Networks, Signals and Systems) Linnaeus Center, School of Electrical Engineering, KTH Royal Institute of Technology, Stockholm, Sweden. He is currently with the
College of Control Science and Engineering, Zhejiang University, Hangzhou, China. His research interests include networked control systems, state estimation, and wireless sensor networks, multiagent systems. Dr. Wu received the Guan Zhao-Zhi Best Paper Award at the 34th Chinese Control Conference in 2015.

Lecture 6

Talk Title: Optimal Operation of Power Distribution and Consumption System: Cyber-Physical-Social System Perspective

Speaker: Nian Liu

Abstract: Ubiquitous Internet of things (IoT) and Power Distribution and Consumption System (PDCS) are deeply integrated to form a Cyber-Physical-Social System (CPSS). In this presentation, the optimal operation of the IoT-based PDCS is presented from the perspective of CPSS. First, the participants of PDCS is analyzed, including their attributes of the cyber field, physical filed, and social field. The relationships and mutual interactions of these participants are also studied. Second, the operation features of IoT-based PDCS are Abstracted in the CPSS perspective. In physical filed, the features include the flexibility of nodes, network, and functions. In cyber filed, the uncertainty of ubiquitous sensing, edge computing, and cybersecurity are essential features. Moreover, new features in the social field include role variability and utility personalization of participants, and diversification of business models. Besides, based on the analysis of the existing studies, five prospective problems are proposed, including feature identification of complex power system, stochastic game the-

ory framework and application with incomplete information, modeling and solving optimization problem with fusion social attributes, scheduling strategy and driving mechanism for edge computing, interactive security mechanism for the IoT-based PDCS, etc. Through the analysis and discussion, we provide analysis and discussion on the multidisciplinary intersection of information, physics and social systems at the theoretical level, and technical support for the construction of ubiquitous power IoT and smart grid at the application level.

Biography: Prof. Nian Liu is a Professor with School of Electrical and Electronic Engineering at North China Electric Power University. He is a member of State Key Laboratory of Alternate Electrical Power System with Renewable Energy Sources and a member of Standardization Committee of Power Supply and Consumption in Power Industry of China. He was a Visiting Research Fellow at RMIT University, Melbourne, Australia. Dr. Liu has authored or co-authored more than 160 journal and conference publications and has been granted for more than 10 patents of China. He is an Editor of IEEE Transactions on Smart Grid, IEEE Transactions on Sustainable Energy, IEEE Power Engineering Letters, and Journal of Modern Power Systems and Clean Energy (MPCE). His major research interests include multi-energy system integration, microgrids, renewable energy integration and cyber-physical system.

Invited Session 12 Hybrid Dynamics and Networks with Applications

Chair ： Jianquan Lu, Southeast University, China

Lecture 1

Talk Title: Opinion Dynamics in Social Networks: Consensus Vs. Clusters

Speaker: Zhiqiang Zuo

Abstract: Most of the results on opinion dynamics entirely rely on interacting network to characterize the relationship among participating social actors, such as information flow, cooperative and antagonistic influence, etc. The interacting network is generally public for social groups. In this paper, we present a model on describing how individual's opinion evolves. Our model is consisted of two functional independence networks, the interacting and appraisal network. The

interacting network inherits the functions as the classical DeGroot model obeys. While the appraisal network describes how each individual's attitude, which may be antagonistic, towards the opinions of the participating individuals. We explicitly show that cooperative appraisal network always leads to consensus in opinions. On the other hand, the antagonistic appraisal network yields opinion clusters except for some special structures, under which opinions also trend to aggregation. They hence bridge the gap between consensus and clusters in opinion dynamics.

Biography: Prof. Zhiqiang Zuo received the Ph.D. degree in control theory in 2004 from Peking University, China. In 2004, he joined the School of Electrical and Information Engineering, Tianjin University, where he is a full professor. From 2008 to 2010, he was a Research Fellow in the Department of Mathematics, City University of Hong Kong. From 2013 to 2014, he was a visiting scholar at the University of California, Riverside. His research interests include nonlinear control, robust control and multi-agent systems. He was selected to be a member of New Century Excellent Talents in University, Ministry of Education in 2011. Dr. Zuo is an Associate Editor of Journal of Franklin Institute.

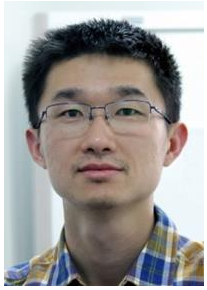
Lecture 2

Talk Title: Stability and Fault-Tolerant Control of Switched Systems and Its Applications

Speaker: Hao Yang

Abstract: The analysis and synthesis of nonlinear switched systems has been a research hotspot in the field of control in recent years, which is of great significance in theory and practice. This talk presents the latest research results on stabilization with unstable mode nonlinear switched systems, and discusses stabilization with partially unstable modes and all unstable modes separately. Moreover, some application directions of theoretical results and achievements on fault-tolerant control of switched systems are further elaborated.

Biography: Prof. Hao Yang was born in Nanjing, China, in 1982. He received the Ph.D. degrees in automatic control from Université de Lille 1 Sciences et Technologies, Villeneuve-d' Ascq, France, and the Nanjing University of Aeronautics and Astronautics (NUAA), Nanjing, China, in 2009. In 2009, he joined the College of Automation Engineering, NUAA, where he is currently a Full Professor. He has published 2 books and over 60 international journal papers. His current research interests include stability



analysis and fault-tolerant control of switched and interconnected systems with their applications. Dr. Yang was a recipient of the National Science Fund for Excellent Young Scholars in 2016 and the Top-Notch Young Talents of Central Organization Department of China in 2017. He has served as an Associate Editor for Nonlinear Analysis: Hybrid Systems, Cyber-Physical Systems, and Acta Automatica Sinica.

Lecture 3

Talk Title: Finite-time Control of Impulsive Systems

Speaker: Xiaodi Li

Abstract: The talk focuses on the finite-time control of impulsive systems. Firstly, in view of two kinds of finite-time controls in different senses of time domain, both related concepts and brief introduction of development are given. Besides, the research significance of these two kinds of finite-time control is introduced in a problem-driven way. Secondly, this talk highlights relevant research achievements, especially in the issue of settling-time of finite-time stability in recent years.

Biography: Prof. Xiaodi Li received the B.S. and M.S. degrees from Shandong

Normal University, Jinan, China, in 2005 and 2008, respectively, and the Ph.D. degree from Xiamen University, Xiamen, China, in 2011, all in applied mathematics. He is currently a Professor with the School of Mathematics and Statistics, Shandong Normal University. From Nov. 2014 to Dec. 2017, he was a Visiting Research Fellow at Laboratory for Industrial and Applied Mathematics in York University, Canada, and the University of Texas at Dallas, USA. In 2017, he was working as Visiting Research Fellow at the Department of Mathematics, City University of Hong Kong, Hong Kong. He has authored or coauthored more than 70 research papers. His current research interests include stability theory, delay systems, impulsive control theory, artificial neural networks, and applied mathematics.

Lecture 4

Talk Title: Multi-source Information Fusion and Applications Based on Complex Network and Deep Learning

Speaker: Zhongke Gao

Abstract: Revealing complicated behaviors from time series constitutes a fundamental problem of continuing interest and it has attracted a great deal of attention from a wide variety of fields on account of its significant importance. The past decade has witnessed a rapid development of complex network studies,

which allow to characterize many types of systems in nature and technology that contain a large number of components interacting with each other in a complicated manner. Recently, the complex network and deep learning have been incorporated into the analysis of time series and fruitful achievements have been obtained. Complex network and deep learning analysis of time series open up new venues to address interdisciplinary challenges in climate dynamics, multiphase flow, brain functions, economics and traffic systems. Some novel methodologies and their applications in this research area will be introduced.

Biography: Prof. Zhongke Gao is now a Full Professor of the School of Electrical and Information Engineering, Tianjin University. He has published 90 SCI-indexed peer-reviewed journal articles in the IEEE Transactions on Neural Networks and Learning Systems, IEEE Transactions on Industrial Informatics, IEEE Transactions on Instrumentation and Measurement, IEEE Transactions on Systems, Man, and Cybernetics: Systems, IEEE Sensors Journal, Knowledge-Based Systems, Chemical Engineering Journal, Experimental Thermal and Fluid Science, etc. 12 first-author papers are selected as the ESI Highly Cited Papers. His Google Scholar Citations is over 2000. He has published one book (academic monograph) in Springer in 2014. He owns 32 Chinese invention patents. Zhongke Gao is the director of Laboratory of Complex Networks and Intelligent Systems at Tianjin University. Zhongke Gao serves as Editorial Board Member for four SCI-indexed international journals. His current research interests include Complex network, Deep learning, Big data analysis, Time series analysis, Brain network and brain cognition, Brain-computer interface, Sensor devices and sensor arrays, Measurement science and technology, Multiphase flow, Multiscale analysis, Nonlinear dynamics, etc.

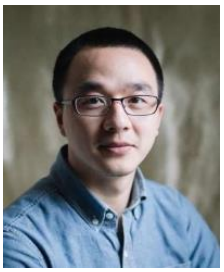
Lecture 5

Talk Title: On the Observability of Logical Networks

Speaker: Yang Liu

Abstract: This talk is about the observability problem on Boolean networks (BNs) using semi-tensor product (STP) of matrices. A necessary and sufficient condition is obtained to determine the observability of BNs. In addition, a necessary and a sufficient condition is obtained to determine the minimal number of nodes, which need to be directly measurable.

Biography: Prof. Yang Liu received the B.S. degree in Mathematics from



Zhejiang Normal University, Jinhua, China, in 2003, and the Ph.D. degree from Tongji University, Shanghai, China, in 2008. He is currently a Professor with the Department of Mathematics, Zhejiang Normal University. His current research interests include hybrid systems and logical networks. Dr. Liu was a recipient of the Shanghai Outstanding Ph.D. Thesis Award in 2012. He is currently an Associate Editor of the Neural Processing Letters (Springer).

Lecture 6

Talk Title: Function Perturbation Impact on Stabilization of Logical Control Networks

Speaker: Haitao Li

Abstract: Gene mutation often occurs in practical genetic regulatory networks (GRNs), which may lead to genetic diseases. Therefore, it is meaningful to investigate the effect of gene mutation on the steady state and intervention of GRNs. This talk presents some new results on the robust stability and stabilization of logical control networks with (stochastic) function perturbations. In addition, some future directions are also discussed.

Biography: Prof. Haitao Li, received the Ph.D. degree at Shandong University

in 2014. Since 2015, he has been with the School of Mathematics and Statistics, Shandong Normal University, where he is currently a professor. From Jan. 2014 to Jan. 2015, he worked as a Research Fellow in Nanyang Technological University. His research interests include logical dynamic systems, networked evolutionary games, nonlinear control, etc. He won the Young Experts of Taishan Scholar Project in 2019, the Second Class Prize of The Natural Science Award of Shandong Province in 2018, the Distinguished Young Scholars of Shandong Province in 2016, the ``Guan Zhaozhi Award'' in 2012, and the ``Best Student Paper Award'' at the 10th World Congress on Intelligent Control and Automation.

Invited Session 13 Artificial Neural Networks Theories and Applications

Chair： Jinling Liang, Southeast University, China

Lecture 1

Talk Title: Toward to AutoML with Pseudoinverse Learning Algorithm

Speaker: Ping Guo

Abstract: On consideration of neural network Structure and learning algorithms together, we propose a non-gradient descent learning scheme for deep feedforward neural networks (DNN). As we known, autoencoder can be used as the building blocks of the multi-layer perceptron (MLP) deep neural network. So, the MLP will be taken as an example to illustrate the proposed scheme of pseudoinverse learning algorithm for autoencoder (PILAE) training. It is worth to note that only few network structure hyperparameters need to be tuned. Hence, the proposed algorithm can be regarded as a quasi-automatic training algorithm which can be utilized in automated machine learning research field.

Biography: Prof. Ping Guo, IEEE senior member, CCF senior member,

School of systems science, Beijing Normal University; and Ph. D. supervisor in computer software and theory of Beijing Institute of Technology. Chair of the Key Laboratory of graphics, image and pattern recognition, Beijing Normal University, Chair of IEEE CIS Beijing Chapter (2015-2016). His research interests include computational intelligence theory and its applications in pattern recognition, image processing, software reliability engineering, and astronomical data processing. He has published more than 360 papers, hold 6 patents, and the author of two books: "*Computational Intelligence in Software Reliability Engineering*", and "*Image Semantic Analysis*" received 2012 Beijing municipal government award of science and technology (third rank) entitled R*egularization Method and its Application*. Professor Guo received his master's degree in optics from the Department of physics, Peking University, and received his Ph.D degree from the Department of computer science and engineering, Chinese University Hong Kong. His personal home page: *http://sss.bnu.edu.cn/~pguo.*

Lecture 2

Talk Title: Motif Prediction and Analyses in DNA Sequences by Deep Neural Networks

Speaker: Deshuang Huang

Abstract: Recent biological studies have shown that binding-site motif mining plays a crucial role in the transcription phase of gene expression, so the study of motif will help to understand the complex biomolecular system and explain disease pathogenesis. Generally, how to carry out an in-depth research on motifs through computational methods has always been one of the core issues in the modeling of life system gene regulation processes. In this talk, I will first present the fundamental issue for motif prediction of DNA sequences, then systematically present motif prediction of DNA sequences in combination with the popular emerging technology “Deep Neural Networks”. Firstly, several classical models for deep neural network and the research status of DNA sequence motif prediction will be briefly introduced. Secondly, the existing shortcomings of deep-learning based motif prediction is discussed, and correspondingly a variety of improved motif prediction methods including high-order convolutional neural network architecture, weakly-supervised convolutional neural network architecture, deep-learning based sequence + shape framework and bidirectional recurrent neural network for DNA motif prediction. Finally, some new research problems in this aspect will be pointed out and over-reviewed.

Biography: Prof. De-Shuang Huang is Chaired Professor in Department of Computer Science and Director of Institute of Machine Learning and Systems Biology at Tongji University, China. He is currently the Fellow of the International Association of Pattern Recognition (IAPR Fellow), the Board Member of the International Neural Network Society (INNS) Governors. His main research interest includes neural networks, pattern recognition and bioinformatics.

Lecture 3

Talk Title: Stability Analysis of Neural Dynamical Networks with Time-Delays

Speaker: Zhanshan Wang

Abstract: Neural dynamical networks are a kind of optimal model, which can be used to solve a class of optimization problems. In general, the stable equilibrium point of optimal model corresponds to the optimal solution of the concerned problem. Therefore, how to establish some sufficient conditions for the existence and stability of equilibrium point of the neural dynamical networks is

a fundamental problem. Neural networks with time delay can bring some new insights for the applications of optimal problems. Therefore, how to establish the stability conditions and reduce the conservativeness of the existing result has become a research branch of academic community. In this report, how to use the information on time delay both in the construction of Lyapunov-Krasovskii functional (LKF) and calculation of the derivative of LKF will be introduced. Especially, the delay decomposition method, flexible terminal method and multiple-integral based LKF method will be mainly introduced for the neural networks with time delays. Then the relationship between stability and synchronization/consensus will be discussed for the collective dynamics of interconnected neural dynamics, in which one can find the evolutionary process of static analysis of a dynamical system.

Biography: Prof. Zhanshan Wang is a currently in the College of Information

Science and Engineering, Northeastern University, Shenyang, China. He received the Ph.D. degree in control theory and control engineering from the Northeastern University, Shenyang, China, in 2006. Since 2010, he has been a Professor with Northeastern University. He has authored and coauthored more than 150 journal and conference papers and 6 monographs. He is the holder of ten Chinese patents. His research interests include stability theory, neural networks theory, learning control, fault diagnosis, fault tolerant control, nonlinear control theory, and their applications in smart grid. He received the Excellent Doctoral Dissertation Tutor Award of Chinese Association of Automation in 2018, the Nomination of 100 Excellent Doctoral Dissertation in China in 2009, the Excellent Doctoral Dissertations in Liaoning Province in 2008. He was elected to Ministry of Education's Supporting Plan for Excellent Talents in the New Century in 2010 and the Excellent Postdoctoral Students in Liaoning Province in 2010. He was an Associate Editor for IEEE Transaction on Neural Networks and Learning Systems. He is currently a member of the editorial board of Acta Automatica Sinica.

Lecture 4

Talk Title: Group Sparse Neural Networks: Structure Optimization and Fault Tolerant Learning

Speaker: Jian Wang

Abstract: Large-scale high dimension problems have been sharply increased especially in computational intelligence research area. Deep neural network learning models have been widely employed to tackle these tasks such as image processing, commercial prediction, industrial data explanation. More generated high-performance supercomputers can deal with these big data prob-

lems to some extent. And the application and theoretical analysis of fault tolerant learning are very important for neural networks. However, it still strongly depends on effective network structure and efficient learning system. Group Lasso regularization plays an essential role in reaching a parsimonious network and feature selection simultaneously. By selecting suitable penalization coefficient, its group sparse characteristic has been demonstrated with competitive performance. To solve the non-differentiable property of Group Lasso penalty, a specific smoothing technique has been adopted during training which also serves for the comprehensive convergent analysis of the proposed algorithms.

Biography: Prof. Jian Wang is from China University of Petroleum (East China), Qingdao, China. He received the Ph.D. degree in computational mathematics from the Dalian University of Technology, Dalian, China, in 2012. From September 2010 to September 2011, he was a Visiting Scholar at the Department of Electrical and Computer Engineering, University of Louisville, United States. He is Associate Editors of the *Journal of Applied Computer Science Methods* and the *IEEE Transactions on Neural Networks and Learning Systems*. He served as the Publication Chair of the 24th International Conference on Neural Information Processing and the Program Committee Chair of the 2016 and 2018 International Symposium on New Trends in Computational Intelligence. He is currently the Director for Cross-Media Big Data Joint Laboratory with China University of Petroleum (East China), Qingdao, China. His current research interests include machine learning, regularization theory and neural networks.

Lecture 5

Talk Title: Compressing Neural Networks with Tensor Networks

Speaker: Zenglin Xu

Abstract: Tensor is an important data structure to represent multiway data, e.g., recommendation systems, face recognition, sensor networks, etc. Tensor networks can be seen as Building blocks of tensors form tensor networks, while building blocks of tensor networks form quantum states. This talk will discuss the connections between tensor networks and deep neural networks. Finally, we will present our recent work of compressing neural networks with tensor network structures, such as block-term Tucker decomposition, and tensor ring decomposition.

Biography: Prof. Zenglin Xu is a currently 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 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 80 papers in prestigious journals and conferences such as NeurIPS, ICML, IJCAI, AAAI, IEEE PAMI, IEEE TNNLS, 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 NeurIPS, ICML, AAAI, IJCAI, etc. He regularly servers as a reviewer to IEEE TPAMI, JMLR, PR, IEEE TNNL, etc. He also serves as associate editors of a number of journals, such as Neural Networks, Neurocomputing, and so on.

Lecture 6

Talk Title: A Novel Deep-Belief-Network-Based Particle Filter (DBN-PF) for Quantitative Analysis of Gold Immunochromatographic Strips

Speaker: Nianyin Zeng

Abstract: In this talk, a novel statistical pattern recognition method is proposed for accurately segmenting test and control lines from the gold immunochromatographic strip (GICS) images for the benefits of quantitative analysis. A new dynamic state-space model is established, based on which the segmentation task of test and control lines is transformed into a state estimation problem. Especially, the transition equation is utilized to describe the relationship between contour points on the upper and the lower boundaries of test and control lines, and a new observation equation is developed by combining the contrast of between-class variance and the uniformity measure. Then, an innovative particle filter (PF) with a hybrid proposal distribution, namely, deep-belief-network-based particle filter (DBN-PF) is put forward, where the deep belief network (DBN) provides an initial recognition result in the hybrid proposal distribution, and the particle swarm optimization algorithm moves particles to regions of high likelihood. The performance of proposed DBN-PF method is comprehensively evaluated on not only an artificial dataset but also the GICS images in terms of several indices as compared to the PF and DBN methods. It is demonstrated via experiment results that the proposed approach is effective in quantitative analysis of GICS.

Biography: Prof. Nianyin Zeng is currently in the Department of Instrumental & Electrical Engineering of Xiamen University. From September 2017 to August 2018, he was an ISEF Fellow founded by the Korea Foundation for Advance Studies and also a Visiting Professor at the Korea Advanced Institute of Science and Technology (KAIST). His current research interests include intelligent data analysis, artificial/computational intelligence, time-series modeling and applications. He published over 50 SCI-indexed papers including 8 ESI Highly Cited Papers according to the most recent Clarivate Analytics ESI report, and also won the second prize of the Provincial Natural Science Award.

Dr. Zeng is currently serving as an Associate Editor for Neurocomputing, Editorial Board members for Computers in Biology and Medicine, Biomedical Engineering Online, and also a Guest Editor for Frontiers in Neuroscience. He was awarded the Key Talent in Xiamen City.

Presentation Session

Session 1

Lecture 1

Talk Title: Coexisting Strange Nonchaotic Attractors in a Multistable System

Speaker: Yunzhu Shen

Abstract: It is one of the important scientific problems to exploring strange nonchaotic dynamics in the field of nonlinear dynamics. It is closely related to the complex behavior and novel phenomena of nonlinear dynamics, and has a wide range of applications in the field of secure communication. Strange nonchaotic attractors (SNAs) have fractal geometric structure, but they show no sensitive dependence on initial conditions. In this paper, we investigate coexisting strange nonchaotic attractors (SNAs) in a quasiperiodically forced multistable system. We also describe symmetric basins of attraction for coexisting attractors. We find different types of routes to coexisting SNAs via coexisting tori by changing control parameters, such as Heagy-Hammel routes, intermittent routes and fractalization route. We characterize SNAs by the largest Lyapunov exponents, phase sensitivity exponents and power spectrum.

Lecture 2

Talk Title: Infinite Number of Fractal Nonchaotic Attractors with Intermittency in a Piecewise Map

Speaker: Yongxiang Zhang

Abstract: We identify a countable infinity of parameter regimes with strange nonchaotic attractors (SNAs). At the edge of each arc parameter area, there is an uncountable infinity of SNAs with torus intermittency. The mechanism for the creation of SNAs in different regime is induced by a n-frequency quasiperiodic orbit through a quasiperiodic analog of saddle-node bifurcation (Type-I intermittent route). We describe the transition between the torus and SNAs by the largest Lyapunov exponent and phase diagram. These SNAs are characterized by

the phase sensitivity exponents, rational approximations, Fourier transform and distribution of finite-time Lyapunov exponents.

Lecture 3

Talk Title: Mechanism analysis of Hamiltonian Conservative Chaotic Systems Based on 4D Euler Equations

Speaker: Guanghan Liu

Abstract: Due to its complex dynamic characteristics, the Conservative Chaotic System (CCS) has more advantages than the Dissipative Chaos System (DCS) in the application field of secure communication based on chaos. In this study, we construct two Hamiltonian conservative chaotic systems (HCCS), which based on the 4D Euler equations and a proposed constructing method, respectively. Then we studied the dynamical properties of these two new systems using dynamical evolution diagram, Lyapunov exponents, Hamilton energy and Casimir energy. The two systems look similar, but we find that one can be explained by Casimir power, while the other cannot. In addition, a pseudo-random signal generator was developed based on the proposed HCCS, which was tested based on the NIST test and implemented using field programmable gate array technology.

Lecture 4

Talk Title: Multistability and Hidden Chaos in the Brushless DC Motor System

Speaker: Philippe Faradja

Abstract: The brushless DC motor (BLDCM), a type of permanent magnet synchronous motor (PMSM) is investigated. The BLDCM transition to chaos is briefly investigated firstly on the local level through local bifurcations such pitchfork and Hopf bifurcation.
Then on the nonlocal level through manifold, invariant sets and stability basin. In particular homoclinic bifurcation is determined through the method of homotopy.
All the transition parameter values are given. Apart of transition, multistability of the BLDCM is observed and assessed with stability basin that shows the evolution of multistability along the bifurcation parameters.
For some parameter values all dynamic modes (stable fixed point, limit cycle,

chaotic attractor) coexist. For other parameter values multistability concerns different stable equilibria.
Also, hidden chaos which is of non-Shilnikov type is examined and reported in BLDCM with the method of homotopy and with the definition from basin of attraction. Different basins of attraction containing all the equilibria are presented and illustrated.
It is shown that under some fixed parameters the range of hidden chaos is narrow and bifurcation diagram cannot determine its critical limit values. Transient features of hidden chaos are also highlighted.

Session 2

Lecture 1

Talk Title: Chaotic Ground Penetrating Radar based on Compression Sensing for Underground Cavity Detection

Speaker: Zhe Shi

Abstract: Urban underground cavity has drawn extensive attention of the government and the society since it can ultimately lead to sudden rod subsidence, and may cause casualties. Ground Penetrating Radar (GPR) is a nondestructive geophysical electromagnetic method and has been widely used in underground cavity detection. But the received signal is usually weak due to the complex environment and heavy clutter condition in civil engineering application. Chaotic GPR has been demonstrated to have the characteristics of strong anti-interference ability, good electromagnetic compatibility, and high range resolution. However, the traditional GPR sampling method needs to conform to the Nyquist sampling theory, which means a large amount of data needs to be collected, transmitted, and processed, causing higher hardware costs and computational burden.
In this paper, a chaotic ground penetrating radar based on Compressed Sensing (CS) is proposed to detect underground cavities. This system uses Chaotic Pulse Position Modulation (CPPM) as the signal source, which not only has all the advantages of chaotic ground penetrating radar, but also uses compressed sensing method to break through the Nyquist sampling theory. The basic idea of CS theory is that when the signal is very sparse or highly compressible in some basis (i.e., most basis coefficients are small or zero-valued), use far fewer measurements suffice to exactly reconstruct the signal than needed by Nyquist sampling theory. In GPR data, the target is sparse, so we can use CS method to reduce the data in signal acquisition and processing, which is practically important for civil engineering.

Simulation and experimental results show that our proposed CS-based chaotic GPR can detect underground cavity effectively with very few data, just about 10% of the original data. In addition, the chaotic signal is not only used as a radar transmitted signal, bust also used to construct a measurement matrix of CS, which is demonstrated that it has similar performance to traditional random Gaussian matrix, but has low hardware complexity in design.

Lecture 2

Talk Title: Locating Underground Pipe Using Chaotic Pulse Position Modulation Signal

Speaker: Xinpeng Chen

Abstract: Ground penetrating radar (GPR) based on chaotic signals has attracted much attention due to its high range resolution, strong anti-interference ability, low interception probability and good electromagnetic compatibility. In addition, the ground penetrating radar based on chaotic signals can overcome the contradiction between detection distance and resolution. Here, we applied chaotic GPR to underground pipe location. Chaotic Pulse Position Modulation (CPPM) with a bandwidth of 1.56 GHz is utilized as the probe signal. The localization of the pipes is achieved by correlating the chaotic echo signal with its delayed duplicate and back-projection algorithm. The simulation and experimental results show that metal pipe and non-metal pipe can be located with range resolution of 10 cm. Furthermore, we compare our chaotic radar with the stepped frequency modulated signal radar or impulse radar in detecting non-metal pipe. The results demonstrate that the proposed chaotic radar possesses better performance in pipe location.

Lecture 3

Talk Title: Invariant Density and Power Spectrum Selection via the Inverse Frobenius-Perron Problem Solution using Monotization

Speaker: Michaël A. Van Wyk

Abstract: The general inverse Frobenius-Perron (IFP) problem of constructing an ergodic map with a prescribed invariant density and power spectrum finds

application for modeling of natural and artificial systems and processes encountered in fields as diverse as physics, biology, economics and engineering. Proposed solutions to this problem provide freedom in specifying either the invariant density function or the power spectrum, but not both simultaneously. With modern simulation environments striving to enable greater realism when modeling systems and processes, the need grows for IFP solutions that exhibit greater flexibility for choosing both these statistics.
In this paper, we investigate how the structure of piecewise defined maps relate to their versatility to accommodate different choices for the invariant density and power spectrum. Whereas piecewise linearity and a Markov structure limits the class of achievable invariant density functions to piecewise constant functions, we demonstrate that complete maps—i.e. piecewise defined maps for which each branch is surjective—constrains the achievable power spectra. Using this result, we propose a new class of piecewise incomplete maps that is more flexible for the purpose of modeling and simulation.
The inverse Frobenius-Perron problem is solved for the newly proposed map class using an earlier result regarding the monotonization of random variable transformations. It is shown that this solution facilitates the independent specification of the invariant density as well as the power spectrum characteristics (spectral bandwidth and center frequency of each spectral mode). The proposed technique is demonstrated by constructing maps with beta invariant density functions and bimodal power spectrums. We conclude that the proposed technique offers greater flexibility than existing techniques for the purpose of simulation and modelling of natural and artificial systems and processes.

Lecture 4

Talk Title: Research on a Novel High Dimension Dissipative Hyper-Chaotic System and Application

Speaker: Xiaodong Jiao

Abstract: Chaotic system has greatly potential engineering application value as its extremely complex characteristic. In this paper, a 5D dissipative hyper-chaotic system is proposed. At first, the abundant dynamics are uncovered, and the numerical analysis shows that the system displays the coexistence of quasi-periodic, chaos and hyper-chaotic behaviors. This system describes a general form of fluid and forced-dissipative dynamic system. The vector field of the hyper-chaotic system is decomposed into inertial, internal, dissipation and external torques, correspondingly, the energies are analyzed in detail. And then, by constructing the Lyapunov-like function, the bound of the 5D hyper-chaotic system is found. Finally, the system passes the NIST tests, and FPGA technique

is used to realize the hyper-chaotic system.

Session 3

Lecture 1

Talk Title: PDE, Fractal Theory and Urban Growth Models

Speaker: Li Zhang

Abstract: Urban growth is not in static equilibrium but in dynamic and nonlinear variation. Moreover, the complexity spatial expansion of urban growth has close relationship with many urban problems, such as the declining of countryside, traffic congestion, the environmental pollution and the standard reduction of the inhabitant quality of life and health, etc.
So, there are many outstanding urban pattern models related with the land area growth such as Cellular Automata (CA) or modified CA models combined with GIS technology. Another aspect of urban pattern model is population density process like the Clark model, Smeed model, Sherratt-Tanner model, Diffusion Limited Aggregated (DLA) and Dielectric Breakdown (DB) model.
However, there still exist many questions to be answered such as: can we find out an appropriate PDE model like the diffusion reaction model to combine the current urban models by introducing different cost functions mentioned above? is there any inner relationships between the model and the fractal dimension? can the model explain the empirical results such as the annual growth rate and the density gradient or the convergence rate effectively? how to introduce the policy target as a control aim into the PDE models based on the empirical data? In order to solve the above questions, we would present some future works based on the current PDE models, urban growth theory, fractal theory and empirical results.

Lecture 2

Talk Title: Symmetry Analysis of Julia Sets Based on Group Theory

Speaker: Yuanyuan Sun

Abstract: Julia set was obtained by Gaston Julia, a French mathematician, on

the basis of theory of iteration for complex functions. It is one of the research focus of fractal geometry. Julia set has typical self-similarity and symmetry. However, it is difficult to be described by classical mathematical methods due to the complicated structures. This study investigates Julia set from the view of group theory on consideration of its symmetry. The following theorems are proved according to group theory. Let $J_m : f(z) = z^m + c(m \in \mathbf{Z}, c \in \mathbf{C})$ and the planar motion of J_m be defined as $M(J_m)$, then $M(J_m)$ is m-order group of motions or symmetric group. Particularly, the periodic points of filled Julia set with quadratic mapping $f(z) = z^2 + c(c \in \mathbf{C})$ constitute n-order $(n \in N)$ cyclic groups. When n is a prime number, there is only one circular distribution structure for the periodic points of filled Julia set.

Lecture 3

Talk Title: A Hybrid Chaotic Radar System for Intrusion Detection

Speaker: Ruixin Xie

Abstract: Intrusion detection technologies have been widely used to ensure the safety of important places. Traditional intrusion detection methods commonly use a single detection device to achieve regional protection, such as video motion detector, infrared sensor, leaky coaxial cable (LCX) sensor, optical fiber sensor, electronic fence, ground surveillance radar, etc. However, these devices have their own defects such as poor concealment, vulnerability to weather change, topographic environment and external electromagnetic interferences, etc. In this paper, we propose and experimentally demonstrate a hybrid chaotic radar system for intrusion detection. This radar system includes a chaotic guided radar based on LCXs and a single-transmitting-dual-receiving chaotic radar. The former is used for early warning of intruders crossing the protected area perimeter, and then the latter is applied to further track and locate intruders within the protected area. The chaotic guided radar uses the wideband chaotic signal as the probe signal, and a pair of LCXs is applied for transmitting the probe signal and receiving the echo signal, respectively. The intruder crossing the protected area perimeter can be detected using the chaotic correlation method and comparing the correlation traces before and after intrusion. The single-transmitting-dual-receiving chaotic radar transmits the uncorrelated chaotic signal as the detection signal and receives the echo signals using two receivers. The intruder within the protected area can be further located and tracked utilizing the chaotic correlation method and two-dimensional ellipse location method. Experimental results demonstrate the proposed hybrid

chaotic radar system can detect the intruders crossing the protected area perimeter and give an early warning, and then locate and track the intruders within the protected area. The location accuracy and range resolution can reach 10 cm and 30 cm, respectively. Additionally, this radar system possesses the excellent anti-interference performance for radio frequency interferences and noise, which makes it perform superbly in the detection environment with strong noise and multiple radars cooperation. It is reasonably believed that our hybrid chaotic radar system can be a promising candidate for area security monitoring.

Lecture 4

Talk Title: Non-ideal Memristor Synapse-Coupled Bi-Neuron Hopfield Neural Network: Numerical Simulations and Breadboard Experiments

Speaker: Chengjie Chen

Abstract: This paper presents a third-order non-ideal memristor synapse-coupled bi-neuron Hopfield neural network (HNN), in which a non-ideal memristor synapse is employed to generate an electromagnetic induction current caused by the potential difference between two neurons. The memristive HNN model possesses an odd number of equilibrium points including one (or three, dependent on the memristor coupling strength) unstable saddle point, two unstable index-2 saddle-foci, and two (or four) stable node-foci. Bifurcation plots, local attraction basins, and phase plane plots show that the memristive HNN model behaves bi-stability of coexisting chaotic and stable point attractors, which is perfectly validated by breadboard experiments based on discrete components.

Session 4

Lecture 1

Talk Title: Dynamics Analysis of Laser Complex Chaotic System and Its Self-synchronization

Speaker: Jian Liu

Abstract: In order to reveal the essence of laser detuning, we focus on the characteristics and self-synchronization of a 3D laser detuning dynamical system with both complex variables and complex parameters. In particular, both

period-doubling route to chaos (detuning) and stable period 3 oscillation in the chaotic region are found in the laser system by varying imaginary part f of a complex parameter, which is previously unexplored. And for certain value of imaginary part f, the dynamical complexity decreases dramatically, the system state changes suddenly from chaos to period, which means that transient chaos occurs under certain conditions. Moreover, self-synchronization of the laser system is also achieved in complex space by adjusting the feedback gain in the nonlinear feedback controller. Finally, numerical simulation illustrates the effectiveness and feasibility of the theoretical results.

Lecture 2

Talk Title: The Dynamics and Hopf Bifurcation of a Generalized Immune System –Cancerous Cells Interactions Model with Distributed Response Delay Based on Modified Frequency Domain Method

Speaker: Lijun Pei

Abstract: Recently, immunotherapy or combined chemo-immunotherapy becomes more and more common and popular in the treatment of cancers. The aim of the immune-based therapies is to fully cure or at least to retard the progression of the disease by an increase of the effectiveness of patient's own immune system. But due to complex and unknown interactions mechanism between the immune system and cancer cells, it is not a trivial task. Nowadays scientists together with the medical doctors and biologist put a big effort to deeply investigate these interactions. Mathematical models can help them to solve this difficult task and they already did so in certain degree. In this paper, a modified frequency domain method based on GHBT theorem is used to analyze the dynamics of a generalized immune system-cancerous cells interactions model with distributed response delay. The modified frequency domain method, is a dynamic process independent of the kernel function used in the model. The immune reaction on the detection of antigen requires transmitting signals that starts production of appropriate immune agents, production of certain cells and proteins etc. Thus, this response needs some time. This response delay is not constant and should be distributed around certain values, so it can be replaced by distinct delay probability densities. The introduction of distributed delay time makes the model more accurate. The general formula of Hopf bifurcation is first obtained, and then the Hopf bifurcation problem is analyzed for different probability density functions, and the occurrence of limit cycles is predicted. Especially, the modified frequency domain method is no longer aimed at special kernel functions, which avoids the problem of using linear chai technique in the past. Finally, the correctness of the theoretical results is verified

by numerical simulation.

Lecture 3

Talk Title: Periodically Varied Initial Boosting Behaviors in Memristive System with Cosine Memductance Nonlinearity

Speaker: Xue Ren

Abstract: In this paper, a four-dimensional (4D) memristive system is constructed using a novel ideal memristor with cosine memductance nonlinearity. Due to the special memductance nonlinearity, this memristive system has a line equilibrium set (0, 0, 0, δ) located along the coordinate of the memristor inner state variable, whose stabilities are periodically varied with the change of δ. Nonlinear, one-dimensional initial boosting behaviors, which are triggered not only by the memristor initial but also by other two initials, are numerically uncovered. More specially, a wide variety of coexisting attractors with different position off set sand topological structures are revealed along the boosting route. PSIM circuit simulations are performed to confirm the aforementioned unique dynamical features.

Session 5

Lecture 1

Talk Title: Transient Hidden Attractor of Plasma Chaotic System and Its Circuit Implementation

Speaker: Yingjuan Yang

Abstract: A method for finding hidden chaotic attractors in the plasma system is presented. A physical interpretation is provided of the stability distribution for each type of equilibrium point. Homotopy and numerical continuation are also employed to check whether the basin of chaotic attraction intersects with the neighborhood of a saddle equilibrium. Bifurcation analysis, phase portrait analysis, and basins of different dynamical attraction are used as tools to distinguish visually the self-excited chaotic attractor, hidden chaotic attractor and coexisting attractors. The hidden attractors near the stable equilibrium point of the plasma chaotic system is found to be transient chaotic attractors. We build an

analog circuit to realize the transient behavior of hidden attractor in plasma chaotic system. The simulation results of oscilloscope can clearly show the process of the hidden attractor convergence to the stable equilibrium point in plasma chaotic system after a period of chaotic motion.

Lecture 2

Talk Title: Investigation of a Hamiltonian Conservative Chaotic System with Hidden Nature and Different Ha Miltonian Energy Level Coexistences

Speaker: Ting Gou

Abstract: In this paper, a Hamiltonian conservative chaotic system derived from a generalized 4D Euler equation is discussed, and its hidden nature is interpreted because of the natural preservation of phase volume and line equilibrium. By the analysis of the Casimir energy and Casimir power and the stability of equilibrium points, the periodic motions can be analytically determined by the integrals of motion which is found to be consistent with the center equilibrium points. The aperiodic dynamic behavior is roughly controlled by the energy level of the Hamiltonian, like the distribution of the largest Lyapunov exponent. From the energy bifurcation associated with energy levels and the Poincarémap obtained from the zero Casimir power surface under fixed energy level, rich coexisting orbits representing various motions are discovered, i.e., the coexistences of periodic orbits, chaotic orbits, quasi-periodic orbits, chaotic orbit and quasi-periodic orbit.

Lecture 3

Talk Title: Study on Network Topology of UAV Swarm Under Reconnaissance Mission

Speaker: Congcong Cheng

Abstract: The information exchange pattern of UAV swarm depends on its network topology, which in turn affects the cooperated mission performance of UAV swarm. In this paper, two typical approaches, namely dynamic network topology and fixed network topology, are comparatively designed to construct the network topology of UAV swarm under the background of reconnaissance mission. Then the UAV swarm is modeled based on agent approach and a

quantitative metric is proposed to evaluate the mission performance of UAV swarm. To test the performance of the two types of network topologies, simulated experimental studies are conducted and experimental results based on the proposed quantitatively metric are compared. The results indicate that the fixed network topology is more suitable for UAV swarm than that of dynamic network topology in terms of mission performance.

Session 6

Lecture 1

Talk Title: Dynamical Analysis of the Hindmarsh Rose Neuron Model with Memristor Using Energy Method

Speaker: Lin Xu

Abstract: The continuous exchange of charged ions across the nerve membrance control the membrance potential of neurons. The Hindmarsh-Rose (HR) model with memristor is capable of producing biologically relevant dynamical states. The spike mechanism of neurons and neural networks can be analyzed by finding the energy conversion of the HR neuron with memristor. The energy aspects and HR neuron models with flux controlled memristor are analyzed in this paper. The energy function for MHR has been derived and the dynamics has been analyzed in the presence of various parameters. It is found that the bursting mode and energy of the system change with control parameter, initial point and the intensity of memristor. Besides, the difference in the initial value lead to whether there is equilibrium point or not. The generalized Hamilton energy is employed to analyze the HR neuron model. Bifurcation diagram and Lyapunov exponent demonstrate this model has diverse dynamics as periodic, bursting and chaotic behavior. Finally, numerical simulations and simulated circuit pertaining to dynamics and energy function are provided to demonstrate the effectiveness of the derived theoretical results.

Lecture 2

Talk Title: Bursting/spiking Behaviors and Bifurcations in Chay Neuron Model and FPGA-Based Validations

Speaker: Xiao Tan

Abstract: Due to the real importance of the outward current carried by K^+ ions and the inward one carried by Na^+ and Ca^{2+} ions in the three-dimensional (3D) Chay model, dynamics associated to the maximal conductance of K^+ ions channel and the maximal conductance of mixed Na^+–Ca^{2+} ions channel are explored in this paper. By utilizing general dynamics exploring tools and fast-slow dynamics analysis, the representative electrical activities of bursting and spiking behaviors endowing with the fast-slow structure are revealed and classified under different maximal conductance of K^+ ions and Na^+–Ca^{2+} ions channels. Under some specified model parameters, MATLAB-based numerical simulations are executed to explore the manifold periodic bursting, chaotic bursting, and chaotic spiking behaviors. Besides, the bifurcation mechanisms for periodic fold/fold bursting, chaotic fold/homoclinic bursting and spiking, and periodic fold/homoclinic bursting behaviors are revealed and expounded qualitatively. Finally, to employ a field programmable gate array (FPGA) with fully utilizing its programmable and reconfigurable features, a digital hardware electronic neuron with multiplier less realization is synthesized, upon which experimental measurements are executed to confirm the MATLAB-based numerical simulations.

Lecture 3

Talk Title: Some Systems of Coupled Sylvester-Type Quaternion Matrix Equations

Speaker: Zhuoheng He

Abstract: Sylvester-type equations have shown significant successes in singular system control, robust control, neural network, H/-optimal control, feedback, control theory, graph theory, and so on. Quaternions and quaternion matrices have wide applications in many fields such as signal and color image processing, control theory, orbital mechanics, computer science, and etc. In this talk, we consider some systems of coupled Sylvester-type quaternion matrix equations using different approaches. We derive some necessary and sufficient conditions for the solvability to these Sylvester-type quaternion matrix equations. Moreover, the general solutions to these quaternion matrix equations are explicitly given when they are solvable. We also provide some numerical examples to illustrate our results.

Conference Information

Conference site

Nanjing Zhongshan Hotel (Jiangsu Provincial Conference Center) is located at No. 307 Zhongshan East Road, located at the Nanjing-Ningbo Expressway Nanjing City, near the Presidential Palace, the Eastern Suburb Scenic Area (Zhongshan Mausoleum Scenic Area), and the Qinhuai Scenic Belt (Master) Temple, only 3 km from the city center - Xinjiekou, 5 km from the railway station and only 10 minutes' walk from the Nanjing Museum. The environment is elegant and the transportation is convenient.

Nanjing Zhongshan Hotel is one of the largest hotels in Jiangsu Province, integrating accommodation, catering, business and entertainment. The hotel has a total construction area of 56,000 square meters and was once the seat of the Kuomintang "Inspirational Society". The hotel has a variety of exquisite rooms with free broadband internet access. The hotel has a full range of supporting facilities, including bars, ticketing centers, gymnasiums, indoor swimming pools, sauna centers, shopping centers, washing centers, travel agencies, and large parking lots to meet the multi-level needs of guests.

Hotel Address: No. 307, Zhongshan East Road, Xuanwu District, Nanjing (Zhongshan Mausoleum Zone, near Jiefang Road)

Notice: **The attendee can mention the IWCFTA conference when making the reservation to enjoy special offer from the hotel: Twin Room ￥380; Double Room ￥400; Breakfast ￥30/per. Tel: 18951717578. (参会人报 IWCFTA 会议或者复杂系统会议可以享受协议价格住宿：标准间：380 元；大床房：400 元；早餐 30 元每人。预订电话：18951717578（李经理）。)**

Transportation

Surrounding traffic		
Nanjing South Railway Station	**11 km from the hotel**	**Take metro line 3 to Daxinggong station (Linchang direction), and transfer to metro line 2 to Xi'anmen station (Jingtianlu direction), get off and walk about 600 meters. Take a taxi for about 31 yuan.**
Xinjiekou	**3 km from the hotel**	**Take metro line 2 to Xi'anmen station (Jingtianlu direction), get off and walk about 600 meters. Take a taxi for about 13 yuan.**
Nanjing Railway Station	**7.1 km from the hotel**	**Take metro line 3 to Daxinggong station (Mozhoudonglu direction), and transfer to metro line 2 to Xi'anmen station (Jingtianlu direction), get off and walk about 600 meters. Take a taxi for about 21 yuan.**
Nanjing Lukou International Airport	**40.7 km from the hotel**	**Take metro line s1 to Nanjing South Railway subway station, and transfer to metro line 3 to Daxinggong station (Linchang direction), and transfer to metro line 2 to Xi'anmen station (Jingtianlu direction), get off and walk about 600 meters. Take a taxi for about 130 yuan.**