

# 第三十八届中国控制会议论文集

## Proceedings of the 38th Chinese Control Conference

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## Preface

The Chinese Control Conference (CCC) is an annual technical conference initiated and sponsored by the Technical Committee on Control Theory (TCCT) of Chinese Association of Automation (CAA) since 1979, and this is the 38th session. The series of CCC aim to provide a forum for scientists and engineers over the world to report their latest research results, to exchange their ideas and experience, and to advance the development of systems and control and its applications.

Held on July 27-30, 2019 in Guangzhou, China, a famous historical and cultural city, CCC2019 is sponsored by the TCCT, CAA and Systems Engineering Society of China (SESC), and locally organized by Guangdong University of Technology, China. The conference is also technically co-sponsored by Academy of Mathematics and Systems Science of Chinese Academy of Sciences (CAS), China Society for Industrial and Applied Mathematics (CSIAM), South China University of Technology, The Automation Society of Guangdong Province, Asian Control Association (ACA), IEEE Control Systems Society (CSS), Institute of Control, Robotics and Systems (ICROS), Korea, and The Society of Instrument and Control Engineers (SICE), Japan.

It's our great honor to have 7 world-class experts as plenary speakers. They are: Professor Frank Allgöwer (University of Stuttgart, Germany), Professor Robert R. Bitmead (University of California at San Diego, USA), Professor Xiaohong Guan (Xi'an Jiaotong University, China), Professor Weihua Gui (Central South University, China), Professor Zhong-Ping Jiang (New York University, USA), Professor Tielong Shen (Sophia University, Japan), Professor Le Yi Wang (Wayne State University, USA).

CCC2019 has received 2414 submissions. After a rigorous full-paper peer-review process organized by the Conference Program Committee, 1595 papers (including 1521 regular papers and 74 position papers) have been accepted and included in the Conference Proceedings, among which 96% are in English. The authors are from 23 countries/regions including Australia, Canada, Chile, China, Czech Republic, Denmark, France, Germany, Hong Kong (China), India, Japan, South Korea, Macau (China), Netherlands, Norway, Russia, Singapore, South Africa, Spain, Sweden, Taiwan (China), United Kingdom, and United States of America. The topics of the Proceedings focus on, but not limited to Systems Theory and Control Theory, Nonlinear Systems and Control, Complexity and Complex System Theory, Distributed Parameter Systems, Stability and Stabilization, Stochastic Systems, System Modeling and Identification, Hybrid Systems and DEDS, Optimal Control, Optimization and Scheduling, Robust Control, Adaptive Control and Learning Control, Variable Structure Control, Cloud Computing and Computational Intelligence, Fuzzy System and Fuzzy Control, Process Control, Predictive Control, Motion Control, Signal Processing and Information Fusion, Big Data Analysis and Control, Navigation and Guidance, Control Design, Intelligent Robots, Fault Diagnosis and Reliable Control, Knowledge Automation, Cyber-Physical System, Control of Network Systems and Networked Control Systems, Multi-Agent Systems and Distributed Control, Sensor Networks and Internet of Things (IoT), New Energy Technology and Control in Environment, Vehicle Control and Transportation Systems, Data-Driven Modeling and Control, Micro-Nano and Quantum Systems, Systems Biology and Life Systems, Intelligent Manufacturing and Industrial Intelligence, Systems Engineering Theory and Method, System Simulation, Integration and Evaluation, Smart Grid, Pattern Recognition, Game Theory and Social Networks, Aircraft Control, Neural Networks and Deep Learning, Information Systems and Cyber Security, Social/Economic Systems and Control, Automation and Control Education.

The Conference Proceedings will be included in the IEEE Conference Publications Program (CPP) with IEEE Catalog Number CFP1940A-ART.

CCC2019 confers the Guan Zhao-Zhi Best Paper Award and the SCIS-CCC Poster Paper Award, and presents the Chen Han-Fu Award, the 6th TCCT Outstanding Contribution Award, and the IEEE CSS Beijing Chapter Young Author Award in recognition of young scholars who have demonstrated excellence in their contributing papers to CCC2019, thereby further promoting the development of systems and control theory and its applications

in China.

Taking this opportunity, we, on behalf of the conference program committee, would like to express our sincere thanks to all individuals who have contributed to CCC2019. Our special thanks also extend to all contributors of the papers, members of the program committee, and the publisher, Shanghai Systems Science Press.



Minyue Fu



Jian Sun

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## Plenary Speakers

**Frank Allgöwer** is director of the Institute for Systems Theory and Automatic Control and professor in Mechanical Engineering at the University of Stuttgart in Germany. Frank's main interests in research and teaching are in the area of systems and control with a current emphasis on the development of new methods for optimization-based control, networks of systems, data-based control and systems biology. Frank received several recognitions for his work including the IFAC Outstanding Service Award, the IEEE CSS Distinguished Member Award, the State Teaching Award of the German state of Baden-Württemberg, and the Leibniz Prize of the Deutsche Forschungsgemeinschaft.

Frank is President of the International Federation of Automatic Control (IFAC) for the years 2017-2020. He was Editor for the journal *Automatica* from 2001 to 2015 and is editor for the Springer Lecture Notes in Control and Information Science book series and has published over 500 scientific articles. Since 2012 Frank serves a Vice-President of the German Research Foundation (DFG).



**Robert R. Bitmead** occupies the Cymer Corporation Endowed Chair in Mechanical & Aerospace Engineering at the University of California, San Diego. He holds degrees in Applied Mathematics and Electrical Engineering from Sydney University and Newcastle University, both in Australia. He has held faculty positions at the Australian National University and James Cook University of North Queensland. He is a control theorist with a long experience in control applications in many industrial sectors. His theoretical work is strongly informed and guided by these applications. He was the recipient of the 2014 ASME Rufus Oldenburger Medal and of the 2015 IEEE Controls Systems Transition to Practice Award. Bob is President of the IEEE Control Systems Society for 2019. He was a member of the IFAC Council from 1996 to 2002 and is Editor-in-Chief of the *IFAC Journal of Systems & Control*. He is Fellow of IEEE, IFAC and the Australian Academy of Technological Sciences and Engineering. He brews his own beer and is an accredited and active Australian Rules Football umpire.



**Xiaohong Guan** received his B.S. and M.S. degrees in Control Engineering from Tsinghua University, Beijing, China, in 1982 and 1985, respectively, and his Ph.D. degree in Electrical and Systems Engineering from the University of Connecticut in 1993. He was a senior consulting engineer with Pacific Gas and Electric from 1993 to 1995. He visited the Division of Engineering and Applied Science, Harvard University from Jan. 1999 to Feb. 2000. From 1985 to 1988 and since 1995 he has been with the Systems Engineering Institute at Xi'an Jiaotong University, Xi'an, China, and was appointed as the Cheung Kong Professor of Systems Engineering in 1999, and Dean of School of Electronic and Information Engineering since 2008. From 2001 he has also been with the Center for Intelligent and Networked Systems, Tsinghua University, Beijing, China, and served the Head of Department of Automation, Tsinghua University, 2003-2008.



Professor Guan is a member of Chinese Academy of Science and IEEE Fellow. He has been serving the Editor of *IEEE Transactions on Smart Grid* since 2014. His research interests include economics and security of networked systems, optimization based planning and scheduling of electrical power and energy systems, manufacturing systems, etc., and cyber-physical systems including smart grid, sensor networks, etc.



**Weihua Gui**, academician of Chinese Academy of Engineering, professor and doctoral supervisor of Central South University. He graduated from Central South Institute of Mining and Metallurgy in 1981 with the master's degree in industrial automation. He is currently the director of the Academic Committee of Central South University, the academic leader of the Innovation Research Group of the National Natural Science Foundation, the director of the Engineering Research Center of the Ministry of Education of Nonferrous Metallurgy Automation, the vice chairman of the China Automation Society, and the vice chairman of the China Nonferrous Metals Society. He has long been committed to complex metallurgical production process control theory, technology and engineering application research, breaking through the key technical problems of automation of non-ferrous metal smelting and aluminum processing processes, such as copper, aluminum, lead and zinc, and the application effect is remarkable. He won 3 second prizes for national scientific and technological progress, 8 first prizes at provincial and ministerial level. He was awarded the Ho Leung Ho Lee Foundation Science and Technology Progress Award in 2009 and Hunan Guangzhao Technology Award in 2012. He has won the “National Model Teacher”, “National Excellent Teacher”, “National Excellent Science and Technology Worker”, “National Nonferrous Metals Industry Labor Model”, “China Nonferrous Metals Industry Excellent Science and Technology Worker”, “China Process Control Lifetime Achievement Award”, “China Process Control Technology Contribution Award”, “Yang Jiayu Technology Award” and other honorary titles.



**Zhong-Ping Jiang** received the B.Sc. degree in mathematics from the University of Wuhan, Wuhan, China, in 1988, the M.Sc. degree in statistics from the University of Paris XI, France, in 1989, and the Ph.D. degree in automatic control and mathematics from the Ecole des Mines de Paris (now, called Paris Tech-Mines), France, in 1993, under the direction of Prof. Laurent Praly.

Currently, he is a Professor of Electrical and Computer Engineering at the Tandon School of Engineering, New York University. His main research interests include stability theory, robust/adaptive/distributed nonlinear control, adaptive dynamic programming and their applications to information, mechanical and biological systems. He is coauthor of four books *Stability and Stabilization of Nonlinear Systems* (with Dr. I. Karafyllis, Springer, 2011), *Nonlinear Control of Dynamic Networks* (with Drs. T. Liu and D.J. Hill, Taylor & Francis, 2014), *Robust Adaptive Dynamic Programming* (with Y. Jiang, Wiley-IEEE Press, 2017) and *Nonlinear Control Under Information Constraints* (with T. Liu, Science Press, 2018). He also is the (co)author of 15 book chapters, over 200 published/accepted journal papers, and numerous conference papers. His work has received 19,800 citations with an h-index of 73, by Google Scholar.



Dr. Jiang is a Deputy Editor-in-Chief of the *Journal of Control and Decision* and of the *IEEE/CAA Journal of Automatica Sinica*, a Senior Editor for the *IEEE Control Systems Letters*, an Editor for the *International Journal of Robust and Nonlinear Control* and has served as an Associate Editor for several journals including *Mathematics of Control, Signals and Systems* (MCSS), *Systems & Control Letters*, *IEEE Transactions on Automatic Control*, *European Journal of Control*, and *Science China: Information Sciences*. Dr. Jiang is a recipient of the prestigious Queen Elizabeth II Fellowship Award from the Australian Research Council (1998), the CAREER Award from the U.S. National Science Foundation (2001), JSPS Invitation Fellowship from the Japan Society for the Promotion of Science (2005), the Distinguished Overseas Chinese Scholar Award from the NSF of China (2007), and the Chair Professorship by the Ministry of Education of China (2009). His recent awards include the Steve and Rosalind Hsia Best Biomedical Paper Award at the 2016 World Congress on Intelligent Control and Automation in Guilin, China, the Best Paper Award at the 2017 Asian Control Conference, Gold Coast, Australia, and the Best Paper Award on Control at the 2018 IEEE Conf. on Real-Time Computing and Robotics, Maldives.

Prof. Jiang is a Fellow of the IEEE and a Fellow of the IFAC.

**Tielong Shen** is a Full Professor in control engineering at Sophia University, Tokyo, Japan. He graduated from Northeast Heavy Machinery Institute, 1982, and received his PhD degree in Mechanical Engineering from Sophia University 1992, and joined Sophia University as Assistant Professor with Tenure in April 1992, where he is currently chairing Shen Laboratory. His research interests include control theory and applications in automotive powertrain systems, power systems, and mechanical systems. In 2005, his laboratory founded transient control engine testbench and started long-term academic-industrial collaborative research on advanced engine control technology with Toyota automotive Corporation, Japan. He has served SICE, TCCT of CAA, IFAC and IEEE as Chair/vice-chair including General Chair of SICE&CCC2015, IPC Chair of IFAC AAC2016, IFAC ECoSM2018, etc. He is currently a member of the IEEE Technical Committee on Automotive Control and IFAC Technical Committee on Automotive System Control. He is currently serving as General Chair of SICE Annual Conference 2021, and General Chair of IFAC Conference on ECOSM 2021.



**Le Yi Wang** received the Ph.D. degree in electrical engineering from McGill University, Montreal, Canada, in 1990. Since 1990, he has been with Wayne State University, Detroit, Michigan, where he is currently a professor in the Department of Electrical and Computer Engineering. His research interests are in the areas of complexity and information, system identification, robust control, H-infinity optimization, time-varying systems, adaptive systems, hybrid and nonlinear systems, information processing and learning, as well as medical, automotive, communications, power systems, and computer applications of control methodologies. He was a keynote speaker in several international conferences. He serves on the IFAC Technical Committee on Modeling, Identification and Signal Processing. He was an Associate Editor of the *IEEE Transactions on Automatic Control* and several other journals. He was a Visiting Faculty at University of Michigan in 1996, Visiting Faculty Fellow at University of Western Sydney, Australia, in 2009 and 2013, and Visiting Faculty at Vienna University of Technology, Austria, in 2016. He is an Eminent Engineer in Tau Beta Pi, a member of Academy of Scholars at Wayne State University, and a Fellow of IEEE.

