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: EDITORIAL

IEEE ACCESS SPECIAL SECTION EDITORIAL: RECENT ADVANCES ON HYBRID COMPLEX NETWORKS: ANALYSIS AND CONTROL

Complex networks typically involve multiple disciplines due to network dynamics and their statistical nature. When modeling practical networks, both impulsive effects and logical dynamics have recently attracted increasing attention. Hence, it is of interest and importance to consider hybrid complex networks with impulsive effects and logical dynamics. Relevant research is prevalent in cells, ecology, social systems, and communication engineering. In hybrid complex networks, numerous nodes are coupled through networks and their properties usually lead to complex dynamic behaviors, including discrete and continuous dynamics with finite values of time and state space. Generally, continuous and discrete sections of the systems are described by differential and difference equations, respectively. Logical networks are used to model the systems where time and state space take finite values. Although interesting results have been reported regarding hybrid complex networks, the analysis method and relevant results could be further improved with respect to conservative impulsive delay inequalities and reproducibility of corresponding stability or synchronization criteria. Therefore, it is necessary to devise effective approaches to improve the analysis methods and results dealing with hybrid complex networks.

This Special Section of IEEE ACCESS on “Recent Advances on Hybrid Complex Networks: Analysis and Control” provides a valuable and timely platform for exchanging the latest advances in hybrid complex networks.

The Call for Papers generated great enthusiasm in the scientific community. Of the 51 submissions received, 17 articles were accepted for inclusion in the Special Section after a thorough review process by at least two independent referees. The 17 accepted articles are broadly categorized into two groups: 14 articles report theoretical results dealing with analysis and control of hybrid complex networks including multi-agent networks, logical networks, and fuzzy systems, while the remaining three articles discuss applications in the fields of electric vehicles, social networks, and forecasting stock prices.

In the first group, the article “Distributed event-triggered control for prescribed finite-time consensus of linear multi-agent systems,” by Lu considers the prescribed finite-time consensus problem of linear multi-agent systems

based on distributed event-triggered control strategies. Different from most existing prescribed finite-time consensus control rules that are based on continuous communication between agents and their neighbors, the proposed control laws are built based on the event-triggered mechanism.

In the article “Bifurcation analysis and probabilistic energy landscapes of two-component genetic network,” Zhu *et al.* investigate the global kinetics of an activator–repressor genetic oscillator through the bifurcation analysis and probabilistic energy landscape. The proposed approach is quite general and provides a realistic pathway for analyzing the global stability, robustness, and kinetics of a complex gene network.

The article “Pinning stabilization of probabilistic boolean networks with time delays,” by Liu *et al.* discusses the stabilization issues for probabilistic Boolean networks with time delays. Using the semi-tensor product of matrices, three algorithms are proposed for designing minimum pinning controllers.

In the article “Output tracking of boolean control networks with impulsive effects,” Li *et al.* discuss the output tracking of Boolean control networks with impulsive effects (BCNs-IE). By constructing an auxiliary BCN-IE and using obtained stable complex attractors, a necessary and sufficient condition and an algorithm to design state feedback controllers for the output tracking problem are proposed.

The article “Robust stability and stabilisation of delayed Boolean networks with disturbance,” by Jiang *et al.* considers a type of delayed Boolean networks (DBNs) affected by disturbances. Using the semi-tensor product method, the robust stability of DBNs without control and the robust stabilization are considered. Several necessary and sufficient conditions are proposed.

In the article “Event-triggered H_∞ filtering for networked systems under hybrid probability deception attacks,” Lu *et al.* consider the deception attacks of wide concern in cyber-attacks and discuss the feasibility of H_∞ filtering for a networked system based on event-triggered mechanisms.

The article “Static output feedback control for fuzzy systems with stochastic fading channel and actuator faults,” by Chen *et al.* focuses on the issue of static output feedback control for Takagi–Sugeno fuzzy systems in the discrete-time

domain. Using the Lyapunov–Krasovskii function, sufficient conditions for calculating controller gains are established.

In the article “Couple-group consensus for first order discrete-time multiagent systems with competition-cooperation and input saturation constraints,” Han *et al.* deal with the couple-group consensus for the first-order discrete-time systems with input saturation constraints. Based on the idea of competition and cooperation, a novel control protocol is proposed to achieve group consensus.

The article “Further results on large-scale complex logical networks,” by Liu *et al.* presents a brief survey on the recent efforts of dealing with large-scale logical networks (LNs), including their approximation, network aggregation approach, and logical matrix factorization technique. Using the network aggregation approach, the stability of a large-scale version of network pairing problem and the topological structure of large-scale probabilistic LNs are considered.

In the article “Impulsive control via variable impulsive perturbations on a generalized robust stability for Cohen–Grossberg neural networks with mixed delays,” Cao *et al.* propose an impulsive control strategy via variable impulsive perturbations for robust stability with respect to manifolds for a class of Cohen–Grossberg neural networks with mixed delays and uncertain parameters. The results generalize and extend some known robust stability results considering stability with respect to manifolds rather than isolated states.

The article “A systematic analysis of link prediction in complex network,” by Gul *et al.* gives a precise assessment of prevail link mining approaches, develops a scientific system for interface expectation in complex organizations, and addresses various difficulties and techniques.

In the article “Nonlinear PI control for high-order agents with unknown high-frequency gain signs under switching topologies,” Wang proposes the nonlinear proportional-integral control algorithms for consensus of high-order agents with unknown high-frequency gain signs (UHFGs) in switching topologies and investigates the output leaderless consensus of heterogeneous agents with UHFGs.

The article “Asynchronous control for Markov switching Lur’e systems with round-robin protocol,” by Luan *et al.* addresses the asynchronous control design problem for discrete-time Markov switching Lur’e systems (MSLSs). By adopting the round-robin protocol in scheduling the information exchange order, the mode-dependent stochastic Lur’e type Lyapunov function is analyzed and several sufficient criteria with prescribed performance are presented to guarantee that the resulting discrete-time MSLSs are stochastically stable.

The article “Exponential synchronization of partially coupled heterogeneous networks with time-delays and heterogeneous impulses,” by Feng *et al.* focuses on exponential synchronization for a class of partially coupled heterogeneous networks with time-delays and heterogeneous impulses. The common equilibrium solution and the average trajectory are selected as the synchronization targets.

Synchronization criteria are deduced by using Lyapunov function and comparison principle.

In the second group, the article “A comprehensive evaluation on variable sampling intervals of power battery system for electric vehicles,” by Yang *et al.* describes a comprehensive approach relevant to sampling intervals for future cloud-database controlling design. Diverse precision and robustness investigations for various intervals are presented and the content is verified based on information entropy theory.

In the article “Network opinion evolution model incorporating the influence of media heterogeneity,” Luo *et al.* add the role of social media users into the opinion interaction evolution model and consider the influence of its heterogeneity on the opinion evolution process and final state. Aiming to characterize information transmission with the participation of media users, an opinion dynamics model is proposed to reproduce a realistic process of opinion interaction between regular and media users.

The article “Forecasting stock price based on frequency components by EMD and neural networks,” by Shu and Gao, proposes a novel hybrid model to predict stock prices. It combines empirical mode decomposition (EMD), convolutional neural network, and long short-term memory.

In conclusion, the authors would like to thank the authors for submitting their high-quality research articles to this Special Section. They highly appreciate the contributions of the reviewers and their constructive comments and suggestions. They also acknowledge the guidance from the IEEE ACCESS Editor-in-Chief and staff members.

JIANQUAN LU, *Lead Editor*

*School of Mathematics
Southeast University
Nanjing 210096, China*

DANIEL W. C. HO, *Guest Editor*

*Department of Mathematics
City University of Hong Kong
Hong Kong, China*

TINGWEN HUANG, *Guest Editor*

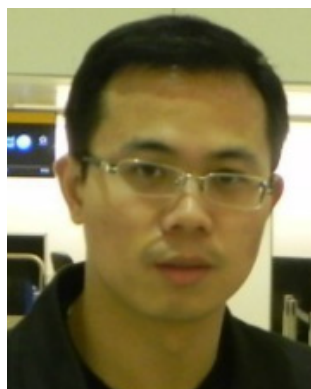
*Department of Science
Texas A&M University at Qatar
Doha, Qatar*

JÜRGEN KURTHS, *Guest Editor*

*Potsdam Institute for Climate Impact Research
14473 Potsdam, Germany
Institute of Physics
Humboldt University of Berlin
12489 Berlin, Germany
Lobachevsky University of Nizhny Novgorod
603950 Nizhny Novgorod, Russia*

LJILJANA TRAJKOVIC, *Guest Editor*

*School of Engineering Science
Simon Fraser University
Burnaby, BC V5A 1S6, Canada*



JIANQUAN LU (Senior Member, IEEE) received the B.S. degree in mathematics from Zhejiang Normal University, Zhejiang, China, in 2003, the M.S. degree in mathematics from Southeast University, Nanjing, China, in 2006, and the Ph.D. degree from the City University of Hong Kong, Hong Kong, in 2009.

From 2010 to 2012, he was an Alexander von Humboldt Research Fellow with PIK, Germany. He is currently a Professor at the School of Mathematics, Southeast University. His current research interests include collective behavior in complex dynamical networks and multiagent systems, logical networks, and hybrid systems. He has published over 100 articles in refereed international journals. He was named as a Highly Cited Researcher by Clarivate Analytics, in 2018, and he was elected as a Most Cited Chinese Researcher by Elsevier, from 2014 to 2018. He was a recipient of an Alexander von Humboldt Fellowship, in 2010; the Program for New Century Excellent Talents in University by the Ministry of Education, China, in 2010; the Second Award of Jiangsu Provincial Progress in Science and Technology, as the First Project

Member, in 2016; and the First Award of Jiangsu Provincial Progress in Science and Technology, as the Second Project Member, in 2010. He is an Associate Editor of *Neural Processing Letters* (Springer), *Journal of Franklin Institute* (Elsevier), and *Neural Computing and Applications* (Springer), and a Guest Editor of *Science China: Information Sciences, Mathematics and Computers in Simulation* (Elsevier) and *IET Control Theory & Applications*.



DANIEL W. C. HO (Fellow, IEEE) received the B.S., M.S., and Ph.D. degrees in mathematics from the University of Salford, Salford, U.K., in 1980, 1982, and 1986, respectively.

From 1985 to 1988, he was a Research Fellow with the Industrial Control Unit, University of Strathclyde, Glasgow, U.K. In 1989, he joined the City University of Hong Kong, Hong Kong, where he is currently a Chair Professor of applied mathematics and an Associate Dean with the College of Science. He has over 250 publications in scientific journals. His current research interests include control and estimation theory, complex dynamical distributed networks, multiagent systems, and stochastic systems. He was a recipient of the Chang Jiang Chair Professor awarded by the Ministry of Education, China, in 2012, and the ISI Highly Cited Researchers Award in Engineering by Clarivate Analytics, from 2014 to 2020. He has been on the Editorial Board of a number of journals, including the IEEE TRANSACTIONS ON NEURAL NETWORKS AND LEARNING SYSTEMS, *IET Control Theory & Applications*, the *Journal of the Franklin Institute*, and the *Asian Journal of Control*.



TINGWEN HUANG (Fellow, IEEE) received the B.S. degree in mathematics from Southwest University, China, in 1990, the M.S. degree in applied mathematics from Sichuan University, China, in 1993, and the Ph.D. degree in applied mathematics from Texas A&M University, College Station, TX, in 2002.

After graduating from Texas A&M University, he worked there as a Visiting Assistant Professor. He later joined Texas A&M University at Qatar (TAMUQ) as an Assistant Professor, in August 2003, and was promoted to a Professor, in 2013. His research interests include computational intelligence, smart grid, dynamical systems, optimization and control, and cybersecurity. He was named as a Highly Cited Researcher by Clarivate Analytics (formerly Thomson Reuters), in 2018. He received the Faculty Research Excellence Award from Texas A&M University at Qatar, in 2015. He is an Associate Editor of IEEE TRANSACTIONS ON CYBERNETICS, IEEE TRANSACTIONS ON NEURAL NETWORKS AND LEARNING SYSTEMS, and *Journal of Control and Decision*.



JÜRGEN KURTHS received the B.S. degree in mathematics from the University of Rostock, Rostock, Germany, the Ph.D. degree from the Academy of Sciences of the German Democratic Republic, Berlin, Germany, in 1983, an Honorary degree from the N. I. Lobachevsky State University of Nizhny Novgorod, Nizhny Novgorod, Russia, in 2008, and an honorary degree from Saratov State University, Saratov, Russia, in 2012.

He was a Full Professor with the University of Potsdam, Potsdam, Germany, from 1994 to 2008. Since 2008, he has been a Professor of nonlinear dynamics with the Humboldt University of Berlin, Berlin, and the Chair of the research domain transdisciplinary concepts with the Potsdam Institute for Climate Impact Research, Potsdam. Since 2009, he has been the Sixth-Century Chair of the University of Aberdeen, Aberdeen, U.K. He became a member of the Academia Europaea, in 2010, the Macedonian Academy of Sciences and Arts, in 2012, and of the Royal Society of Edinburgh in 2021. He has authored over 680 articles, which are cited more than 40 000 times (H-index: 104). His current research interests include synchronization,

complex networks, time series analysis, and their applications.

Dr. Kurths is a Fellow of the American Physical Society. He received the Alexander von Humboldt Research Award from the Council of Scientific and International Research, India, in 2015. He is named as an ISI Highly Cited Researcher in physics and engineering by Thomson Reuters. He is the Editor-in-Chief of *CHAOS*.



LJILJANA TRAJKOVIC (Life Fellow, IEEE) received the Dipl. Ing. degree from the University of Pristina, Yugoslavia, in 1974, the M.Sc. degree in electrical engineering and computer engineering from Syracuse University, Syracuse, NY, USA, in 1979 and 1981, respectively, and the Ph.D. degree in electrical engineering from the University of California at Los Angeles, in 1986.

From 1995 to 1997, she was a National Science Foundation (NSF) Visiting Professor with the Electrical Engineering and Computer Sciences Department, University of California at Berkeley, Berkeley. She was a Research Scientist at Bell Communications Research, Morristown, NJ, USA, from 1990 to 1997, and a member of the Technical Staff at AT&T Bell Laboratories, Murray Hill, NJ, from 1988 to 1990. She is currently a Professor with the School of Engineering Science, Simon Fraser University, Burnaby, Canada. Her research interests include communication networks, computer-aided circuit analysis and design, and nonlinear circuits and dynamical systems.

Dr. Trajkovic is a Professional Member of IEEE-HKN and a Distinguished Lecturer of the IEEE Systems, Man, and Cybernetics Society, from 2020 to 2021, and the IEEE Circuits and Systems Society, from 2002 to 2003, 2010 to 2011, and 2020 to 2021. She served as the IEEE Division X Delegate/Director, from 2019 to 2020 and the IEEE Division X Delegate-Elect/Director-Elect, in 2018. She served as the Senior Past President, from 2018 to 2019; the Junior Past President, from 2016 to 2017; the President, from 2014 to 2015; the President-Elect, in 2013; the Vice President Publications, from 2010 to 2011 and 2012 to 2013; the Vice President Long-Range Planning and Finance, from 2008 to 2009; and a Member at Large of the Board of Governors of the IEEE Systems, Man, and Cybernetics Society, from 2004 to 2006. She served as the 2007 President of the IEEE Circuits and Systems Society and a member of its Board of Governors, from 2001 to 2003 and 2004 to 2005. She served as the Chair of the IEEE Circuits and Systems Society Joint Chapter of the Vancouver/Victoria Sections, from 2001 to 2021. She was the Chair of the IEEE Technical Committee on Nonlinear Circuits and Systems, in 1998. She was the General Co-Chair of SMC 2020 and the General Co-Chair of SMC 2021, SMC 2020, SMC 2019, and SMC 2018 Workshops on BMI Systems, SMC 2016, and HPSR 2014. She was the Special Sessions Co-Chair of SMC 2017, the Technical Program Chair of SMC 2017 and SMC 2016 Workshops on BMI Systems, the Technical Program Co-Chair of ISCAS 2005, and the Technical Program Chair and the Vice General Co-Chair of ISCAS 2004. She serves as the Editor-in-Chief for the *IEEE TRANSACTIONS ON HUMAN-MACHINE SYSTEMS*, from 2021 to 2023. She served as an Associate Editor for the *IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS—I: REGULAR PAPERS*, from 1993 to 1995 and 2004 to 2005; the *IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS—II: EXPRESS BRIEFS*, in 2018 and from 1999 to 2001 and 2002 to 2003; and the *IEEE Circuits and Systems Magazine*, from 2001 to 2003.

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