

Guest Editorial Special Issue on Dynamics and Behaviors in Social Networks

Claudio Altafini, Giacomo Como, Julien M. Hendrickx, Alexander Olshevsky and Alireza Tahbaz-Salehi

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Guest Editorial

Special Issue on Dynamics and Behaviors in Social Networks

Claudio Altafini, Giacomo Como, Julien M. Hendrickx, Alexander Olshevsky, and Alireza Tahbaz-Salehi

Mathematical models of *social networks*, i.e., communities of interacting individuals, have existed for more than 50 years and have been used extensively by Sociologists, Behavioral Scientists, and Economists. The traditional focus has been on obtaining models that capture sociological effects like interpersonal influence (tendency of individuals to be influenced by others), homophily (tendency to associate with other individuals of similar behavior, opinions, and characteristics), polarization (tendency of a community to split into opposite factions), crowd effects (tendency to follow the opinion of the majority), echo chambers (tendency of an isolated community to self-amplify their beliefs), and so on.

With the advent of on-line social media, the breadth and scope of the research in social network theory has scaled drastically in both size and accuracy, as numbers of interacting individuals have soared, and recorded data streams have rendered the analysis of individual behaviors, preferences, and interpersonal relationships more quantitative than ever before. Alongside graph-theoretical notions drawn from network science such as centrality, connectivity, and resilience, tools from dynamical systems and control prove very useful when trying to capture and understand the emerging behavior of such complex systems. Indeed, the last few years have witnessed a steep increase of the number of works studying social networks from a control systems perspective.

This special issue of the IEEE TRANSACTIONS ON CONTROL OF NETWORK SYSTEMS (TCNS) consolidates this trend and gathers original contributions that identify and solve some of the emerging challenges in the field. It contains 14 articles addressing a wide range of topics ranging from non-Bayesian social learning to evolutionary dynamics in population games, social influence and opinion formation processes, their coupling with epidemic processes and recommendation systems, as well as optimal targeting problems.

We believe that this special issue presents an excellent – although by no means exhaustive – cross section of current research focused on the mathematical modeling, analysis, and

control of social systems. We hope that it will be of great interest to the broad readership of TCNS.

Our deepest thanks go to all authors who submitted their work, as well as to all the anonymous reviewers who contributed their time and energy to the peer-review process and provided excellent suggestions. We would also like to thank the proficient and timely editorial support provided by Arji A. Barakat. Finally, we wish to thank the Editor-in-Chief, Professor Jeff S. Shamma, for the opportunity to put together this special issue and for his gracious support along the way.



Claudio Altafini received a Master degree (“Laurea”) in Electrical Engineering from the University of Padova, Italy, in 1996 and a PhD in Optimization and Systems Theory from the Royal Institute of Technology, Stockholm, Sweden in 2001. From 2001 till 2013 he was with the International School for Advanced Studies (SISSA) in Trieste, Italy. Since 2014 he is a Professor in the Division of Automatic Control, Dept. of Electrical Engineering at Linköping University, Sweden. He is a past Associate Editor for IEEE Trans. on Automatic Control and IEEE

Trans. on Control of Network Systems, and he is currently serving as Associate Editor for Automatica. His research interests are in the areas of nonlinear systems analysis and control, with applications to quantum mechanics, systems biology, social networks and complex networks in general.



Giacomo Como (M’12) is a Professor at the Department of Mathematical Sciences, Politecnico di Torino, Italy. He is also a Senior Lecturer at the Automatic Control Department, Lund University, Sweden. He received the B.Sc., M.S., and Ph.D. degrees in Applied Mathematics from Politecnico di Torino, in 2002, 2004, and 2008, respectively. He was a Visiting Assistant in Research at Yale University in 2006–2007 and a Postdoctoral Associate at the Laboratory for Information and Decision Systems, Massachusetts Institute of Technology, from 2008

to 2011. Prof. Como currently serves as Associate Editor of *Automatica* and as chair of the IEEE-CSS Technical Committee on Networks and Communications. He served as Associate Editor for the *IEEE Transactions on Network Science and Engineering* (2015–2021) and of the *IEEE Transactions on Control of Network Systems* (2016–2022). He was the IPC chair of the IFAC Workshop NecSys’15 and a semiplenary speaker at the International Symposium MTNS’16. He is recipient of the 2015 George S. Axelby Outstanding Paper Award. His research interests are in dynamics, information, and control in network systems with applications to cyber-physical systems, infrastructure networks, and social and economic networks.

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Julien M. Hendrickx has been a Professor of Mathematical Engineering at UCLouvain, in the Ecole Polytechnique de Louvain, since 2010. He obtained an Engineering degree in Applied Mathematics (2004) and a Ph.D. in Mathematical Engineering (2008) from the same university. He has been a visiting researcher at the University of Illinois at Urbana Champaign in 2003-2004, at the National ICT Australia in 2005 and 2006, and at the Massachusetts Institute of Technology in 2006 and 2008. He was a postdoctoral fellow at the Laboratory

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Alexander Olshevsky received the B.S. degrees in Applied Mathematics and Electrical Engineering from the Georgia Institute of Technology, Atlanta, GA, USA, both in 2004, and the M.S. and Ph.D. degrees in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology, Cambridge, MA, USA, in 2006 and 2010, respectively. He is currently an Associate Professor in the Department of Electrical and Computer Engineering, Boston University, Boston, MA, USA. His research interests include control systems, optimization, and

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Alireza Tahbaz-Salehi is a Professor of Managerial Economics and Decision Sciences at the Kellogg School of Management, Northwestern University. He received the B.Sc. degree from Sharif University of Technology, Tehran, Iran, in 2004 and the M.S.E. degree in electrical engineering, the M.A. degree in economics, and the Ph.D. degree in electrical and systems engineering from the University of Pennsylvania, Philadelphia, in 2006, 2008, and 2009, respectively. Prior to joining Northwestern, he was a Postdoctoral Associate at the Laboratory for Information and Decision Systems, Massachusetts Institute of Technology, from 2009 to 2011 and the Daniel W. Stanton Associate Professor of Business at Columbia Business School from 2011 to 2017.

His research focuses on the implications of network economies for information aggregation, business cycle fluctuations, and financial stability.