Editorial

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Biographical notes: Christoforos N. Hadjicostis received SB Degrees in Electrical Engineering, Computer Science and Engineering, and Mathematics, the MEng Degree in Electrical Engineering and Computer Science in 1995, and the PhD Degree in Electrical Engineering and Computer Science in 1999, all from the Massachusetts Institute of Technology, Cambridge, MA. He has served as an Assistant and Associate Professor in the ECE Department at the University of Illinois at Urbana-Champaign, and he is currently Department Chair in the ECE Department at the University of Cyprus. His research spans fault diagnosis and tolerance, error control coding, monitoring and control of networked systems, and discrete event systems.

Cedric Langbort is currently an Assistant Professor of Aerospace Engineering at the University of Illinois at Urbana-Champaign (UIUC). He is also affiliated with the Coordinated Science Laboratory and the Information Trust Institute. He studied at Supaero in Toulouse, France (Aerospace Engineering degree; MS control theory) and the Institut Non-Lineaire in Nice (MS dynamical systems) before receiving the PhD Degree in Theoretical Applied Mechanics from Cornell University in January 2005. He then spent a year and a half as a

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The focus of this Special Issue is on the highly interdisciplinary research needed for a new theory that addresses the capabilities, and constraints, of contemporary distributed control systems featuring networked information processing and other communication technologies. Increase in the use of heterogeneous channels, such as the internet or dedicated bus lines particularly in the context of distributed systems, challenges the conventional assumptions of perfect communication and instantaneous observation. The detrimental effects introduced by network and communication processing calls for the development of new systematic design and analysis tools that stem from the fusion of concepts from control, communication, optimisation, and algebra.

The aim of this Special Issue is to compile a coherent collection of recent results rooted in multiple disciplines, so that it can inspire further work in information processing and decision making over communication networks and uncertain information channels. Topics of interest range from optimal and robust control under decentralised information structures to distributed estimation and diagnosis, to consensus, agreement, and optimisation, and to stochastic dynamic games and teams.

The topic of the Special Issue is very timely. From a theoretical point of view, this issue follows on the recent trend of successes in blending the theories of communication and control that have, until recently, followed distinct paths since mid 1980s after a period of joint evolution in 1960s and 1970s. From a technological point of view, the recent proliferation of affordable sensing and networking/communication technology, and the ever increasing dependency of business and government sectors alike on networked infrastructures has resulted in a need for advanced design/analysis tools and for effective monitoring and control strategies for numerous emerging distributed control systems. We hope that this Special Issue will foster further development of

ideas that unite concepts from the fields of control, communications, and distributed algorithms/optimisation, and will increase the common ground for researchers in these areas.

The Special Issue tries to reflect various subareas of interest within the context of information processing and decision making in distributed control systems. We now briefly describe these subareas and their associated papers.

A significant number of papers in this issue deal with the problem of decentralised control and decentralised stabilisation, where multiple decision makers act on a general plant utilising limited information exchanges and/or under imperfect information. Imer and Başar study the sequential estimation problem when one decision maker is an encoder, the other one acts as a decoder, and the decision makers optimise the estimation quality subject to a limit on the number of channel uses. Rotkowitz, Cogill and Lall study the role of delay in interconnected dynamic systems, and establish conditions under which the optimal control problem can be recast as a convex optimisation problem. Garone, Sinopoli and Casavola study the problem of optimal LQG control over networks where packet acknowledgements are imperfectly transmitted back to the transmitter and the authors exhibit that the optimal control policies are non-linear. Jovanovic studies the distributed control problem, within an optimal control framework, and characterises conditions when it is sufficient to work with information available locally at the controllers to generate the actions directly. Martini, Egerstedt and Bicchi study decentralised control for a linear system using a graph theoretic approach and via a partition of the set of controllers characterised through a graph. Following a similar setting, Gattami and Murray study stabilisation conditions using frequency domain characterisations in arbitrarily connected networks of linear systems. Robinett III and Wilson study the design of distributed team control laws for stabilisation of a non-linear system with tools from energy shaping and estimation theory.

There are three papers which represent different important avenues of research in networked systems. Among these, the paper by Lakshmikantha, Srikant and Beck studies throughput performance of routing policies in networks by employing a differential equation model and by investigating the role of small size packets in improving the performance. Information theory also finds its comfortable place in the special issue. Grover and Sahai investigate an information theoretic view of the well-known Witsenhausen counterexample. They study a multi-dimensional extension of this counterexample, and provide lower and upper bounds on the optimal policies using tools from information theory and coding with side information. On the topic of signal denoising, Touri, Voulgaris and Hadjicostis study the problem of discrete signal sequence reconstruction when the observed sequence is an additively perturbed filtered version of the original sequence, and also investigate the complexity of the proposed reconstruction procedure.

A number of papers make contributions in the technologically important and mathematically intriguing field of consensus and inference. Among these, Vanka, Gupta and Haenggi study the consensus problem in the context of wireless systems, where channel interference is present and obtain upper and lower bounds on the speed of convergence of the averaging consensus schemes, and provide insights on the effects of the geometry of the network on this convergence. Wang and Elia study the consensus problem where communication channels have memory modelled as stable linear systems and show the interesting relationship between channel gain and network topology for consensus. Uhlig, Kiyavash and Neogi, on the other hand, study the crucial application

area of air traffic control using tools from control theory, in particular analysing the consensus on positioning of aircrafts, also considering Byzantine settings.

Before closing this editorial, we would like to thank all authors who submitted manuscripts to this Special Issue. We received many worthy papers but unfortunately we could not accommodate all of them, also due to time and scheduling considerations. We would also like to thank the many diligent referees who helped in the evaluation of the submitted manuscripts with their very careful and timely reviews, and at times multiple reviews, as well as Dr. Ge Guo, the Editor-in-Chief of the *International Journal of Systems, Control and Communications*, who gave us the opportunity to edit this Special Issue and ensured that the process is kept under control with his guidance and prompt response to each of our requests.

We hope that the reader will find this Special Issue interesting and exciting. While the intersection between decision making and communication theories in the context of distributed control systems remains largely unexplored, we are optimistic that more intensive and fruitful cross-fertilisation between these fields will take place in the near future.