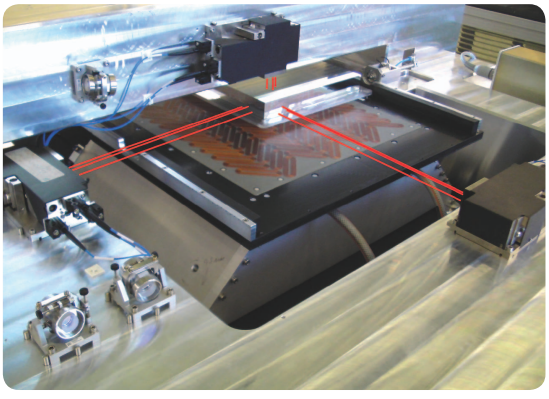
Technical Committee on Hybrid Systems

This column focuses on the activities of the IEEE Control Systems Society (CSS) technical committees (TCs). In addition to providing information about the activities of a selected TC, the column is a call for participation and contributions by researchers with related interests. For information about joining a CSS TC, please contact the TC chair. A list of TCs and contact information can be found on the Technical Activities portion of the CSS Web site (www.ieeecss.org/). The main objectives of the CSS TCs are to provide educational opportunities, inform CSS members of advances in control subspecialties, and provide opportunities for technical discussion. The mission of the IEEE CSS Technical Activities Board (TAB) is to provide technical resources and opportunities for collaboration in the areas of control systems within each TC, across TCs, and beyond our Society. This mission is achieved through the collected efforts of the 19 CSS TCs; the contributions from enthusiastic members; and the voluntary services of liaison officers, representatives, and members of related committees of our interests. Please contact me at bullo@engineering.ucsb.edu if you have any thoughts, ideas, or comments for making our TCs more vibrant and exciting.

Francesco Bullo

Hybrid behavior is an essential characteristic of real-life systems ranging from biological networks and disease dynamics to power electronics switching circuits and communication networks. The explanation for the omnipresence of hybrid phenomena lies in the fact that the combination of relatively simple discrete and continuous actions/dynamics can produce a very rich behavior. This observation motivated the establishment of a successful research direction within control systems theory, which started roughly more than a decade ago and focuses on modeling, analysis, and synthesis problems that involve hybrid systems. Furthermore, the hybrid systems research community has been building up a synergy of computer science and control theory methods that are essential for the design of cyberphysical systems. The impact of hybrid systems theory on our society can be traced in a multitude of relevant applications, such as collision avoidance in smart vehicles, robotic surgery, nanolevel manufacturing, deep-sea exploration, energy efficient buildings, air traffic control, and wireless sensor networks. Recent research activities within the hybrid systems community deal with incorporation of hardware limitations (for example, memory and computational power) and human language specifications (for example, high-level robotic surveillance tasks) in the design of control systems. These activities have the potential to generate breakthroughs in the development of real-time control systems for high-tech prototypes, such as high-accuracy power amplifiers for magnetic resonance imaging scanners, electromagnetic fuel injection systems, robotic surveillance, automatic tuning of synthetic gene networks, and high-precision planar actuators with integrated magnetic bearings (the prototype actuator in the photo is developed at the Department of Electrical Engineering of Eindhoven University of Technology, The Netherlands).



The planar actuator prototype.

Digital Object Identifier 10.1109/MCS.2011.2181581
Date of publication: 16 March 2012

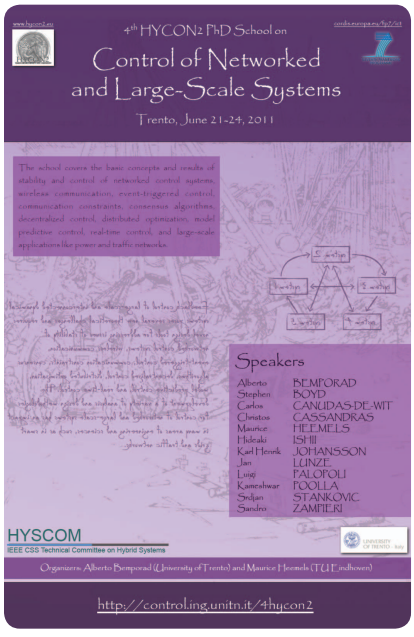
TC ACTIVITIES

Each year the IEEE CSS Hybrid Systems Committee (HYSCOM) is involved in the organization of various research and educational activities that highlight the impact of hybrid systems theory in the development of our society. For example, HYSCOM is currently participating in the organization

The workshop participants for "Control of Networked and Large-Scale Systems."

of the IFAC Conference on Analysis and Design of Hybrid Systems (Eindhoven, June 2012); the Conference on Hybrid Systems: Computation and Control, part of the Cyber-Physical Systems Week (Beijing, April 2012); and the IFAC Conference on Nonlinear Model Predictive Control (Noordwijkerhout, August 2012).

During 2011, HYSCOM supported the HYCON2 Ph.D. school "Control of Networked and Large-Scale Systems," organized by Alberto Bemporad and Maurice Heemels in Trento, Italy, June 2011. The targets of the school were graduate students and researchers willing to learn the main concepts of control of hybrid networked and large-scale systems, as well as graduate students and postgraduate researchers already working in this field. The program included four full days of lectures, with enough time slots to allow scientific discussions among the participants and with the speakers. Twelve selected speakers lectured during the school covering the basic concepts and results on stability and control of networked control systems, wireless communication, event-triggered control, communication constraints, consensus algorithms, decentralized control, distributed optimization, hybrid model predictive control, real-time control, and fundamental large-scale applications like power and traffic networks. The school was attended by 102 students, of which five were from research institutes, two from private companies, and the rest attending Ph.D. programs in several countries. More information about the school can be found at the Web site control.ing.unitn.it/4hycon2/index.html.



The poster for the 2011 summer school "Control of Networked and Large-Scale Systems."

CONTACT INFORMATION

HYSCOM is currently chaired by Mircea Lazar, who took over the position at the end of Alberto Bemporad's term in January 2011. CSS members interested in participating in HYSCOM activities are welcome to contact the committee chair (m.lazar@tue.nl). Information about the TC activities is provided on the IEEE CSS Web site (www.ieeecss.org/technical-activities/hybrid-systems).