

Technical Committee on Hybrid Systems

Over the past two decades, we have seen the emergence of many complex systems resulting from the tight interaction of digital components with physical plants. Digital components monitor and regulate several physical variables (for example, temperature, velocity, pressure, and density) through feedback control loops. Examples of such systems include automotive, transportation systems, chemical processes, critical infrastructure, energy, robotics, and health care. These are all examples of hybrid systems whose models are heterogeneous: discrete systems model computation and communication parts, and (stochastic) differential/difference equations model continuous physical processes.

The focus of the IEEE Control Systems Society (CSS) Technical Committee on Hybrid Systems (TC-Hybrid) is to promote research and education on hybrid systems. The TC provides scientific forums, summer schools, invited sessions within different conferences, workshops for technical discussion, special issues of many journals, and online information (for example, Wikipedia and collections of software tools on hybrid systems) to researchers and students interested in the field of hybrid systems and its applications. TC-Hybrid currently has 117 members. The current TC chair is Majid Zamani (University of Colorado Boulder, United States), and the cochairs are Manuel Mazo Jr. (Delft University of Technology, The Netherlands), Sadegh

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Soudjani (Newcastle University, United Kingdom), and Jana Tumova (KTH Royal Institute of Technology, Sweden). This column summarizes the main activities of the TC during 2020 and early 2021.

TECHNICAL COMMITTEE ACTIVITIES

The TC meets annually at CSS-sponsored conferences. Recent TC meetings were held virtually at the 2020 IEEE Conference on Decision and Control (CDC) and American Control Conference. The first TC meeting of 2021 was scheduled to take place virtually at the 2021 CDC.

The TC helps organize invited sessions, tutorials, and workshops at many conferences and special issues of various journals. Here, we list some of those activities that happened during 2020 and early 2021.

Maurice Heemels (Eindhoven University of Technology, The Netherlands), Sandra Hirche (Technical University of Munich, Germany), Karl H. Johansson (KTH Royal Institute of Technology, Sweden), and Cameron Nowzari (George Mason University, United States) organized two invited sessions on event-triggered control during the 2020 CDC.

Sam Coogan (Georgia Institute of Technology, United States) and Murat Arcak (University of California, Berkeley, United States) organized a tutorial “Monotone Systems Theory for Reachability and Safety,” during the 2020 CDC.

Arcak, Abhishek Halder (University of California, Santa Cruz, United States), Heiner Litz (University of California, Santa Cruz, United States), Linh Phan (University of Pennsylvania, United States), Ricardo Sanfelice (University of California, Santa Cruz, United States), and Zamani organized the workshop “Computation-Aware Algorithmic Design for Cyberphysical Systems” during the 2021 Cyber-Physical Systems and Internet-of-Things Week. Mazo and Romain Postoyan (CNRS, Université de Lorraine, France) jointly taught a Dutch Institute of Systems and Control course, Modeling and Control of Hybrid Systems, during summer 2020.

Kai Cai (Osaka City University, Japan), Maria Prandini (Politecnico di Milano, Italy), Xiang Yin (Shanghai Jiao Tong University, China), and Zamani proposed the special issue “Security, Privacy, and Safety of Cyberphysical Systems” in *Nonlinear Analysis: Hybrid Systems (NAHS)*.

Alessandro Abate (University of Oxford, United Kingdom) and Necmiye Ozay (University of Michigan, United States) are editing a special issue for *NAHS* by inviting the authors of selected papers that appeared at the seventh IFAC Conference on Analysis and Design of Hybrid Systems to contribute extended versions of their manuscripts.

For the first time, TC-Hybrid and the TC on Discrete Event Systems (TC-DES) started a joint *TC Outstanding Student Paper Prize*, which recognizes

young talent associated with TC-Hybrid or TC-DES and promotes student membership and participation in those TCs. The prize is awarded to a student who is the primary author of a paper presented at the CDC and a member of TC-Hybrid or TC-DES. It is given at the CDC of year $N + 1$ for a paper presented at the CDC of year N . The first prize was scheduled to be given during the TC-Hybrid meeting at the 2021 CDC for a paper presented at the 2020 CDC. The nominations received

for papers presented during the 2020 CDC were evaluated by five committee members in terms of originality, clarity, and impact.

JOINING THE TECHNICAL COMMITTEE

To join the TC, email the TC chair, Prof. Zamani, at majid.zamani@colorado.edu. Upon receipt of your request, the TC chair will process it and add you to the TC email list.

Majid Zamani

Technical Committee on Power Generation

There is an urgent need to develop new power generation technologies and improve existing ones, such that they are more efficient and cleaner while also being economical. Additionally, there is a need for more efficient technologies for energy conversion and storage. Of the approaches that are currently being considered to meet this challenge, most require the use of feedback control systems to optimize performance and operate safely. In many situations, the control problems motivated by these technologies are quite challenging, requiring new analytical and numerical techniques.

The IEEE Control Systems Society (CSS) Technical Committee on Power Generation (TC-PG) was established in 2010 as a means of coordinating the scholarly activities of control systems researchers working in the power generation area. Its mission is to nourish incipient research efforts and foster interaction between energy/power engineers and control theorists. This has been done through the promotion,

coordination, and organization of activities sponsored by the CSS at the boundary of these two communities. Efforts have focused primarily on the organization of special sessions, workshops, and minicourses. The committee also occasionally arranges special issues of journals.

Since its inception, the activity and scope of TC-PG has been organized around four technological thrusts: 1) nuclear power generation, including both fission and fusion power; 2) renewables, including wind, solar, hydro, and others; 3) fossil power generation; and 4) efficient energy-usage technologies, such as smart building systems. However, this past year, the committee undertook a revision to this scope. It has been broadened to also encompass control applications relating to power conversion technologies (such as power electronic converters and drives) as well as energy storage systems (such as battery technologies).

The reason for this expansion in scope is threefold. At the most basic level, innovations in these areas are on an equal footing with those in power generation, as our society strives to achieve

cleaner and more efficient uses of energy resources. Moreover, fascinating and highly challenging control problems emerge in both energy conversion and storage systems, and control techniques for these technologies constitute thriving areas of research. As a further motivation, general energy conversion and storage technologies do not currently fall under the purview of another CSS TC, and the expansion in the scope of TC-PG is intended to provide researchers and practitioners in these areas with a “home” within the CSS.

TC-PG normally meets twice a year—once at the American Control Conference and once at the IEEE Conference on Decision and Control. Over the next few years, I look forward to expanding the committee’s membership, especially in the areas of power conversion and energy storage. If your interests align with the scope of the committee and you would like to join, I encourage you to email me directly at jscruggs@umich.edu.

Jeff Scruggs