Technical Committee on Hybrid Systems

Cyberphysical systems exhibit both continuous and discrete dynamics due to the interaction among physical, digital, and computing components. For example, power systems with switching components have variables that evolve continuously according to classical circuit laws and jump when switches occur. Also, mechanical systems with parts that collide with other parts or with their environment, typically have velocities that abruptly change direction at those collisions. More generally, a hybrid system is a dynamical system with variables that may evolve continuously and, also at times, exhibit jumps. Many systems in science and engineering combine such hybrid behavior.

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, nano-level manufacturing, deep-sea exploration, energy-efficient buildings, air-traffic control, wireless sensor networks, and many more. Recent research activities within the hybrid systems community deal with incorporation of hardware limitations (such as memory and computational power) and human-language specifications (for example, in 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.

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The focus of the IEEE Control Systems Society (CSS) Technical Committee on Hybrid Systems Technical Committee (TC-HS) is to promote research and education on hybrid systems. The TC is dedicated to providing informational forums, meetings for technical discussion, and information over the web to researchers in the CSS who are interested in the field of hybrid systems and its applications.

The main events dedicated to hybrid systems are the Hybrid Systems: Computation and Control Conference, which is part of the Cyberphysical Systems Week sponsored by IEEE, and the Analysis and Design of Hybrid Systems Conference, which is organized by IFAC. TC-HS currently has 57 members. Since January 1, 2016, the TC chair has been Ricardo Sanfelice (University of California, Santa Cruz) and TC Cochair Alessandro Abate (University of Oxford). A TC meeting was held at the American Control Conference (ACC) in Boston. Another TC meeting was scheduled for the IEEE Conference on Decision and Control (CDC) in Las Vegas. This column summarizes the activities of the TC in 2016.

TC-HS collaborates closely with its corresponding IFAC TC, 1.3 Discrete Event and Hybrid Systems, in organizing joint discussions during yearly IEEE and International Federation of Automatic Control (IFAC) conferences.

TC ACTIVITIES

The TC meets annually at IEEE-sponsored conferences. The TC meeting at the ACC in Boston brought together previous and new TC members for the near future. The discussions during this meeting included logistics, special issues in journals, and a workshop sponsored by the TC. To facilitate communication between members, an e-mail list was created using Google Groups. During the TC meeting at the 2016 ACC, the idea of frequently issuing a newsletter was determined to be an efficient method to distribute and document information of

The Technical Committee on Hybrid Systems meeting during the 2016 Conference on Decision and Control (from right): Frederick Leve, Fabio Pasqualetti, Rafal Goebel, Jun Chai, Sean Phillips, Dimos Dimarogonas, Raphael Jungers, Majid Zamani, and Vadim Azhmyakov.

interest to members, such as announcements and events. The first issue of the TC newsletter was published in October 2016 (http://hybrid-systems.ieeecss.org/tc-hybrid/newsletter).

The TC is part of the organization of invited sessions and workshops at conferences annually. During 2016, members of the TC organized invited sessions at the ACC, the Nonlinear Control System Symposium (NOLCOS), and the CDC. In particular, the NOLCOS invited session, "Recent Advances in Stability and Control of Hybrid Systems," featured presentations by many of the TC members and allowed for fruitful interactions with members of IFAC TC 1.3 Discrete Event and Hybrid Systems. An invited session, "Variational Analysis in Dynamics and Control," was offered during the CDC in December 2016.

Led by Cochair Alessandro Abate, the TC is working on updating the hybrid systems entry hosted by Wikipedia.org at https://en.wikipedia.org/wiki/Hybrid_system. This entry will be expanded to provide a much more complete summary of the hybrid systems literature, one that not only provides an introduction to newcomers to the field but also serves as a useful resource to researchers. Members of the TC and of the broad community interested in contributing to this effort should contact the cochair at a.abate@tudelft.nl.

Throughout the year and at the TC meeting during ACC 2016, several interesting activities have been put forward, including the organization of a workshop on challenges and new directions of hybrid systems and a special issue in a journal. These activities were scheduled to be discussed further at a TC meeting during the CDC 2016 in Las Vegas.

To join the TC, e-mail the chair at ricardo@ucsc.edu. Upon reception of your request, the TC chair will process your request and add you to the TC e-mail list. Information about TC-HS can be found at http://hybrid-systems.ieeecss.org.

Ricardo Sanfelice

Technical Committee on Systems Biology

Recent technological advances in molecular biology have enabled not only the real-time measurement of molecular activities in cellular systems but also the ability to manipulate some of these through engineered molecular-actuation systems and the ability to design new cellular systems that do not yet exist in nature. These capabilities have expanded the field of systems biology, which originally aimed at providing new biological insights or unravelling mechanisms through a systems perspective. Now the aim of the field, known as synthetic biology, is to design novel cellular systems that are regulated through engineered control systems. This field has been put into the mainstream by the annual International Genetically Engineered Machine (iGEM) competition.

To consolidate activities in life sciences, IEEE launched the Life Science Technical Communities in 2014.

In light of these developments, the IEEE Control Systems Society (CSS) Technical Committee on Systems Biology (TC-SB, see http://systems-biology.ieeecss.org/) has been committed to advancing and disseminating systems and control theory and applications in systems and synthetic biology. The theoretical developments cover almost all topics in systems and control theory, including output regulation, robust control, model-order reduction, systems identification, stochastic systems theory, network dynamics, and nonlinear systems theory. On the other hand, the applications range from the topical area of personalized medicine, in-silico cells and organs (including the liver, brain, and heart), cyborg cell design, and metabolic engineering to the design of synthetic biological circuits. It is through the dedication and effort from many members of our Society (that is, not only the members of the TC-SB) that systems and control theory has been embraced by the international community of systems and synthetic biology.

Members of the TC-SB have regularly organized invited sessions on both systems and synthetic biology at the annual American Control Conference as

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