

Pre-Conference Workshops

Title: Verification and Control of Stochastic Hybrid Systems

Time and Location: Tuesday, July 16, 2013, 09:00 - 17:00 (Rm. D1.1)

Presenters: Maryam Kamgarpour, Alessandro Abate, Tembine Hamidou, Holger Hermanns, Maria Prandini

Stochastic hybrid systems (SHS) have been used in several application domains including systems biology, power grid networks and air traffic control. Due to their modeling capabilities, developing theoretical results and computational tools for verification and control of these systems has been a subject of investigation within the systems and control community. In this workshop, the problems of verification and control for stochastic hybrid systems are defined and several computationally tractable methods to address these problems are presented.

The workshop intends to raise awareness and interest in the audience about the stochastic hybrid systems control techniques. The primary targeted audience is students at a graduate level in systems and control. At the same time, by bringing together a heterogeneous panel of experts presenting their state-of-the-art research results, the workshop targets a wider audience of researchers and practitioners. Furthermore, it shall facilitate and encourage collaboration between participants with a diverse background and from different organizations.

Topics include: abstractions of controlled stochastic hybrid systems, model checking for discrete and continuous time Markov chains, approximate dynamic programming with randomized algorithms, stochastic model predictive control, mean field analysis for large stochastic games.

Title: HYCON2 Workshop on Distributed Optimization in Large Networks and its Applications

Time and Location: Tuesday, July 16, 2013, 09:00 - 17:10 (Rm. D1.2)

Presenters: Mikael Johansson, Luca Schenato, Angelia Nedich, Joao Xavier, Vladimir Havlena

The proliferation of relatively inexpensive devices capable of communicating, computing, sensing, interacting with the environment and storing information is promising an unprecedented number of novel applications throughout the cooperation of these devices toward a common goal. These applications include swarm robotics, wireless sensor networks, smart energy grids, smart traffic networks, smart camera networks. These applications also pose new challenges, of

which distributed and asynchronous optimization is one of the major ones. In fact, distributed optimization has been attracting ever growing attention in the past years since many problems in large scale network can be cast as convex optimization problems. The objective of this workshop is to provide a self-contained overview of this growing body of literature in distributed optimization from a control perspective. Although several invited sessions and special events have appeared in international conferences, this would be one of the first workshop to address the problem of distributed optimization from a control perspective.

The Workshop is intended to provide to a wide and diverse audience interested in distributed optimization in large scale networks with an overview of the state-of-the-art from a control point of view. In particular, being the first part of the workshop devoted to tutorial seminars, it is particularly suitable for **Ph.D. students and young researchers** who are willing to enter this new area of research and are not necessarily experts, since most relevant mathematical tools and references will be provided. However, it is also relevant for **practitioners and researchers in distributed optimization**, since the second part of the workshop will present some recent advances in this area and some industrial application of these tools.

Title: Time Delay Systems: Stability & Control in Applications

Time and Location: Tuesday, July 16, 2013, 09:00 - 17:30 (Rm. D7.1)

Presenters: Fatihcan Atay, Dimitri Breda, Wim Michiels, Silviu-Iulian Niculescu, Hitay Ozbay, Rifat Sipahi

Time delays are ubiquitous in dynamical systems around us, as found in mechatronics systems, energy management systems, traffic flow dynamics, tele-operation and remote control systems, synchronization of agent-based dynamics, population dynamics, HIV infection dynamics, financial investment and stock trading strategies, and supply chain management. Delays bring about significant effects on the evolution of such systems, causing instability, poor performance, and limitation on the ability to control, which ultimately result in poorly functioning and inefficient dynamical behavior. On the other hand, there are also situations where delays have beneficial effects and can be used as controller parameters.

In this one day workshop, the lecturers will cover both the theory and relevant applications, starting from the fundamentals and developing toward complex problems. Discussions include stability theory, stabilization, delay-dependent and delay-independent stability, structured control design, utilization of advanced numerical tools,

spectrum calculations, H-infinity control, existing capabilities, limitations and open research problems. Application examples in particular include network systems, biological systems, engineering problems, resource-competition dynamics, and supply chains.

The lecturers will utilize fundamentals tools, such as eigenvalue problems, state space representations, root locus, frequency domain analysis and control design, from classical and modern control theory, to present the workshop materials. The lecturers will mainly focus on Linear Time-Invariant Time Delay Systems, and will use PowerPoint slides as well as Matlab demonstrations via projector to deliver their lectures. The audience is welcome to bring their laptops to actively participate. Lecturers will also provide hand outs to the audience regarding presentation material as well as key references. Demo files will be available for upload after the workshop.

Title: Fault Diagnosis, Fault-tolerant Control, and Cooperative Control of Manned and Unmanned Systems

Time and Location: Tuesday, July 16, 2013, 09:00 - 17:30 (Rm. D7.2)

Presenters: Youmin Zhang, YangQuan Chen, Christopher Edwards, Cameron Fulford, Philippe Goupil , Qinglei Hu, Hugh H.T. Liu, Andres Marcos, Vicenç Puig, Didier Theilliol and Antonios Tsourdos

Unmanned systems including Unmanned Aerial Vehicles/Systems (UAVs or UAS), Unmanned Ground Vehicles (UGVs), and Unmanned Underwater Vehicles (UUVs) etc are gaining more and more attention during the last a few years due to their important contribution and cost-effective application in several tasks such as surveillance, search, rescue missions, geographic studies, military and security applications. Health management and fault-tolerant control of manned aerial vehicles have a long history since the initial research on self-repairing flight control systems in US Air Force and NASA begun in mid-1980s. However, due to safety of manned aerial vehicles to the pilot, experimental test and further practical research and development have been bounded due to such constraints. Benefited from the recent and significant advance and development of UAVs, development and application of fault-tolerant control as well as cooperative control techniques have been emerged and developed quickly in recent years, since UAVs provide a cheap and operative experimental test-bed for development, implementation, and testing the latest developed fault-tolerant and cooperative guidance, navigation and control techniques. Based on the experiences gained by the 12 different participating organizations ranging from academic institutions, research organization, and industry of the leading groups in Canada, USA, France, Spain, UAE, and UK, the workshop will demonstrate the state-of-the-art techniques

and development in health management, fault diagnosis, fault-tolerant guidance, navigation and control, safety and reliability, as well as multi-vehicle cooperative guidance, navigation and control techniques.

In this workshop, overview of past, current and future research activities and research outcomes on the health management, fault diagnosis, fault-tolerant control, and cooperative control applications with emphasis to UAVs, civilian aircraft and spacecraft will be presented, which include quadrotor rotary and fixed-wing UAVs etc. Linear and nonlinear techniques for modeling, fault diagnosis, fault-tolerant control, path and trajectory planning/re-planning, cooperative/formation flight guidance, navigation and control, based on a quadrotor helicopter UAV and several fixed-wing aircraft and UAVs testbeds will be presented in the workshop. Furthermore, fault diagnosis, fault-tolerant control, and cooperative control strategies development with practical application scenarios on persistent surveillance and coverage control with multiple unmanned systems will be presented. Multiple UAS operations toward verifiable autonomy and assessment of the potential insertion of UAS in the air transportation system will also be discussed.

The audience will gain information and knowledge on the latest development and applications on the active research topics in health management, fault detection and diagnosis, fault-tolerant control and cooperative control of manned and unmanned aerial vehicles by world-leading researchers from both academia and industry.