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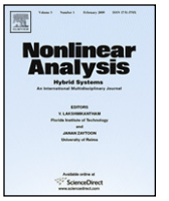

Editorial

Special issue related to the 2008 IFAC world congress

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Hybrid systems, combining event-driven and time-driven dynamics, have become ubiquitous in modern technology and the center of significant research activity within various disciplines including computer science and systems and control engineering. The International Federation of Automatic Control (IFAC) has been providing a forum for such activity by instituting a series of conferences on the analysis and design of hybrid systems, and establishing a Technical Committee on Discrete Event and Hybrid Systems.

For this special issue, the authors of 16 papers related to different aspects of Hybrid Systems were initially invited to submit an original paper presenting their newest results, related to their presentation at the IFAC World Conference held in Seoul, Korea, in July 2008. The submissions were carefully reviewed, and 11 of them are accepted for inclusion in this special issue.

This special issue is dedicated to the memory of Laura Recalde, who passed away last December, and includes her last published paper. Laura Recalde has contributed to establishing Petri nets as a framework for modeling, analysis and control of hybrid systems. The paper of Laura Recalde together with Cristian Mahulea and Manuel Silva deals with the state observability of times continuous-Petri-net systems with infinite server semantics. Several concepts – distinguishable modes, structural observability, weak structural or generic observability – are established for these nonlinear systems that represent a subclass of piecewise linear systems.

The next three papers deal with reachability analysis for different classes of Hybrid Systems. Althoff, Stursberg, and Buss aim at investigating and evaluating the combined use of zonotopes and polytopes for the computation of reachable sets of hybrid systems with linear continuous dynamics. Girard and Le Guernic propose an approach for computing an over-approximation of the set of states reachable on bounded time-interval. The main contribution of this work is that it deals with continuous-time linear systems whose sets of initial states and inputs are given by arbitrary compact convex sets represented by their support functions. Ramdani, Meslem, and Candau address nonlinear reachability computation for uncertain monotone systems whose flows preserve a suitable partial ordering on initial conditions. The proposed method represents a substantial improvement over previous works of the authors because the bounds are obtained in a separate manner and the whole solution set is no longer needed to address mode switching.

A special class of hybrid systems is that of switched systems, a topic dealt with by the next three papers. Lin and Antsaklis investigate the disturbance attenuation properties for a class of switched linear systems with parametric uncertainties and exterior disturbances. The aim is to characterize the conditions under which the switched system can achieve a finite disturbance attenuation level. Izak, Görges, and Liu address stability and control issues of systems with uncertain and time-varying sampling period and time delay. These systems are transformed into polytopic and additive norm-bound uncertainties in the discretized system description. Control design and stability analysis are given in the form of LMIs applying switched parameter-dependent quadratic Lyapunov functions. Kameneva and Nesic analyze the stability of nonlinear systems with quantized feedback in the presence of exogenous disturbances. They show that, under appropriate assumptions using nonlinear modification of the scheme proposed by Liberzon and Nesic, it is possible to adjust the parameters of the switching scheme and the quantizer to achieve input-to-state (ISS) and nonlinear gain l_2 stability for these systems. ISS is also addressed in the paper by Lieu and Hill, which studies the uniform stability and ISS properties for discrete-time impulsive hybrid systems via comparison approach, employing the vector-value function.

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On the optimal-control front, Sui, Feng, and Hovd descibe an output feedback time-optimal control approach for constrained linear systems with bounded disturbances. Moving horizon estimation is used to estimate the states. The terminal controller, comprising several predetermined local linear feedback laws, combines the merits of the underlying standard time optimal controllers resulting in a system with a large attraction domain, a good asymptotic performance and a low on-line computational effort. Minami, Azuma, and Sugie propose an optimal feedback quantizer for a class of n-dimensional system with discrete-valued input. This quantizer is applied to the generation of binary halftone images.

Finally, the paper by Bect presents a general formulation of the Fokker–Planck–Kolmogorov (FPK) equation for stochastic hybrid systems within the framework of generalized stochastic hybrid systems (GSHS). This work attempts to unify the different instances of the FPK equation for stochastic hybrid systems, and provides GSHS practitioners with a tool to derive the evolution equation for the probability law of a given state.

Last but not least, we express our sincere thanks to the reviewers for their valuable assistance and contribution to the reviewing process for this special issue.

Guest Editors of the special issue:
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