IEEE CONTROL SYSTEMS SOCIETY TECHNICAL COMMITTEE ON DISCRETE EVENT SYSTEMS

Newsletter..... August 2016

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Editorial

Welcome to the newsletter of the IEEE Control Systems Technical Committee on Discrete Event Systems!

Personal note from the editor:

WELCOME TO THE AUGUST 2016 NEWSLETTER.

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Activities

2.1 Sponsored Activities

2016 Conference on Decision and Control
Las Vegas, United States, Dec 12 - Dec 14, 2016
http://cdc2016.ieeecss.org/

2016 Multi-Conference on Systems and Control
Buenos Aires, Argentina, Sep 19 - Sep 22, 2016
http://www.msc2016.org/

2.2 Technically Co-Sponsored activities

14th International Conference on Control, Automation, Robotics and Vision (ICARCV 2016)
Phuket, Thailand, Nov 13 - Nov 15, 2016
http://www.icarcv.org/2016

20th International Conference on System Theory, Control and Computing (ICSTCC 2016)

Sinaia, Romania, Oct 13 - Oct 15, 2016
http://ace.ucv.ro/icstcc2016/

3rd Conference on Control and Fault-Tolerant Systems (SysTol'16)
Barcelona, Spain, Sep 7 - Sep 9, 2016
http://systol16.cs2ac.upc.edu/

The 35th Chinese Control Conference
Chengdu, China, Jul 27 - Jul 29, 2016
http://ccc2016.swjtu.edu.cn/

2016 IEEE Conference on Norbert Wiener in the 21st Century: Thinking Machines in the Physical World
Melbourne, Australia, Jul 13 - Jul 15, 2016
http://21stcenturywiener.org/

Selections of Journal Publications

Contributed by: Jin Dai (jdai1@nd.edu)

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SELECTIONS OF THE IEEE TRANSACTIONS ON AUTOMATIC CONTROL
VOLUME: 61, ISSUE: 8,
AUGUST 2016

(1) Event-Triggered State Observers for Sparse Sensor Noise/Attacks

Author: Yasser Shoukry, and Paulo Tabuada

Abstract

This paper describes two algorithms for state reconstruction from sensor measurements that are corrupted with sparse, but otherwise arbitrary, ° ∞noise.° ± These results are motivated by the need to secure cyber-physical systems against a malicious adversary that can arbitrarily corrupt sensor measurements. The first algorithm reconstructs the state from a batch of

sensor measurements while the second algorithm is able to incorporate new measurements as they become available, in the spirit of a Luenberger observer. A distinguishing point of these algorithms is the use of event-triggered techniques to improve the computational performance of the proposed algorithms.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7308014&filter%3DAND%28p_IS_Number%3A7523352%29

(2) A Notion of Robustness for Cyber-Physical Systems

Author: Matthias Rungger, and Paulo Tabuada

Abstract

Robustness as a system property describes the degree to which a system is able to function correctly in the presence of disturbances, i.e., unforeseen or erroneous inputs. In this paper, we introduce a notion of robustness termed input-output dynamical stability for cyber-physical systems (CPS) which merges existing notions of robustness for continuous systems and discrete systems. The notion captures two intuitive aims of robustness: bounded disturbances have bounded effects and the consequences of a sporadic disturbance disappear over time. We present a design methodology for robust CPS which is based on an abstraction and refinement process. We suggest several novel notions of simulation relations to ensure the soundness of the approach. In addition, we show how such simulation relations can be constructed compositionally. The different concepts and results are illustrated throughout the paper with examples.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7300397&filter%3DAND%28p_IS_Number%3A7523352%29

(3) A Uniform Approach for Synthesizing Property-Enforcing Supervisors for Partially-Observed Discrete-Event Systems

Author: Xiang Yin, and Stephane Lafortune

Abstract

The problem under consideration in this paper is that of enforcement by supervisory control of a given property on a partially-observed discrete-event system. We present a general methodology that is applicable to a large class of properties previously studied (individually) in the literature. These properties include, but are not restricted to, safety, diagnosability, opacity, detectability, anonymity

and attractability. When the given system does not satisfy the considered property, the objective is to synthesize a supervisor that restricts the system's behavior and provably enforces the given property; moreover, it is required that this supervisor be maximally permissive. We consider the general case where the system's events are partitioned into observable and unobservable events, and controllable and uncontrollable events, and we do not make any assumptions about these two partitions; in particular, we do not assume that all controllable events are observable. Our uniform approach first maps the considered property to a suitably-defined information state for the partially-observed system and then develops a supervisor synthesis methodology based on a finite bipartite transition system that embeds all reachable information states and all admissible supervisory control strategies. This transition system is called the All Enforcement Structure (or AES). We present an algorithm for the construction of the AES and discuss its properties. Then we use the AES to develop a synthesis algorithm that constructs a supervisor that is provably property enforcing and maximally permissive. We illustrate the application of our uniform approach to the enforcement of the above-mentioned properties.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7286769&filter%3DAND%28p_IS_Number%3A7523352%29

(4) On the Steady-State Control of Timed Event Graphs With Firing Date Constraints

Author: Vinicius Mariano Goncalves, Carlos Andrey Maia, and Laurent Hardouin

Abstract

Two algorithms for solving a specific class of steady-state control problems for Timed Event Graphs are presented. In the first, asymptotic convergence to the desired set is guaranteed. The second algorithm, which builds on from the recent developments in the spectral theory of min-max functions, guarantees Lyapunov stability since the distance between the actual state and the desired set never increases. Simulation results show the efficiency of the proposed approach in a problem of moderate complexity.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7275154&filter%3DAND%28p_IS_Number%3A7523352%29

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SELECTIONS OF THE IEEE TRANSACTIONS ON ROBOTICS
VOLUME: 32 ISSUE: 3
JUNE 2016

(1) Iterative Temporal Planning in Uncertain Environments With Partial Satisfaction Guarantees

Author: Morteza Lahijanian, Matthew R. Maly, Dror Fried, Lydia E. Kavraki, Hadas Kress-Gazit, and Moshe Y. Vardi

Abstract

This paper introduces a motion-planning framework for a hybrid system with general continuous dynamics to satisfy a temporal logic specification consisting of cosafety and safety components in a partially unknown environment. The framework employs a multilayered synergistic planner to generate trajectories that satisfy the specification and adopt an iterative replanning strategy to deal with unknown obstacles. When the discovery of an obstacle renders the specification unsatisfiable, a division between the constraints in the specification is considered. The cosafety component of the specification is treated as a soft constraint, whose partial satisfaction is allowed, while the safety component is viewed as a hard constraint, whose violation is forbidden. To partially satisfy the cosafety component, inspirations are taken from indoor-robotic scenarios, and three types of (unexpressed) restrictions on the ordering of subtasks in the specification are considered. For each type, a partial satisfaction method is introduced, which guarantees the generation of trajectories that do not violate the safety constraints while attending to partially satisfying the cosafety requirements with respect to the chosen restriction type. The efficacy of the framework is illustrated through case studies on a hybrid car-like robot in an office environment.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7469409&filter%3DAND%28p_IS_Number%3A7484799%29

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SELECTIONS FROM AUTOMATICA
VOLUME: 70
AUGUST 2016

(1) Irredundant lattice representations of continuous piecewise affine functions

Author: Jun Xu, Ton J.J. van den Boom, Bart De Schutter, and Shuning Wang

Abstract

In this paper, we revisit the full lattice representation of continuous piecewise affine (PWA) functions and give a formal proof of its representation ability. Based on this, we derive the irredundant lattice PWA representations through removal of redundant terms and literals. Necessary and sufficient conditions for irredundancy are proposed. Besides, we explain how to remove terms and literals in order to ensure irredundancy. An algorithm is given to obtain an irredundant lattice PWA representation. In the worked examples, the irredundant lattice PWA representations are used to express the optimal solution of explicit model predictive control problems, and the results turn out to be much more compact than those given by a state-of-the-art algorithm.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S000510981630098X

(2) Multi-agent planning under local LTL specifications and event-based synchronization

Author: Jana Tumova, and Dimos V. Dimarogonas

Abstract

We study the problem of plan synthesis for multi-agent systems, to achieve complex, high-level, long-term goals that are assigned to each agent individually. As the agents might not be capable of satisfying their respective goals by themselves, requests for other agents° Ø collaborations are a part of the task descriptions. We consider that each agent is modeled as a discrete state-transition system and its task specification takes a form of a linear temporal logic formula. A traditional automata-based approach to multi-agent plan synthesis from such specifications builds on centralized team planning and full team synchronization after each agents° Ø discrete step, and thus suffers from extreme computational demands. We aim at reducing the computational complexity by decomposing the plan synthesis problem into finite horizon planning problems that are solved iteratively, upon the run of the agents. We introduce an event-based synchronization that allows our approach to efficiently adapt to different time durations of different agents° Ø discrete steps. We discuss the correctness of the solution and find assumptions, under which the proposed iterative algorithm leads to provable eventual satisfaction of the desired specifications.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S0005109816301285

(3) Event-based control of linear hyperbolic systems of conservation laws

Author: Nicolas Espitia, Antoine Girard, Nicolas Marchand, and Christophe Prieur

Abstract

In this article, we introduce event-based boundary controls for 1-dimensional linear hyperbolic systems of conservation laws. Inspired by event-triggered controls developed for finite-dimensional systems, an extension to the infinite dimensional case by means of Lyapunov techniques, is studied. The main contribution of the paper lies in the definition of two event-triggering conditions, by which global exponential stability and well-posedness of the system under investigation is achieved. Some numerical simulations are performed for the control of a system describing traffic flow on a roundabout.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S0005109816301315

(4) Model predictive control for discrete event systems with partial synchronization

Author: Xavier David-Henriet, Laurent Hardouinb, Jorg Raischa, and Bertrand Cottenceau

Abstract

In this paper, we consider discrete event systems divided in a main system and a secondary system such that the inner dynamics of each system is ruled by standard synchronizations and the interactions between both systems are expressed by partial synchronizations (i.e. event e2 can only occur when, not after, event e1 occurs) of events in the secondary system by events in the main system. The main contribution consists in adapting model predictive control, developed in the literature for (max,+)-linear systems, to the considered class of systems. This problem is solved under the condition that the performance of the main system is never degraded to improve the performance of the secondary system. Then, the optimal input is selected to respect the output reference and the remaining degrees of freedom are used to ensure just-in-time behavior. The unconstrained problem is solved in linear time with respect to the length of the prediction horizon.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S0005109815005385

(5) Event-triggered leader-following tracking control for multivariable multi-agent systems

Author: Yi Cheng, and Valery Ugrinoviskii

Abstract

The paper considers event-triggered leader®Cfollower tracking control for multi-agent systems with general linear dynamics. For both undirected and directed follower graphs, we propose event triggering rules which guarantee bounded tracking errors. With these rules, we also prove that the systems do not exhibit Zeno behavior, and the bounds on the tracking errors can be tuned to a desired small value. We also show that the combinational state required for the proposed event triggering conditions can be continuously generated from discrete communications between the neighboring agents occurring at event times. The efficacy of the proposed methods is discussed using a simulation example.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S000510981630125X

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SELECTIONS FROM DISCRETE EVENT DYNAMIC SYSTEMS: THEORY AND APPLICATIONS
VOLUME 26, ISSUE 3
SEPTEMBER, 2016

(1) Tight performance bounds in the worst-case analysis of feed-forward networks

Author: Anne Bouillard, and Eric Thierry

Abstract

Network Calculus theory aims at evaluating worst-case performances in communication networks. It provides methods to analyze models where the traffic and the services are constrained by some minimum and/or maximum envelopes (arrival/service curves). While new applications come forward, a challenging and inescapable issue remains open: achieving tight analyzes of networks with aggregate multiplexing. The theory offers efficient methods to bound maximum end-to-end delays or local backlogs. However as shown in a recent breakthrough paper (Schmitt et al. 2008), those bounds can be arbitrarily far from the exact worst-case values, even in seemingly simple feed-forward networks (two flows and two servers), under

blind multiplexing (i.e. no information about the scheduling policies, except FIFO per flow). For now, only a network with three flows and three servers, as well as a tandem network called sink tree, have been analyzed tightly.We describe the first algorithm which computes the maximum end-to-end delay for a given flow, as well as the maximum backlog at a server, for any feed-forward network under blind multiplexing, with piecewise affine concave arrival curves and piecewise affine convex service curves. Its computational complexity may look expensive (possibly super-exponential), but we show that the problem is intrinsically difficult (NP-hard). Fortunately we show that in some cases, like tandem networks with cross-traffic interfering along intervals of servers, the complexity becomes polynomial. We also compare ourselves to the previous approaches and discuss the problems left open.

Full-text available at:
http://link.springer.com/article/10.1007/s10626-015-0213-2

(2) Determinization of timed Petri nets behaviors

Author: Jan Komenda, Sebastien Lahaye, and Jean-Louis Boimond

Abstract

In this paper we are interested in sequentialization of formal power series with coefficients in the semiring (R° »{?° fi},max,+)(R° »{?° fi},max,+) which represent the behavior of timed Petri nets. Several approaches make it possible to derive nondeterministic (max, +) automata modeling safe timed Petri nets. Their nondeterminism is a serious drawback since determinism is a crucial property for numerous results on (max, +) automata (in particular, for applications to performance evaluation and control) and existing procedures for determinization succeed only for restrictive classes of (max, +) automata. We present a natural semi-algorithm for determinization of behaviors based on the semantics of bounded timed Petri nets. The resulting deterministic (max, +) automata can be infinite, but a sufficient condition called strong liveness is proposed to ensure the termination of the semi-algorithm. It is shown that strong liveness is closely related to bounded fairness, which has been widely studied for Petri nets and other models for concurrency. Moreover, if the net cannot be sequentialized we propose a restriction of its logical behavior so that the sufficient condition becomes satisfied for the restricted net. The restriction is based on the synchronous product with non injectively labeled scheduler nets that are built in an incremental hierarchical way from simple scheduler nets.

Full-text available at:
http://link.springer.com/article/10.1007/s10626-015-0214-1

(3) The evaluation of pedestrians° Ø behavior using M/G/C/C analytical, weighted distance and real distance simulation models

Author: Ruzelan Khalid, Mohd. Kamal Mohd. Nawawi, Luthful A. Kawsar, Noraida A. Ghani, Anton A. Kamil, and Adli Mustafa

Abstract

M/G/C/C analytical and simulation models have long been used to evaluate the performance of a large and complex topological network. However, such evaluation is only founded on a network° Øs total arrival rate and its weighted distance. Thus, this paper discusses some concepts and issues in building an M/G/C/C simulation model of a complex geometric system where all its arrival sources and their exact distances to the end of their networks (i.e., corridors) have been taken into consideration in measuring the impacts of various evacuation rates to its throughput, blocking probability, expected service time and expected number of pedestrians. For this purpose, the Dewan Tuanku Syed Putra hall, Universiti Sains Malaysia, Malaysia has been selected as a case study for various evaluations of complex pedestrian flows. These results were analyzed and compared with the results of our analytical and weighted distance simulation models. We then documented the ranges of arrival rates for each of the model where their results exhibited significant discrepancies and suggest ideal rates to best evacuate occupants from the hall. Our model can be utilized by policy makers to recommend suitable actions especially in emergency cases and be modified to build and measure the performance of other real-life complex systems.

Full-text available at:
http://link.springer.com/article/10.1007/s10626-015-0215-0

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SELECTIONS FROM INTERNATIONAL JOURNAL OF CONTROL
PUBLISHED ONLINE JUNE AND JULY 2016

(1) Observer-based event-driven fault-tolerant control for a class of system with state-dependent uncertainties

Author: J. Feng, and N. Li

Abstract

The method of designing an event-driven observer-based fault-tolerant controller is addressed for a state-dependent system with external disturbance and fault in this paper. An event-driven criterion is proposed to determine the updating of the controller based on the state of the Luenberger-type state-dependent observer. As a result, communication resources can be saved significantly while the desired H° fi performance is preserved. The observer error closed-loop system is rewritten as a time-varying delay system. By employing a state-dependent integral function to be a Lyapunov function candidate, the error system is proved to be asymptotically stable. The observer gain, the controller gain and the event parameters in the event condition can be co-designed and obtained in terms of solution to a set of linear matrix inequalities (LMIs). Finally, a numerical example and the tunnel diode circuit model are shown that the proposed method is effective, and the simulation results can reflect that the event-triggered scheme can lead to a larger release period than time-triggering scheme.

Full-text available at:
http://www.tandfonline.com/doi/full/10.1080/00207179.2016.1190986
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