IEEE CONTROL SYSTEMS SOCIETY TECHNICAL COMMITTEE ON DISCRETE EVENT SYSTEMS

Newsletter..... July 2016

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Contents:

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Editorial

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

Personal note from the editor:

WELCOME TO THE JULY 2016 NEWSLETTER.

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Activities

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2.1 Sponsored Activities

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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/

2016 American Control Conference
Boston, United States, Jul 6 - Jul 8, 2016
http://acc2016.a2c2.org/

2.2 Technically Co-Sponsored activities

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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/

24th Mediterranean Conference on Control and Automation (MED'16)
Athens, Greece, Jun 21 - Jun 24, 2016
http://www.med2016.org/

12th World Congress on Intelligent Control and Automation (WCICA 2016)
Guilin, China, Jun 12 - Jun 17, 2016
http://wcica2016.org/

2016 International Conference on Unmanned Aircraft Systems (ICUAS'16)
Arlington, United States, Jun 7 - Jun 10, 2016
http://www.uasconferences.com/

2.3 DES TC meeting during ACC2016

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We held our TC meeting this year on July 7th during ACC' 2016 at Boston. Ten TC members attended the meeting and many issues, ranging from TC webpage, wiki page updates, JDEDS publications, workshops, nominations for co-chairs, and possible collaborations with IFAC and IEEE other TCs. A summary of the TC meeting will be sent out to every TC member later this month.

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: 7,
JULY 2016

(1) Characterization of Admissible Marking Sets in Petri Nets with Uncontrollable Transitions

Author: Shouguang Wang, Dan You, MengChu Zhou, and Carla Seatzu

Abstract

This work studies the equivalent transformation from a legal marking set to its admissible marking set. First, the concepts of escaping-marking set and transforming marking set are defined, and two algorithms are provided to compute the transforming marking set and the admissible marking set. Second, the equivalent transformation of a disjunction of linear constraints expressed in terms of generalized mutual exclusion constraints (GMECs) with non-negative weights via uncontrollable transitions is established.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7272077&filter%3DAND%28p_IS_Number%3A7499900%29%26pageNumber%3D2

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SELECTIONS OF THE IEEE TRANSACTIONS ON CONTROL OF NETWORK SYSTEMS
VOLUME: 3 ISSUE: 2
JUNE 2016

(1) Traffic Network Control From Temporal Logic Specifications

Author: Samuel Coogan, Ebru Aydin Gol, Murat Arcak, and Calin Belta

Abstract

We propose a framework for generating a signal control policy for a traffic network of signalized intersections to accomplish control objectives expressible using linear temporal logic. By applying techniques from model checking and formal methods, we obtain a correct-by-construction controller that is guaranteed to satisfy complex specifications. To apply these tools, we identify and exploit structural properties particular to traffic networks that allow for efficient computation of a finite-state abstraction. In particular, traffic networks exhibit a componentwise monotonicity property which enables reaching set computations that scale linearly with the dimension of the continuous state space.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7100902&filter%3DAND%28p_IS_Number%3A7494747%29

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SELECTIONS FROM THE IEEE TRANSACTIONS ON CONTROL SYSTEM TECHNOLOGY
VOLUME 24, ISSUE 4
JULY 2016

(1) Correct-by-Construction Adaptive Cruise Control: Two Approaches

Author: Petter Nilsson, Omar Hussien, Ayca Balkan, Yuxiao Chen, Aaron D. Ames, Jessy W. Grizzle, Necmiye Ozay, Huei Peng, and Paulo Tabuada

Abstract

Motivated by the challenge of developing control software provably meeting specifications for real-world problems, this paper applies formal methods to adaptive cruise control (ACC). Starting from a linear temporal logic specification for ACC, obtained by interpreting relevant ACC standards, we discuss in this paper two different control software synthesis methods. Each method produces a controller that is correct-by-construction, meaning that trajectories of the closed-loop systems provably meet the specification. Both methods rely on fixed-point computations of certain set-valued mappings. However, one of the methods performs these computations on the continuous state space whereas the other method operates on a finite-state abstraction. While controller synthesis is based on a low-dimensional model, each controller is tested on CarSim, an industry-standard vehicle simulator. Our results demonstrate several advantages over classical control design techniques. First, a formal approach to control design removes potential ambiguity in textual specifications by translating them into precise mathematical requirements. Second, because the resulting closed-loop system is known a priori to satisfy the specification, testing can then focus on the validity of the models used in control design and whether the specification captures the intended requirements. Finally, the set from where the specification (e.g., safety) can be enforced is explicitly computed and thus conditions for passing control to an emergency controller are clearly defined.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7349170&filter%3DAND%28p_IS_Number%3A7488303%29

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SELECTIONS FROM AUTOMATICA
VOLUME 69
JULY 2016

(1) Event-based state estimation of linear dynamic systems with unknown exogenous inputs

Author: Dawei Shi, Tongwen Chen, and Mohamed Darouach

Abstract

In this work, an event-based optimal state estimation problem for linear-time varying systems with unknown inputs is investigated. By treating the unknown input as a process with a non-informative prior, the event-based minimum mean square error

(MMSE) estimator is obtained in a recursive form. It is shown that for the general time-varying case, the closed-loop matrix of the optimal event-based estimator is exponentially stable and the estimation error covariance matrix is asymptotically bounded for each sample path of the event-triggering process. The results are also extended to the multiple sensor scenario, where each sensor is allowed to have its own event-triggering condition. The efficiency of the proposed results is illustrated by a numerical example and comparative simulation with the MMSE estimators obtained based on time-triggered measurements. The results are potentially applicable to event-based secure state estimation of cyber-physical systems.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S0005109816300632

(2) Decentralized event-triggered consensus for linear multi-agent systems under general directed graphs

Author: Dapeng Yang, Wei Ren, Xiangdong Liu, and Weisheng Chen

Abstract

In this paper, the event-triggered consensus problem is studied for multi-agent systems with general linear dynamics under a general directed graph. Based on state feedback, we propose a decentralized event-triggered consensus controller (ETCC) for each agent to achieve consensus, without requiring continuous communication among agents. Each agent only needs to monitor its own state continuously to determine when to trigger an event and broadcast its states to its out-neighbors. The agent updates its controller when it broadcasts its states to its out-neighbors or receives new information from its in-neighbors. The ETCC can be implemented in multiple steps. it is proved that under the proposed ETCC there is no Zeno behavior exhibited. To relax the requirement of continuous monitoring of each agent° Øs own states, we further propose a self-triggered consensus controller (STCC). Simulation results are given to illustrate the theoretical analysis and show the advantages of the event-triggered and self-triggered controllers proposed in this paper.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S0005109816300826

(3) Decentralized fault prognosis of discrete event systems with guaranteed performance bound

Author: Xiang Yin, and Zhaojian Li

Abstract

We study the problem of decentralized fault prognosis of partially-observed discrete event systems. In order to capture the prognostic performance issue in the prognosis problem, we propose two new criteria: (1) all faults can be predicted K steps ahead; and (2) a fault will occur for sure within M steps once a fault alarm is issued; and we refer to (M,K) as the performance bound of the prognostic system. A necessary and sufficient condition for the existence of a decentralized supervisor satisfying these two criteria is provided, which is termed as (M,K)-coprognosability. A polynomial-time algorithm for the verification of (M,K)-coprognosability is also proposed. Finally, we show that the proposed approach is applicable to both disjunctive and conjunctive architectures. Our results generalize previous work on decentralized fault prognosis.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S0005109816300954

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SELECTIONS FROM ANNUAL REVIEWS IN CONTROL

VOLUME 41, 2016

(1) Overview of discrete event systems opacity: Models, validation, and quantification

Author: Romain Jacob, Jean-Jacques Lesage, and Jean-Marc Faure

Abstract

Over the last decade, opacity of discrete event systems (DES) has become a very fertile field of research. Driven by safety and privacy concerns in network communications and online services, much theoretical work has been conducted in order to design opaque systems. A system is opaque if an external observer in unable to infer a ° ∞secret° ± about the system behavior. This paper aims to review the most commonly used techniques of opacity validation for deterministic models and opacity quantification for probabilistic ones. Available complexity results are also provided. Finally, we review existing tools for opacity validation and current applications.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S1367578816300189

(2) A discussion of fault-tolerant supervisory control in terms of formal languages

Author: Thomas Moor

Abstract

A system is fault tolerant if it remains functional after the occurrence of a fault. Given a plant subject to a fault, fault-tolerant control requires the controller to form a fault-tolerant closed-loop system. For the systematic design of a fault-tolerant controller, typical input data consists of the plant dynamics including the effect of the faults under consideration and a formal performance requirement with a possible allowance for degraded performance after the fault. For its obvious practical relevance, the synthesis of fault-tolerant controllers has received extensive attention in the literature, however, with a particular focus on continuous-variable systems. The present paper addresses discrete-event systems and provides an overview on fault-tolerant supervisory control. The discussion is held in terms of formal languages to uniformly present approaches to passive fault-tolerance, active fault-tolerance, post-fault recovery and fault hiding.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S1367578816300049

(3) Real-time management of complex resource allocation systems: Necessity, achievements and further challenges

Author: Spyros Reveliotis

Abstract

Many contemporary applications, ranging from flexibly automated production systems, to automated material handling and intelligent transportation systems, to internet-based workflow management systems, and more recently, to the massively parallelized software systems that emerge in the context of the novel multi-core computing architectures, can be perceived as a set of finite resources that support a number of concurrently running processes. These processes execute in a staged manner and, at each stage, they vie for the allocation of various subsets of the system resources. To effectively support and manage the extensive levels of concurrency and operational flexibility that are contemplated for these environments, and the ensuing complexity, there is a substantial need for formal models and tools that will enable the modeling, analysis and eventually the control of the aforementioned resource allocation function so that the resulting dynamics are, both, behaviorally correct and operationally efficient. This article

overviews a research program that seeks to address the aforementioned need by using the unifying abstraction of the resource allocation system (RAS) and supporting modeling frameworks, like automata, Petri nets, and Markov reward and decision processes, borrowed from the area of Discrete Event Systems (DES) theory. The presented results take advantage of the special structure that exists in the considered RAS classes, and they are characterized by their analytical rigor and computational tractability. The article also highlights the further challenges that must be addressed for the successful completion and promotion of the pursued framework.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S1367578816300128

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SELECTIONS FROM DISCRETE EVENT DYNAMIC SYSTEMS: THEORY AND APPLICATIONS
ARTICLES NOT ASSIGNED TO AN ISSUE

(1) Computation of the delay bounds and synthesis of diagnosers for decentralized diagnosis with conditional decisions

Author: Shoichi Yokota, Takashi Yamamoto, and Shigemasa Takai

Abstract

We consider decentralized diagnosis of discrete event systems in the conditional disjunctive and conjunctive architectures, where the local failure decision and local nonfailure decision are conditional, respectively. For each of these architectures, a notion of conditional codiagnosability, which guarantees the detection of any failure by conditional decentralized diagnosis within a bounded number of steps, has been defined in the literature. In this paper, we compute the minimum number of steps, called the delay bound, within which the occurrence of any failure can be detected in a conditionally codiagnosable system. The delay bound is important to evaluate the ability of diagnosis. In addition, we use the computed delay bound to synthesize local diagnosers with conditional decisions.

Full-text available at:
http://link.springer.com/article/10.1007/s10626-016-0229-2

(2) Supervisory control for collision avoidance in vehicular networks using discrete event abstractions

Author: Eric Dallal, Alessandro Colombo, Domitilla Del Vecchio, and St®¶phane Lafortune

Abstract

We consider the problem of controlling a set of vehicles at an intersection, in the presence of uncontrolled vehicles and a bounded disturbance. We begin by discretizing the system in space and time to construct a suitable discrete event system (DES) abstraction, and formally define the problem to be solved as that of constructing a supervisor over the discrete state space that is safe (i.e., collision-free), non-deadlocking (i.e., the vehicles all cross the intersection eventually), and maximally permissive with respect to the chosen discretization. We show how to model the uncontrolled vehicles and the disturbance through uncontrollable events of the DES abstraction. We define two types of relations between systems and their abstraction: state reduction and exact state reduction. We prove that, when the abstraction is a state reduction of a continuous system, then we can obtain a safe, non-deadlocking, and maximally permissive memoryless supervisor. This is obtained by translating safety and non-deadlocking specifications to the abstract domain, synthesizing the supervisor in this domain, and finally translating the supervisor back to the concrete domain. We show that, when the abstraction is an exact state reduction, the resulting supervisor will be maximally permissive among the class of all supervisors, not merely memoryless ones. Finally, we provide a customized algorithm and demonstrate its scalability through simulation.

Full-text available at:
http://link.springer.com/article/10.1007/s10626-016-0228-3

(3) Compromise approach for predictive control of Timed Event Graphs with specifications defined by P-time Event Graphs

Author: Philippe Declerck

Abstract

In this paper, the aim is to make the predictive control of a plant described by a Timed Event Graph which follows the specifications defined by a P-time Event Graph. We propose a compromise approach between the ideal optimality of the solution and the on-line application of the computed solution when the relevant optimal control cannot be applied for a given computer. The technique is based on a reduction of the number of iterations of the fixed point algorithm such that the computed control remains causal. The analysis of the partial satisfaction of the specifications at each iteration of the algorithm defined in the (max, +) algebra shows that a subset

of constraints is guaranteed by the control computed at each iteration while another one is possibly satisfied.

Full-text available at:
http://link.springer.com/article/10.1007/s10626-016-0227-4

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

(1) Event-triggered filtering and fault estimation for nonlinear systems with stochastic sensor saturations

Author: Yang Liu, Zidong Wang, Xiao He, and D. H. Zhou

Abstract

This paper is concerned with the filtering problem for a class of nonlinear systems with stochastic sensor saturations and event-triggered measurement transmissions. An event-triggered transmission scheme is proposed with hope to ease the traffic burden and improve the energy efficiency. The measurements are subject to randomly occurring sensor saturations governed by Bernoulli-distributed sequences. Special effort is made to obtain an upper bound of the filtering error covariance in the presence of linearisation errors, stochastic sensor saturations as well as event-triggered transmissions. A filter is designed to minimise the obtained upper bound at each time step by solving two sets of Riccati-like matrix equations, and thus the recursive algorithm is suitable for online computation. Sufficient conditions are established under which the filtering error is exponentially bounded in mean square. The applicability of the presented method is demonstrated by dealing with the fault estimation problem. An illustrative example is exploited to show the effectiveness of the proposed algorithm.

Full-text available at:
http://www.tandfonline.com/doi/full/10.1080/00207179.2016.1199916

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