IEEE CONTROL SYSTEMS SOCIETY TECHNICAL COMMITTEE ON DISCRETE EVENT SYSTEMS

Newsletter..... April 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 APRIL 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/

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

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/

13th International Workshop on Discrete Event Systems (WODES 2016)
Xi'an, China, May 30 - Jun 1, 2016
http://wodes2016.diee.unica.it/

2016 5th International Conference on Systems and Control (ICSC'16)

Marrakech, Morocco, May 25 - May 27, 2016
http://lias.labo.univ-poitiers.fr/icsc/icsc2016/

14th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks
Tempe, United States, May 9 - May 13, 2016
http://www.wi-opt.org/

Selections of Journal Publications

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

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Selections from the IEEE Transactions on Automatic Control
VOLUME: 61, ISSUE: 4,
APR 2016

(1) Transient Performance Analysis of Serial Production Lines With Geometric Machines
Author: Guorong Chen, Chuanfeng Wang, Liang Zhang, Jorge Arinez, and Guoxian Xiao

Abstract

A production system is characterized by both its steady state and transient properties. While extensive research efforts have been spent in the analysis of the steady state of production systems, very few results, especially analytical ones, have been reported regarding their transient behavior. Indeed, transient behavior of production systems has significant practical and theoretical implications. A better understanding of the transient properties of production systems is critical to effective utilization of real-time production data for efficient factory floor operation and management. In the framework of serial production lines with geometric machines and finite buffers, this paper develops mathematical models for transient analysis and derives closed-form expressions for evaluating the production rate, consumption rate, work-in-process, and probabilities of machine starvation and blockage, during transients. In addition, a computationally efficient algorithm based on aggregation is developed to

approximate the transient performance measures with high accuracy. Numerical experiments show that the methods developed can be applied to systems with time-varying machine parameters as well.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7122286&filter%3DAND%28p_IS_Number%3A7442193%29

(2) Verification of Hybrid Automata Diagnosability With Measurement Uncertainty

Author: Yi Deng, Alessandro D��Innocenzo, Maria Domenica Di Benedetto, Stefano Di Gennaro, and A. Agung Julius

Abstract

The problem of system diagnosability verification is concerned with whether a fault in the system operation can be diagnosed by using the system model and observations of the system output. In this paper, we investigate the (δ_{d},δ_{m})-diagnosability of hybrid automata, which characterizes the maximum delay for diagnosing faults since their first occurrence, given the measurement uncertainty in observing the system output.

Full-text available at:http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7154423&filter%3DAND%28p_IS_Number%3A7442193%29

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SELECTIONS FROM THE IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING
VOLUME: 13 ISSUE: 2
APR 2016

(1) Synthesis of Human-in-the-Loop Control Protocols for Autonomous Systems

Author: Lu Feng, Clemens Wiltsche, Laura Humphrey, and Ufuk Topcu

Abstract

We propose an approach to synthesize control protocols for autonomous systems that account for uncertainties and imperfections in interactions with human operators.

As an illustrative example, we consider a scenario involving road network surveillance by an unmanned aerial vehicle (UAV) that is controlled remotely by a human operator but also has a certain degree of autonomy. Depending on the type (i.e., probabilistic and/or nondeterministic) of knowledge about the uncertainties and imperfections in the human–automation interactions, we use abstractions based on Markov decision processes and augment these models to stochastic two-player games. Our approach enables the synthesis of operator-dependent optimal mission plans for the UAV, highlighting the effects of operator characteristics (e.g., workload, proficiency, and fatigue) on UAV mission performance. It can also provide informative feedback (e.g., Pareto curves showing the trade-offs between multiple mission objectives), potentially assisting the operator in decision-making. We demonstrate the applicability of our approach via a detailed UAV mission planning case study.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7428972&filter%3DAND%28p_IS_Number%3A7447676%29

(2) Computationally Aware Switching Criteria for Hybrid Model Predictive Control of Cyber-Physical Systems

Author: Kun Zhang, Jonathan Sprinkle, and Ricardo G. Sanfelice

Abstract

This paper describes hybrid model predictive controllers that switch between two predictor functions based on the uncontrollable divergence metric. The uncontrollable divergence metric relates the computational capabilities of the model predictive controller, to the error of the system due to model mismatch of the predictor function during computation of the solution. The contribution of this paper is in its treatment of the model predictive controller to permit optimization to take multiple timesteps to occur, but still rely on the uncontrollable divergence metric. The results demonstrate the approach for control of a vertical takeoff-and-landing aerial vehicle.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7426423&filter%3DAND%28p_IS_Number%3A7447676%29

(3) Modeling and Analysis of Ward Patient Rescue Process on the Hospital Floor

Author: Xiaolei Xie, Jingshan Li, Colleen H. Swartz, Yue Dong, and Paul DePriest

Abstract

On the hospital floor, prompt detection and appropriate treatment of clinical deterioration of ward patients are essential for successful rescue. In this paper, a continuous time Markov chain model is presented to describe the ward patient status and analyze the patient rescue processes, which are characterized by the transitions between different patient states, such as risk, non-risk, intervention by care providers (nurse, physician, rapid response team), or elevation to intensive care, etc. Closed formulas to calculate the probability of the patient in different states are developed for single patient case. A system-theoretic method, referred to as shared resource iteration (SRI), is developed to study the multiple patients scenario. It is justified that such an iterative method is convergent and results in a high accuracy in estimation of patient state probabilities through numerical experiments. Moreover, monotonic properties have been investigated to provide guidance for continuous improvement.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6966798&filter%3DAND%28p_IS_Number%3A7447676%29

(4) Modeling and Verification of Online Shopping Business Processes by Considering Malicious Behavior Patterns

Author: WangYang Yu, Chun Gang Yan, ZhiJun Ding, ChangJun Jiang, and MengChu Zhou

Abstract

Recently, online shopping integrating third-party payment platforms (TPPs) introduces new security challenges due to complex interactions between Application Programming Interfaces (APIs) of Merchants and TPPs. Malicious clients may exploit security vulnerabilities by calling APIs in an arbitrary order or playing various roles. To deal with the security issue in the early stages of system development, this paper presents a formal method for modeling and verification of online shopping business processes with malicious behavior patterns considered based on Petri nets. We propose a formal model called E-commerce Business Process Net to model a normal online shopping business process that represent intended functions, and malicious behavior patterns representing a potential attack that violates the security goals at the requirement analysis phase. Then, we synthesize the normal business process and malicious behavior patterns by an incremental modeling method. According to the synthetic model, we analyze whether an online shopping business process is resistant to the known malicious behavior patterns. As a result, our approach can make the software design provably secured from the malicious attacks at process design time and, thus, reduces the difficulty and cost of modification for imperfect systems at the release phase. We demonstrate our approach through a case study.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6960112&filter%3DAND%28p_IS_Number%3A7447676%29%26pageNumber%3D2

(5) A Timed Petri Nets Model for Performance Evaluation of Intermodal Freight Transport Terminals

Author: Mariagrazia Dotoli, Nicola Epicoco, Marco Falagario, and Graziana Cavone

Abstract

This paper presents a general modeling framework for Intermodal Freight Transport Terminals (IFTTs). The model allows simulating and evaluating the performance of such key elements of the intermodal transportation chain. Hence, it may be used by the decision maker to identify the IFTT bottlenecks, as well as to test different solutions to improve the IFTT dynamics. The proposed modeling framework is modular and based on timed Petri Nets (PNs), where places represent resources and capacities or conditions, transitions model inputs, flows, and activities into the terminal and tokens are intermodal transport units or the means on which they are transported. The model is able to represent the different types of existing IFTTs. Its effectiveness is tested first on an example from the literature and then on a real case study, the railroad inland terminal of a leading Italian intermodal logistics company, showing its ease of application. In the real case study, using the proposed formalism we test the as-is IFTT performance and evaluate alternative possible to-be improvements in order to identify and eliminate emerging criticalities in the terminal dynamics.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7057695&filter%3DAND%28p_IS_Number%3A7447676%29%26pageNumber%3D2

(6) Approaching Minimal Time Control Sequences for Timed Petri Nets

Author: Dimitri Lefebvre

Abstract

The main contribution of this note is to propose algorithms that incrementally compute control sequences that drive the marking of timed Petri nets from an initial value to a reference one with a duration that approaches the minimal duration. These algorithms are based on a partial exploration of the reachability graph that is inspired from model predictive control. They include perturbation rejection and forbidden marking avoidance and are suitable to track trajectories when the initial

and reference markings are far from each other. Application cases illustrate the efficiency of the method.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7239637&filter%3DAND%28p_IS_Number%3A7447676%29%26pageNumber%3D3

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SELECTIONS FROM THE IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS: SYSTEMS
VOLUME 46, ISSUE 4
APR 2016

(1) Linguistic Reasoning Petri Nets for Knowledge Representation and Reasoning

Author: Hu-Chen Liu, Jian-Xin You, Xiao-Yue You, and Qiang Su

Abstract

This paper proposes a linguistic reasoning Petri net (LRPN) model and develops an ordered weighted linguistic reasoning (OWLR) algorithm for knowledge representation and reasoning. Linguistic production rules in the knowledge base of a decision support system are modeled by LRPNs, where the truth degrees of the propositions in the linguistic production rules and the certainty factors of the rules are represented by linguistic 2-tuples. Moreover, both local and global weights of knowledge rules are taken into account in the linguistic reasoning process. The developed OWLR algorithm can allow the rule-based expert systems modeled with LRPNs to execute knowledge reasoning in a more flexible and intelligent manner. Finally, a case study regarding production rescheduling is presented to show the effectiveness and benefits of the proposed LRPN model and the linguistic reasoning approach.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7147827&filter%3DAND%28p_IS_Number%3A7434135%29

(2) Modeling Self-Adaptive Software Systems With Learning Petri Nets

Author: Zuohua Ding, Yuan Zhou, and Mengchu Zhou

Abstract

Traditional models unable to model adaptive software systems since they deal with fixed requirements only, but cannot handle the behaviors that change at runtime in response to environmental changes. In this paper, an adaptive Petri net (APN) is proposed to model a self-adaptive software system. It is an extension of hybrid Petri nets by embedding a neural network algorithm into them at some special transitions. The proposed net has the following advantages: 1) it can model a runtime environment; 2) the components in the model can collaborate to make adaption decisions while the system is running; and 3) the computation is done at the local component, while the adaption is for the whole system. We illustrate the proposed APN by modeling a manufacturing system.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7115165&filter%3DAND%28p_IS_Number%3A7434135%29

(3) A Markov Chain-Based Testability Growth Model With a Cost-Benefit Function

Author: Chenxu Zhao, Krishna R. Pattipati, Guanjun Liu, Jing Qiu, Kehong Lv, and Tianmei Li

Abstract

n this paper, we propose a Markov chain-based testability growth model (TGM) for the just in-time fix program. This model can help the system designers to manage the testability growth process during system maturation. We also derive a cost-benefit model for allocating test resources to optimize a specified testability metric subject to a constraint on cumulative test cost. Bayesian inference, coupled with a hybrid genetic and particle swarm optimization method, is used to estimate the parameters of the TGM from evolving data, and the resulting model is utilized to track and project the testability metric. A near-optimal Lagrangian relaxation-based algorithm is applied to solve the test resource allocation problem. The testability growth and resource allocation models are validated via simulation examples. Results show that the model and algorithms presented in this paper have the potential to efficiently manage the testability growth problem.

Full-text available at:
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7145482&filter%3DAND%28p_IS_Number%3A7434135%29

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SELECTIONS FROM DISCRETE EVENT DYNAMIC SYSTEMS: THEORY AND APPLICATIONS
VOLUME 26 ISSUE 1
MAR 2016

(1) VeriSiMPL 2: An open-source software for the verification of max-plus-linear systems

Author: Dieky Adzkiya, Yining Zhang, Alessandro Abate

Abstract

This work presents a technique to generate finite abstractions of autonomous Max-Plus-Linear (MPL) systems, a class of discrete-event systems employed to characterize the dynamics of the timing related to the synchronization of successive events. Abstractions of MPL systems are derived as finite-state transition systems. A transition system is obtained first by partitioning the state space of the MPL system into finitely many regions and then by associating a unique state of the transition system to each partitioning region. Relations among the states of the transition system are then set up based on the underlying dynamical transitions between the corresponding partitioning regions of the MPL state space. In order to establish formal equivalences, the obtained finite abstractions are proven either to simulate or to bisimulate the original MPL system. The approach enables the study of general properties of the original MPL system formalized as logical specifications, by verifying them over the finite abstraction via model checking. The article presents a new, extended and improved implementation of a software tool (available online) for the discussed formal abstraction of MPL systems, and is tested on a numerical benchmark against a previous version.

Full-text available at:
http://link.springer.com/article/10.1007/s10626-015-0218-x

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SELECTIONS FROM AUTOMATICA
VOLUME 65
MAR 2016

(1) Event-based state estimation of discrete-state hidden Markov models

Author: Dawei Shi, Robert J. Elliot, Tongwen Chen

Abstract

The state estimation problem for hidden Markov models subject to event-based sensor measurement updates is considered in this work, using the change of probability approach. We assume the measurement updates are transmitted through wired or wireless communication networks. For the scenarios with reliable and unreliable communication channels, analytical expressions for the probability distributions of the states conditioned on all the past point- and set-valued measurement information are obtained. Also, we show that the scenario with a lossy channel, but without the event-trigger, can be treated as a special case of the reliable channel results. Based on these results, closed-form expressions for the estimated communication rates under the original probability measure are presented, which are shown to be the ratio between a weighted 1-norm and the 1-norm of the unnormalized conditional probability distributions of the states under the new probability measures constructed. Implementation issues are discussed, and the effectiveness of the results is illustrated by numerical examples and comparative simulations.

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