IEEE CONTROL SYSTEMS SOCIETY TECHNICAL COMMITTEE ON DISCRETE EVENT SYSTEMS

Newsletter..... January 2017

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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:

HAPPY NEW YEAR 2017!
WELCOME TO THE JANUARY 2017 NEWSLETTER.

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Activities

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2.1 Sponsored Activities

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2017 American Control Conference
Seattle, United States, May 24 - May 26, 2017
http://acc2017.a2c2.org/

2017 Conference on Control Technology and Applications
Kohala Coast, United States, Aug 27 - Aug 30, 2017
http://ccta2017.ieeecss.org/

2017 Conference on Decision and Control
Melbourne, Australia, Dec 12 - Dec 15, 2017
http://cdc2017.ieeecss.org/

2.2 Technically Co-Sponsored activities

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The 36th Chinese Control Conference
Dalian, China, Jul 26 - Jul 28, 2017

http://ccc2017.dlut.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/

2017 Indian Control Conference
Guwahati, India, Jan 4 - Jan 6, 2017
http://icc.org.in/

6th International Conference on Systems and Control (ICSC 2017)
Batna, Algeria, May 7 - May 9, 2017
http://lias.labo.univ-poitiers.fr/icsc/icsc2017/

The 6th International Symposium on Advanced Control of Industrial Processes (AdCONIP 2017)
Taipei, Taiwan, May 28 - May 31, 2017
http://www.adconip2017.org/

2017 International Conference on Unmanned Aircraft Systems (ICUAS'17)
Miami, United States, Jun 13 - Jun 16, 2017
http://www.uasconferences.com/

IEEE CASE 2017, the 13th IEEE International Conference on Automation Science and Engineering
Xi'an, China, August 20-23, 2017
http://www.case2017.org

Selections of Journal Publications

Contributed by: Xiang Yin (xiangyin@umich.edu)

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SELECTIONS OF THE IEEE TRANSACTIONS ON AUTOMATIC CONTROL
VOLUME: 62 ISSUE: 1
JANUARY 2017

(1) On Finite-State Stochastic Modeling and Secure Estimation of Cyber-Physical Systems

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

Abstract

The problem of secure state estimation and attack detection in cyber-physical systems is considered in this paper. A stochastic modeling framework is first introduced, based on which the attacked system is modeled as a finite-state hidden Markov model with switching transition probability matrices controlled by a Markov decision process. Based on this framework, a joint state and attack estimation problem is formulated and solved. Utilizing the change of probability measure approach, we show that an unnormalized joint state and attack distribution conditioned on the sensor measurement information evolves in a linear recursive form, based on which the optimal estimates can be further calculated by evaluating the normalized marginal conditional distributions. The estimation results are further applied to secure estimation of stable linear Gaussian systems, and extensions to more general systems are also discussed. The effectiveness of the results are illustrated by numerical examples and comparative simulation.

Full-text available at: http://ieeexplore.ieee.org/document/7433374/

(2) Approximate Safety Verification and Control of Partially Observable Stochastic Hybrid Systems

Author: Kendra Lesser, Meeko Oishi

Abstract

Assuring safety in stochastic hybrid systems is particularly difficult when only noisy or partial observations of the state are available. We first review a formulation of the probabilistic safety problem under partial hybrid observations as a dynamic program over an equivalent information state. Two methods for approximately solving the dynamic program are presented. The first approximates the hybrid system as a finite state Markov decision process, so that the information state is a probability mass function. The second method approximates an indicator

function over the safe region using radial basis functions, to represent the information state as a Gaussian mixture. In both cases we discretize the hybrid observation process, then use point-based value iteration to under-approximate the safety probability and synthesize a safety-preserving control policy. We obtain error bounds and convergence results in both cases, assuming switched affine dynamics and additive Gaussian noise on the continuous states and observations. We compare the performance of the finite state and Gaussian mixture approaches on a simple numerical example.

Full-text available at: http://ieeexplore.ieee.org/document/7420588/

(3) Deterministic Networked Control of Discrete Event Systems With Nondeterministic Communication Delays

Author: Shaolong Shu, Feng Lin

Abstract

We continue to investigate the impacts of communication delays on networked control of discrete event systems (DES). Our previous results show that nondeterministic communication delays result in nondeterminism in the languages generated by the controlled system, which makes the networked control problems more complex. In this paper we investigate the language nondeterminism. We define delay observability and delay controllability. If the language to be synthesized is delay observable and delay controllable, we can synthesize a networked supervisor to control the DES such that the language generated by the controlled system is deterministic, that is, we can synthesize a “deterministic” state-estimate-based networked supervisor. We derive algorithms to check delay controllability and delay observability. If the language to be synthesized is not delay observable and/or delay controllable, we can find its infimal delay controllable and delay observable superlanguage and maximal delay controllable and delay observable sublanguages. We develop algorithms to find these superlanguages and sublanguages. All the algorithms proposed in the paper are of polynomial computational complexity.

Full-text available at: http://ieeexplore.ieee.org/document/7452384/

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SELECTIONS OF AUTOMATICA
VOLUME: 75

JANUARY 2017

(1) On max-plus linear dynamical system theory: The regulation problem

Author: Vinicius Mariano Gonçalves, Carlos Andrey Maia, Laurent Hardouin

Abstract

A class of timed discrete event systems can be modeled by using Timed-Event Graphs, a class of timed Petri nets that can have its firing dynamic described by using an algebra called “Max-plus algebra”. For this kind of systems it may be desirable to enforce some timing constraints in steady state. In this paper, this problem is called a “max-plus regulation problem”. In this context we show a necessary condition for solving these regulation problems and in addition that this condition is sufficient for a large class of problems. The obtained controller is a simple linear static state feedback and can be computed using efficient pseudo-polynomial algorithms. Simulation results will illustrate the applicability of the proposed methodology.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S0005109816303636

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SELECTIONS OF IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING
VOLUME: 14 ISSUE: 1
JANUARY 2017

(1) Quantification of Secrecy in Partially Observed Stochastic Discrete Event Systems

Author: Jun Chen, Mariam Ibrahim, Ratnesh Kumar

Abstract

While cryptography is used to protect the content of information (e.g., a message) by making it undecipherable, behaviors (as opposed to information) may not be encrypted and may only be protected by partially or fully hiding through creation of ambiguity (by providing covers that generate indistinguishable observations from secrets). Having a cover together with partial observability does cause

ambiguity about the system behaviors desired to be kept secret, yet some information about secrets may still be leaked due to statistical difference between the occurrence probabilities of the secrets and their covers. In this paper, we propose a Jensen–Shannon divergence (JSD)-based measure to quantify secrecy loss in systems modeled as partially observed stochastic discrete event systems, which quantifies the statistical difference between two distributions, one over the observations generated by secret and the other over those generated by cover. We further show that the proposed JSD measure for secrecy loss is equivalent to the mutual information between the distributions over possible observations and that over possible system status (secret versus cover). Since an adversary is likely to discriminate more if he/she observes for a longer period, our goal is to evaluate the worst case loss of secrecy as obtained in the limit over longer and longer observations. Computation for the proposed measure is also presented. Illustrative examples, including the one with side-channel attack, are provided to demonstrate the proposed computation approach.

Full-text available at: http://ieeexplore.ieee.org/document/7572174/

(2) Temporal Task Scheduling With Constrained Service Delay for Profit Maximization in Hybrid Clouds

Author: Haitao Yuan, Jing Bi,Wei Tan, Bo Hu Li

Abstract

As cloud computing is becoming growingly popular, consumers' tasks around the world arrive in cloud data centers. A private cloud provider aims to achieve profit maximization by intelligently scheduling tasks while guaranteeing the service delay bound of delay-tolerant tasks. However, the aperiodicity of arrival tasks brings a challenging problem of how to dynamically schedule all arrival tasks given the fact that the capacity of a private cloud provider is limited. Previous works usually provide an admission control to intelligently refuse some of arrival tasks. Nevertheless, this will decrease the throughput of a private cloud, and cause revenue loss. This paper studies the problem of how to maximize the profit of a private cloud in hybrid clouds while guaranteeing the service delay bound of delay-tolerant tasks. We propose a profit maximization algorithm (PMA) to discover the temporal variation of prices in hybrid clouds. The temporal task scheduling provided by PMA can dynamically schedule all arrival tasks to execute in private and public clouds. The sub problem in each iteration of PMA is solved by the proposed hybrid heuristic optimization algorithm, simulated annealing particle swarm optimization (SAPSO). Besides, SAPSO is compared with existing baseline algorithms. Extensive simulation experiments demonstrate that the proposed method can greatly increase the throughput and the profit of a private cloud while guaranteeing the service delay bound.

Full-text available at: http://ieeexplore.ieee.org/document/7415937/

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SELECTIONS OF IEEE TRANSACTIONS ON CONTROL SYSTEMS TECHNOLOGY
VOLUME: 25 ISSUE: 1
JANUARY 2017

(1) A Method for PLC Implementation of Supervisory Control of Discrete Event Systems

Agnelo Denis Vieira, Eduardo Alves Portela Santos, Max Hering de Queiroz, André B. Leal, Amaro Duarte de Paula Neto, José E. R. Cury

Abstract

This paper faces the problem of coordinating equipment operation in a flexible manufacturing system consisting of several subsystems including robots, assembling machines, CNC lathes, and mills. There are two main problems in such a system. The first is controlling each individual subsystem considering its own sensors, actuators, and specialized controller to perform a certain sequence of activities. Due to their expertise and/or application of formal methods, programmable logic controller (PLC) practitioners and equipment manufacturers develop efficient and safe solutions to address this problem. The second problem is coordinating the concurrent operation of these subsystems with the goal of producing what is requested as efficiently as possible and guaranteeing the integrity and safety of the system. Supervisory control theory (SCT) is particularly suited to this problem. This paper presents a method that allows a designer to systematically convert SCT's results into a PLC application program. The resulting program conforms to IEC 61131-3 and preserves the natural modularity of the system to be controlled and control specifications. An extension of this method allows a designer to reuse existing PLC hardware and application programs designed for the control of equipment by easily integrating with the code corresponding to the SCT solution. A major portion of this code may even be automatically generated, reducing development time and minimizing editing errors.

Full-text available at: http://ieeexplore.ieee.org/document/7452406/

(2) Approximate Simulation Budget Allocation for Subset Ranking

JunQi Zhang, ZeZhou Li, Cheng Wang, Di Zang, MengChu Zhou

Abstract

Accurate performance evaluation of discrete event systems needs a huge number of simulation replications and is thus time-consuming and costly. Hence, efficiency is always a big concern when simulations are conducted. To drastically reduce its cost when conducting them, ordinal optimization emerges. To further enhance the efficiency of ordinal optimization, optimal computing budget allocation (OCBA) is proposed to decide the best design accurately and quickly. Its variants have been introduced to achieve goals with distinct assumptions, such as to identify the optimal subset of designs. They are restricted in selecting the best design or optimal subset of designs. However, a highly challenging issue, i.e., subset ranking, remains unaddressed. It goes beyond best design and optimal subset problems. This work develops a new OCBA-based approach to address the issue and establishes its theoretical foundation. The numerical testing results show that, with proper parameters, it can indeed enhance the simulation efficiency and outperform other existing methods in terms of the probability of correct subset ranking and computational efficiency.

Full-text available at: http://ieeexplore.ieee.org/document/7460230/

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