IEEE CONTROL SYSTEMS SOCIETY TECHNICAL COMMITTEE ON DISCRETE EVENT SYSTEMS

Newsletter..... November 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 NOVEMBER 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/

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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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: Xiang Yin (xiangyin@umich.edu)

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SELECTIONS OF THE IEEE TRANSACTIONS ON AUTOMATIC CONTROL
VOLUME: 61 ISSUE: 11
NOVEMBER 2016

(1) Automata Theory Meets Barrier Certificates: Temporal Logic Verification of Nonlinear Systems

Author: Tichakorn Wongpiromsarn, Ufuk Topcu, and Andrew Lamperski

Abstract

We consider temporal logic verification of (possibly nonlinear) dynamical systems evolving over continuous state spaces. Our approach combines automata-based verification and the use of so-called barrier certificates. Automata-based verification allows the decomposition the verification task into a finite collection of simpler constraints over the continuous state space. The satisfaction of these constraints in turn can be (potentially conservatively) proved by appropriately constructed barrier certificates. As a result, our approach, together with optimization-based search for barrier certificates, allows computational verification of dynamical systems against temporal logic properties while avoiding explicit abstractions of the dynamics as commonly done in literature.

Full-text available at: http://ieeexplore.ieee.org/document/7364197/

(2) Relative Observability and Coobservability of Timed Discrete-Event Systems

Author: Kai Cai, Renyuan Zhang, and W. M. Wonham

Abstract

We study supervisory control of timed discrete-event systems (TDES) under partial observation, and propose new observability concepts effective for supervisor synthesis. First, we consider monolithic/centralized supervisory control, and introduce timed relative observability and timed relative weak observability. The former concept extends our previous work to the timed case, while the latter exploits choices of forcible events to preempt the clock event tick. We prove that timed relative (respectively, weak) observability is stronger than timed (respectively, weak) observability, weaker than normality, and closed under set union; hence there exists the supremal relatively (respectively, weakly) observable sublanguage of a given language. We move on to study decentralized

supervisory control of TDES, and propose timed relative coobservability and timed relative weak coobservability as extensions of their centralized counterparts. It is shown that timed relative (respectively, weak) coobservability is stronger than timed (respectively, weak) coobservability, weaker than conormality, and closed under set union; therefore the supremal relatively (respectively, weakly) coobservable sublanguage of a given language exists. Finally, algorithms are designed to compute the supremal relatively (weakly) (co)observable and controllable sublanguages, which are demonstrated with a Guideway example.

Full-text available at: http://ieeexplore.ieee.org/document/7368119/

(3) Synthesis of Joint Control and Active Sensing Strategies Under Temporal Logic Constraints

Author: Jie Fu, and Ufuk Topcu

Abstract

This paper proposes an approach to control of discrete systems with incomplete information and sensing capabilities, with respect to temporal logic constraints. The approach introduces active sensing to alleviate computational effort in control design for systems interacting with uncontrollable environments under incomplete information. Particularly, it transforms a deterministic controller under complete information into a randomized, observation-based controller. Interleaving the latter with strategic queries to sensors, the temporal logic specification is proven to be satisfied almost surely. The effectiveness of the method is demonstrated with robotic motion planning examples.

Full-text available at: http://ieeexplore.ieee.org/document/7384426/

(4) Performance Analysis of a Network of Event-Based Systems

Author: Chithrupa Ramesh, Henrik Sandberg, and Karl H. Johansson

Abstract

We consider a scenario where multiple event-based systems use a contention resolution mechanism (CRM) to communicate with their respective controllers over a wireless network. We present a Markov model that captures the joint interactions of the event-triggering policy and the CRM. This model is obtained by decoupling interactions between the different systems in the network, drawing inspiration from Bianchi's analysis of IEEE 802.11. We present Monte-Carlo simulations that validate our model under various network configurations, and verify the accuracy of the performance analysis.

Full-text available at: http://ieeexplore.ieee.org/document/7394122/

(5) Decentralized Supervisory Control With Intersection-Based Architecture

Author: Xiang Yin, and St®¶phane Lafortune

Abstract

We investigate a new decentralized control architecture, called intersection-based architecture . We propose a decentralized control protocol under this architecture, called state-estimator-intersection-based protocol (SEI-protocol), where each local supervisor sends its state estimate to the fusion sites and these sites take the intersection of these estimates in order to make a control decision. The necessary and sufficient conditions for the achievability of the specification under this protocol is provided. This condition is termed as state-estimator-intersection-based coobservability (SEI-coobservability). A polynomial-time algorithm for the verification of SEI-coobservability is provided. We show that the languages that can be achieved under the SEI-protocol are incomparable with languages that can be achieved under existing architectures.

Full-text available at: http://ieeexplore.ieee.org/document/7394137/

(6) Symbolic Models for Networks of Control Systems

Author: Giordano Pola, Pierdomenico Pepe, and Maria Domenica Di Benedetto

Abstract

In this note, we propose symbolic models for networks of discrete-time nonlinear control systems. If each subsystem composing the network admits an incremental input-to-state stable Lyapunov function and if some small gain theorem-type conditions are satisfied, a network of symbolic models, each one associated with each subsystem composing the network, is proposed and shown to be approximately bisimilar to the original network with any desired accuracy.

Full-text available at: http://ieeexplore.ieee.org/document/7403879/

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SELECTIONS OF AUTOMATICA
VOLUME: 73
NOVEMBER 2016

(1) Optimization of Markov decision processes under the variance criterion

Author: Li Xia

Abstract

In this paper, we study a variance minimization problem in an infinite stage discrete time Markov decision process (MDP), regardless of the mean performance. For the Markov chain under the variance criterion, since the value of the cost function at the current stage will be affected by future actions, this problem is not a standard MDP and the traditional MDP theory is not applicable. In this paper, we convert the variance minimization problem into a standard MDP by introducing a concept called pseudo variance. Then we derive a variance difference formula that quantifies the difference of variances of Markov systems under any two policies. With the difference formula, the correlation of the variance cost function at different stages can be decoupled through a nonnegative term. A necessary condition of the optimal policy is obtained. It is also proved that the optimal policy with the minimal variance can be found in the deterministic policy space. Furthermore, we propose an efficient iterative algorithm to reduce the variance of Markov systems. We prove that this algorithm can converge to a local optimum. Finally, a numerical experiment is conducted to demonstrate the efficiency of our algorithm compared with the gradient-based method widely adopted in the literature.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S000510981630245X

(2) Online minimization of sensor activation for supervisory control

Author: Weilin Wang

Abstract

In supervisory control, the objective of observation is to guarantee a correct control decision. To observe an event occurrence, an associated sensing device must be activated, which incurs a cost. In this paper, an online algorithm is developed to minimize sensor activation while ensuring that the collected information is sufficient. In previous work, it was determined that observation problems can be reduced to distinguishing certain pairs of states. Now, this is extended by taking into account future system evolution. Applying the extended result, the online algorithm only needs to look one step ahead and remember the current state estimate.

Full-text available at:
http://www.sciencedirect.com/science/article/pii/S0005109816302436

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SELECTIONS OF IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING
VOLUME: 13 ISSUE: 4
OCTOBER 2016

(1) A Generalized Stochastic Petri Net Approach for Modeling Activities of Human Operators in Intermodal Container Terminals

Author: Guido Maione, Agostino Marcello Mangini, and Michele Ottomanelli

Abstract

This paper proposes a Petri net (PN) representation of the activities performed by the key human operators for unloading/loading containers in an intermodal maritime container terminal (CT) with a low level of automation. These processes are the core of the export, import, and transshipment cycles executed in the terminal. The aim of this paper is to consider both the human component and the material handling resources, e.g., cranes and transporters, by defining an accurate model, which describes how to coordinate humans and use the system resources necessary for serving mother or feeder ships. The developed generalized stochastic PN-based model is of limited complexity and represents a complete, unambiguous, and readable model of the target process before coding it in the target simulation tool. The modular integrated model is tested and validated by the simulation of typical and perturbed scenarios of the Taranto CT, a real terminal that is taken as a case study for its complexity and similarity to CTs with multiple transport modes.

Full-text available at: http://ieeexplore.ieee.org/document/7467519/

(2) Robust Networked Control of Discrete Event Systems

Author: Fei Wang, Shaolong Shu, and Feng Lin

Abstract

In this paper, we investigate the robust control problem of discrete event systems in a networked environment. In other words, we use a supervisor to control several possible plants (discrete event systems) to achieve given specifi- cations when there are communication delays and losses in communication networks linking the supervisor and the plants. We translate the robust networked control problem into a conventional networked control problem by constructing an augmented automaton for all possible plants and an augmented specification automaton for the corresponding specification automata. We then solve the robust networked control problem. We consider two cases. The first case is when all the specifications are the same. For this case, we derive a necessary and sufficient condition for the existence of a robust networked supervisor. The second case is when the specifications are different, which is more general compared with the first case. In the second case, we can only obtain a sufficient condition for the existence of a networked supervisor. The results are illustrated by an example of customized products filling line.

Full-text available at: http://ieeexplore.ieee.org/document/7526316/

(3) A Novel Model Repair Approach of Timed Discrete-Event Systems With Anomalies

Author: Francesco Basile, Pasquale Chiacchio, and Jolanda Coppola

Abstract

In this paper, the model repair of timed discreteevent systems where anomalies may occur is considered. The nominal model is assumed to be known, and a set of observed timed sequences is given. The approach works with time Petri net models and is based on the formulation of a mixed-integer linear programming problem. The repaired model is obtained from the nominal one by adding fault transitions as well as by extending the firing interval of transitions.

Full-text available at: http://ieeexplore.ieee.org/document/7563299/

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SELECTIONS OF IEEE TRANSACTIONS ON CYBERNETICS
VOLUME: 46 ISSUE: 11
NOVEMBER 2016

(1) Policy Search for the Optimal Control of Markov Decision Processes: A Novel Particle-Based Iterative Scheme

Author: Giorgio Manganini, Matteo Pirotta, Marcello Restelli, Luigi Piroddi, and Maria Prandini

Abstract

Classical approximate dynamic programming techniques based on state-space gridding become computationally impracticable for high-dimensional problems. Policy search techniques cope with this curse of dimensionality issue by searching for the optimal control policy in a restricted parameterized policy space. We here focus on the case of discrete action space and introduce a novel policy parametrization that adopts particles to describe the map from the state space to the action space, each particle representing a region of the state space that is mapped into a certain action. The locations and actions associated with the particles describing a policy can be tuned by means of a recently introduced policy gradient method with parameter-based exploration. The task of selecting an appropriately sized set of particles is here solved through an iterative policy building scheme that adds new particles to improve the policy performance and is also capable of removing redundant particles. Experiments demonstrate the scalability of the proposed approach as the dimensionality of the state-space grows.

Full-text available at: http://ieeexplore.ieee.org/document/7303937/

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