IEEE CONTROL SYSTEMS SOCIETY TECHNICAL COMMITTEE ON DISCRETE EVENT SYSTEMS

Newsletter..... December 2018

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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!

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Activities

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2.1 Sponsored Activities

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2018 Conference on Decision and Control
Miami Beach, FL, USA, December 17-19, 2018
https://cdc2018.ieeecss.org/

2019 American Control Conference
Philadelphia, Pennsylvania, United States, Jul 10 - Jul 12, 2019
http://acc2019.a2c2.org/

2019 Conference on Control Technology and Applications
Hong Kong, China, Aug 19 - Aug 21, 2019
http://ccta2019.ieeecss.org/

2.2 Technically Co-Sponsored activities

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38th Chinese Control Conference (CCC 2019)
Guangzhou, China, Jul 27 - Jul 30, 2019
http://www.ccc2019.cn/en/index.html

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Selections of Journal Publications

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Contributed by: Xiang Yin (yinxiang@sjtu.edu.cn)

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SELECTIONS OF THE IEEE TRANSACTIONS ON AUTOMATIC CONTROL
VOLUME: 63 ISSUE: 12
DECEMBER 2018

(1) Synthesis of Maximally Permissive Nonblocking Supervisors for the Lower Bound Containment Problem

Author: Xiang Yin ; Stéphane Lafortune

Abstract

In this paper, we investigate the nonblocking supervisor synthesis problem for centralized partially observed discrete event systems. The goal is to synthesize a maximally permissive nonblocking supervisor that not only satisfies a class of properties, e.g., safety, but also contains a given lower bound behavior described by a regular language. We show that this synthesis problem can be effectively reduced to a synthesis problem that has been solved in the literature. A new notion, called R -compatibility, is proposed for the purpose of reduction. Our result generalizes existing algorithms for supervisory synthesis of partially observed discrete event systems. This also leads to solutions of several synthesis problems that were open previously, e.g., the nonblocking range control problem.

Full-text available at: https://ieeexplore.ieee.org/document/8340757

(2) Decentralized Supervisory Control of Discrete Event Systems: An Arborescent Architecture to Realize Inference-Based Control

Author: Ahmed Khoumsi ; Hicham Chakib

Abstract

The two simplest language-based decentralized controls of discrete event systems are called conjunctive and permissive (C&P) and disjunctive and antipermissive (D&A) controls. On the other side, inference-based control is the most general language-based decentralized control. In this paper, we propose a decentralized control method, called arborescent control, which constructs and uses a tree-like control architecture that depends on the control objective. Each node n of the tree is a disjunction or conjunction of the enabling/disabling decisions of

the two children of n . We show that if inference-based control is applicable to the control objective, then every leaf of the obtained tree is a C&P or D&A control. This means that by combining adequately C&P and D&A controls, we can realize every control objective that is realizable by inference-based control.

Full-text available at: https://ieeexplore.ieee.org/document/8309411

(3) Optimal Event-Driven Multiagent Persistent Monitoring of a Finite Set of Data Sources

Author: Nan Zhou ; Xi Yu ; Sean B. Andersson ; Christos G. Cassandras

Abstract

We consider the problem of controlling the movement of multiple cooperating agents so as to minimize an uncertainty metric associated with a finite number of data sources. In a one-dimensional (1-D) mission space, we adopt an optimal control framework and show that the solution can be reduced to a simpler parametric optimization problem: Determining a sequence of locations where each agent may dwell for a finite amount of time and then switch direction. This amounts to a hybrid system which we analyze using the infinitesimal perturbation analysis (IPA) to obtain a complete online solution through an event-driven gradient-based algorithm which is also robust with respect to the uncertainty model used. The resulting controller depends on observing the events required to excite the gradient-based algorithm, which cannot be guaranteed. We solve this problem by introducing a new metric for the objective function which creates a potential field guaranteeing that gradient values are nonzero. This approach is compared to an alternative graph-based target-visit scheduling and dwell times optimization algorithm. The simulation examples are included to demonstrate the proposed methods.

Full-text available at: https://ieeexplore.ieee.org/document/8344784

(4) Probabilistic Motion Planning Under Temporal Tasks and Soft Constraints

Author: Meng Guo ; Michael M. Zavlanos

Abstract

This paper studies motion planning of a mobile robot under uncertainty. The control objective is to synthesize a finite-memory control policy, such that a high-level task specified as a linear temporal logic formula is satisfied with a desired high probability. Uncertainty is considered in the workspace properties, robot actions, and task outcomes, giving rise to a Markov decision process that models the proposed system. Different from most existing methods, we consider cost optimization both in the prefix and suffix of the system trajectory. We also analyze the

potential tradeoff between reducing the mean total cost and maximizing the probability that the task is satisfied. The proposed solution is based on formulating two coupled linear programs, for the prefix and suffix, respectively, and combining them into a multiobjective optimization problem, which provides provable guarantees on the probabilistic satisfiability and the total cost optimality. We show that our method outperforms relevant approaches that employ Round-Robin policies in the trajectory suffix. Furthermore, we propose a new control synthesis algorithm to minimize the frequency of reaching a bad state when the probability of satisfying the tasks is zero, in which case, most existing methods return no solution. We validate the above-mentioned schemes via both numerical simulations and experimental studies.

Full-text available at: https://ieeexplore.ieee.org/document/8272366

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SELECTIONS OF AUTOMATICA
VOLUME: 98
DECEMBER 2018

(1) Linear programming based time lag identification in event sequences

Author: Marco F.Huber ; Marc-André Zöller ; Marcus Baum

Abstract

Many technical systems like manufacturing plants or software applications generate large event sequences. Knowing the temporal relationship between events is important for gaining insights into the status and behavior of the system. This paper proposes a novel approach for identifying the time lag between different event types. This identification task is formulated as a binary integer optimization problem that can be solved efficiently and close to optimality by means of a linear programming approximation. The performance of the proposed approach is demonstrated on synthetic and real-world event sequences.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S0005109818304242

(2) Combinatorial methods for invariance and safety of hybrid systems

Author: Nikolaos Athanasopoulos ; Raphaël M.Jungers

Abstract

Inspired by Switching Systems and Automata theory, we investigate how combinatorial analysis techniques can be performed on a hybrid automaton in order to enhance its safety or invariance analysis. We focus on the particular case of Constrained Switching Systems, that is, hybrid automata with linear dynamics and no guards. We follow two opposite approaches, each with unique benefits: First, we construct invariant sets via the 'Reduced' system, induced by a smaller graph which consists of the essential nodes, called the unavoidable nodes. The computational amelioration of working with a smaller, and in certain cases the minimum necessary number of nodes, is significant. Second, we exploit graph liftings, in particular the Iterated Dynamics Lift (-Lift) and the Path-Dependent Lift (-Lift). For the former case, we show that invariant sets can be computed in a fraction of the iterations compared to the non-lifted case, while we show how the latter can be utilized to compute non-convex approximations of invariant sets of a controlled complexity.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S000510981830431X

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SELECTIONS OF CONTROL ENGINEERING PRACTICE
VOLUME: 81
DECEMBER 2018

(1) Application of online supervisory control of discrete-event systems to multi-robot warehouse automation

Author: Yuta Tatsumoto ; Masahiro Shiraishi ; Kai Cai ; Zhiyun Lin

Abstract

In this paper we present an online supervisory control approach, based on limited lookahead policy, that is amenable for the control of multi-agent discrete-event systems. We then apply this online control scheme to model and control a warehouse automation system served by multiple mobile robots; the effectiveness of this scheme is demonstrated through a case study. Moreover, we build an experiment testbed for testing the validity of our proposed method with implementation on real robots.

Full-text available at: https://www.sciencedirect.com/science/article/abs/pii/S0967066118305070

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