

Newsletter..... December 2016

Editor: Hai Lin  
Chair, IEEE CSS Technical Committee on DES  
Associate Professor  
Distributed Cooperative Systems Research (DISCOVER) Lab  
Department of Electrical Engineering  
University of Notre Dame  
Notre Dame, IN 46556,  
USA

Phone: (+1) 574-631-3177  
Fax: (+1) 574-631-4393  
e-mail: hlin1@nd.edu  
Website: <http://www3.nd.edu/~hlin1/>

It is the responsibility of the contributor to ensure that they have the necessary permissions/clearance required for the transmittal of their news item.

---

Contents:

1. Editorial
  
2. Recent Activities of the CSS
  - 2.1 Sponsored Activities
  - 2.2 Technically Co-Sponsored activities
  
3. Journals
  - 3.1 Selections from the IEEE Transactions on Automatic Control Volume: 61, Issue: 12, December 2016
  - 3.2 Selections from Automatica Volume: 74, December 2016
  - 3.3 Selections from the Discrete Event Dynamic Systems: Theory & Applications: 26, Issue: 4, December 2016
  - 3.4 Selections from the SIAM Journal of Control and Optimization: 54, Issue: 6, November 2016
  - 3.5 Selections from the Asian Journal of Control: 18, Issue: 6, December 2016

---

Editorial

---

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

Personal note from the editor:

WELCOME TO THE December 2016 NEWSLETTER. HAPPY HOLIDAYS!

HAI

---

Activities

---

### 2.1 Sponsored Activities

=====

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

=====

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)

=====

SELECTIONS OF THE IEEE TRANSACTIONS ON AUTOMATIC CONTROL  
VOLUME: 61 ISSUE: 12  
DECEMBER 2016

(1) Optimal Control of Production Rate in a Manufacturing System Prone to Failure With General Distribution for Repair Time

Author: Bassam N. Khoury

Abstract

The hedging-point policy is shown to be the optimal production rate control policy minimizing the expected total inventory cost over an infinite time horizon for a single-product production-inventory system prone to failure with exponentially distributed time to failure and generally distributed repair time. Then, using Laplace transform techniques, general expressions of the steady state probabilities and the optimal policy parameter, minimizing the expected inventory cost per unit of time, are developed for the general case of repair time. These general expressions are in turn used to deal with the special cases of exponentially, deterministically, and discretely distributed repair time.

Full-text available at: <http://ieeexplore.ieee.org/document/7442818/>

(2) Optimal Control of an Inventory System With Joint Production and Pricing Decisions

Author: Ping Cao, and Jingui Xie

Abstract

In this study, we consider a stochastic inventory system in which the objective of the manufacturer is to maximize the long-run average profit by dynamically offering the selling price and switching the production on or off. The demand process is non-homogeneous Poisson with a price-dependent arrival rate. System costs consist of switching costs, inventory holding and backlogging costs. We show that an  $(s, S, p)$  policy is optimal. Moreover, we characterize the structural properties of the optimal profit function and pricing strategy, and show that the optimal price is a quasiconcave function of the inventory level when the production is off and is a quasiconvex function when the production is on.

Full-text available at: <http://ieeexplore.ieee.org/document/7360141/>

(3) Optimal Dynamic Outpatient Scheduling for a Diagnostic Facility With Two Waiting Time Targets

Author: Na Geng, and Xiaolan Xie

Abstract

Timely examination becomes more and more important for the diagnosis of patients. When the patient arrives for reserving the examination, the scheduler needs to instantly assign a date to the patient by weighing the following factors: the acceptance of current lower-priority patient request may result in the rejection of future higher-priority and more urgent patients, whereas the rejection of the current patient may lead to the unused diagnostic capacity. To deal with this problem, this paper proposes a finite-horizon Markov decision process (MDP) model for optimal outpatients scheduling by considering their waiting time target, i.e., the maximal waiting time the patient can endure. Two types of outpatients with different waiting time targets and different rewards are considered. The objective is to maximize the expected revenue. Two time dimensions, i.e., days and time periods within a day, are used to model patient arrivals and their waiting time targets. A complete characterization of the optimal scheduling policy is given by proving the monotonicity and concavity properties of the reward functions, switching curves between different scheduling options of an incoming patient, and dynamic evolution of the optimal control policy. Extensive numerical experiments are performed to show the impact of different parameters and compare the optimal policy with other simple policies including two designed with the properties of the optimal policy.

Full-text available at: <http://ieeexplore.ieee.org/document/7395304/>

=====  
=====

=====  
=====

SELECTIONS OF AUTOMATICA  
VOLUME: 74  
DECEMBER 2016

(1) Petri net controllers for Generalized Mutual Exclusion Constraints with floor operators

Author: Ziyue Ma, Zhiwu Li, Alessandro Giua

## Abstract

In this paper a special type of nonlinear marking specifications called stair generalized mutual exclusion constraints (stair-GMECs) is defined. A stair-GMEC can be represented by an inequality whose left-hand is a linear combination of floor functions. Stair-GMECs have higher modeling power than classical GMECs and can model legal marking sets that cannot be defined by OR-AND GMECs. We propose two algorithms to enforce a stair-GMEC as a closed-loop net, in which the control structure is composed by a residue counter, remainder counters, and duplicate transitions. We also show that the proposed control structure is maximally permissive since it prevents all and only the illegal trajectories of a plant net. This approach can be applied to both bounded and unbounded nets. Several examples are proposed to illustrate the approach.

Full-text available at:

<http://www.sciencedirect.com/science/article/pii/S0005109816303107>

(2) Optimistic optimization for model predictive control of max-plus linear systems

Author: Jia Xu, Ton van den Boom, Bart De Schutter

## Abstract

Model predictive control for max-plus linear discrete-event systems usually leads to a nonsmooth nonconvex optimization problem with real valued variables, which may be hard to solve efficiently. An alternative approach is to transform the given problem into a mixed integer linear programming problem. However, the computational complexity of current mixed integer linear programming algorithms increases in the worst case exponentially as a function of the prediction horizon. The focus of this paper is on making optimistic optimization suited to solve the given problem. Optimistic optimization is a class of algorithms that can find an approximation of the global optimum for general nonlinear optimization. A key advantage of optimistic optimization is that one can specify the computational budget in advance and guarantee bounds on the suboptimality with respect to the global optimum. We prove that optimistic optimization can be applied for the given problem by developing a dedicated semi-metric and by proving it satisfies the necessary requirements for optimistic optimization. Moreover, we show that the complexity of optimistic optimization is exponential in the control horizon instead of the prediction horizon. Hence, using optimistic optimization is more efficient when the control horizon is small and the prediction horizon is large.

Full-text available at:

<http://www.sciencedirect.com/science/article/pii/S0005109816302709>

(3) Reachability and observability reduction for linear switched systems with constrained switching

Author: Mert Baştuğ, Mihály Petreczky, Rafael Wisniewski, John Leth

Abstract

We present an algorithm for reducing the number of continuous states of a discrete time linear switched system, such that the reduced system has the same input-output behavior as the original system for a subset of switching sequences. The procedure can be interpreted as reachability and observability reduction for a linear switched system with constrained switching. The proposed method is expected to be useful for abstraction based control synthesis methods for hybrid systems.

Full-text available at:

<http://www.sciencedirect.com/science/article/pii/S0005109816303259>

=====

=====

SELECTIONS OF DISCRETE EVENT DYNAMIC SYSTEMS: THEORY AND APPLICATIONS  
VOLUME: 26 ISSUE: 4  
DECEMBER 2016

(1) Analytic evaluation of the cycle time on networked conflicting timed event graphs in the  $(\text{Max}, +)$  algebra

Author: W. M. Boussahel, S. Amari, R. Kara

Abstract

This work deals with performance evaluation of Conflicting Timed Event Graph (CTEG), a class of Petri net exhibiting phenomena such as synchronization, parallelism and resources sharing. It is well known that the dynamic of Timed Event Graphs (TEG) admits a linear state space representation in the  $(\text{Max}, +)$  algebra which makes the analysis and control of this class easier. There is also a possibility of associating conflicts with the TEGs by adding conflict places that are mostly considered as safe; this extended class is called CTEG. We first present an analytic evaluation of the cycle time of CTEG as a function of the cycle time of each TEG and of the timers of the conflict places. Finally, in a more general context, we

look for a relaxation of the safety hypothesis on the conflict places in order to model and evaluate the cycle time on CTEGs with multiple shared resources.

Full-text available at:

<http://link.springer.com/article/10.1007/s10626-015-0220-3>

(2) On-line compositional controller synthesis for AGV

Author: Johan Girault, Jean-Jacques Loiseau, Olivier H. Roux

Abstract

This paper deals with the on-line design of a supervisor to coordinate an automated guided vehicle (AGV) fleet. This supervisor ensures the system safety (no collision) and a good coordination between vehicles (no blocking situations). It is the so-called Wonham-Ramadge supervisor, it is the least restrictive, and ensures controllability and nonblocking. We propose a compositional procedure to resolve this problem allowing an efficient on-line synthesis. A calculation on the fly is made at every attribution of a new mission for an AGV, to actualize the supervisor and adapt it to the new situation. This compositional approach allows to increase the number of AGV taken on compared to the monolithic approach. We show on some tests the efficiency of this method for the on-line synthesis of supervisor to coordinate a fleet of mobile robots for real cases.

Full-text available at:

<http://link.springer.com/article/10.1007/s10626-015-0222-1>

(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>

(4) A poisson equation for the risk-sensitive average cost in semi-markov chains

Author: Rolando Cavazos-Cadena

Abstract

This work concerns semi-Markov chains evolving on a finite state space. The system development generates a cost when a transition is announced, as well as a holding cost which is incurred continuously during each sojourn time. It is assumed that these costs are paid by an observer with positive and constant risk-sensitivity, and the overall performance of the system is measured by the corresponding (long-run) risk-sensitive average cost criterion. In this framework, conditions are provided under which the average index does not depend on the initial state and is characterized in terms of a single Poisson equation.

Full-text available at:

<http://link.springer.com/article/10.1007/s10626-015-0224-z>

(5) Eigenproblems of latin squares in bipartite (min, max, +)-systems

Author: Subiono, Muhammad Syifa' ul Mufid, Dieky Adzkiya

Abstract

This work discusses the eigenproblems of bipartite (min, max, +)-systems when the system matrices are Latin squares. We propose an approach to characterize and compute the eigenvalue, trivial eigenvectors and nontrivial eigenvectors. The time complexity of the overall approach is a polynomial w.r.t. the dimension of the system.

Full-text available at:

<http://link.springer.com/article/10.1007/s10626-014-0204-8>

(6) Finite approximation of the first passage models for discrete-time Markov decision processes with varying discount factors

Author: Xiao Wu, Junyu Zhang

Abstract

This paper deals with the finite approximation of the first passage models for discrete-time Markov decision processes with varying discount factors. For a given control model  $M$  with denumerable states and compact Borel action sets, and possibly unbounded reward functions, under reasonable conditions we prove that there exists a sequence of control models  $M_n$  such that the first passage optimal rewards and policies of  $M_n$  converge to those of  $M$ , respectively. Based on the convergence theorems, we propose a finite-state and finite-action truncation method for the given control model  $M$ , and show that the first passage optimal reward and policies of  $M$  can be approximated by those of the solvable truncated finite control models. Finally, we give the corresponding value and policy iteration algorithms to solve the finite approximation models.

Full-text available at:

<http://link.springer.com/article/10.1007/s10626-014-0209-3>

=====  
=====

=====  
=====

SELECTIONS OF SIAM JOURNAL OF CONTROL AND OPTIMIZATION  
VOLUME: 54 ISSUE: 6  
DECEMBER 2016

(1) A Weighted Pair Graph Representation for Reconstructibility of Boolean Control Networks

Kuize Zhang, Lijun Zhang, and Rong Su

Abstract

A new concept of weighted pair graphs (WPGs) is proposed to represent a new reconstructibility definition for Boolean control networks (BCNs), which is a generalization of the reconstructibility definition given in Definition 4 in [E. Fornasini and M. Valcher, IEEE Trans. Automat. Control, 58 (2013), pp. 1390--1401]. Based on the WPG representation, an effective algorithm for determining the new reconstructibility notion for BCNs is designed with the help of the theories of finite automata and formal languages. We prove that a BCN is not reconstructible iff its WPG has a complete subgraph. In addition, we prove that a BCN is reconstructible in the sense of Definition 4 in [E. Fornasini and M. Valcher, IEEE Trans. Automat. Control, 58 (2013), pp. 1390--1401] iff its WPG has no cycles, which is simpler to check than the condition in Theorem 4 in [E. Fornasini and M. Valcher, IEEE Trans. Automat. Control, 58 (2013), pp. 1390--1401].

Full-text available at: <http://epubs.siam.org/doi/abs/10.1137/140991285>

=====

=====

=====

=====

SELECTIONS OF ASIAN JOURNAL OF CONTROL  
VOLUME: 18 ISSUE: 6  
NOVEMBER 2016

(1) Cooperative Tasking for Deterministic Specification Automata

Author: Mohammad Karimadini, Hai Lin and Ali Karimoddini

#### Abstract

This paper proposes necessary and sufficient conditions for task decomposability with respect to an arbitrary finite number of agents. It is furthermore shown that fulfilling the decomposed local tasks by individual agents guarantees the satisfaction of the original global decomposable task. A divide-and-conquer approach for cooperative tasking among multi-agent systems is proposed. The basic idea is to decompose an assigned global specification (given as a deterministic automaton) into subtasks for individual concurrent agents such that the fulfillment of these subtasks by each individual agent leads to the satisfaction of the global specification as a team. A cooperative scenario involving three robots has been implemented to illustrate the proposed technique. This work provides insights into what kinds of tasks can be achieved distributively, which helps designers specify achievable global tasks for a group of agents and design necessary information sharing among each other for a particular task.

Full-text available at: <http://onlinelibrary.wiley.com/doi/10.1002/asjc.1300/f>