IEEE CONTROL SYSTEMS SOCIETY TECHNICAL COMMITTEE ON DISCRETE EVENT SYSTEMS

Newsletter..... October 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 American Control Conference
Milwaukee, Wisconsin, United States, June 27–29, 2018
http://acc2018.a2c2.org/

2018 Conference on Control Technology and Applications
Copenhagen, Denmark, August 21-24, 2018
http://ccta2018.ieeecss.org/

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

2.2 Technically Co-Sponsored activities

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2018 SICE International Symposium on Control Systems
Tokyo, Japan, March 9-11, 2018
http://iscs2018.sice-ctrl.jp/

The 14th Workshop on Discrete Event Systems
Sorrento Coast, Italy, May 30 - June 1, 2018
http://wodes2018.unisa.it/

30th Chinese Control and Decision Conference (2018 CCDC)
Shenyang, China, June 9-11, 2018

http://www.ccdc.neu.edu.cn/

2018 International Conference on Unmanned Aircraft Systems
Dallas, TX, USA, June 12-15, 2018
http://www.uasconferences.com/

37th Chinese Control Conference (CCC2018)
Wuhan, China, July 25-27, 2018
http://ccc2018.cug.edu.cn/

23rd International Conference on Methods and Models in Automation and Robotics
Międzyzdroje, Poland, August 27-30, 2018
http://mmar.edu.pl/

22nd International Conference on System Theory, Control and Computing
Sinaia, Romania, October 10-12, 2018
http://www.icstcc.ugal.ro/2018/

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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: 10
OCTOBER 2018

(1) Dynamic Pricing Control for Open Queueing Networks

Author: Li Xia ; Sha Chen

Abstract

Pricing control is an important problem in service systems and it aims to control customer behaviors through an economic way, instead of administrative commands. In this paper, we study a dynamic pricing and service rate control problem in an open Jackson network with

limited capacity. The goal is to determine the optimal admission prices and the optimal service rates at every state such that the long-run average social welfare is maximized. The original problem is decomposed into a rate-setting problem plus a price-setting problem. To solve the rate-setting problem, we derive a difference formula based on the sensitivity-based optimization theory. When the cost rate function is convex in service rates and the value rate function is concave in arrival rates, we decompose the rate-setting problem into a series of convex optimization subproblems. When the rate functions have linear structure, these subproblems are even simpler and a bang–bang control is optimal. For the price-setting problem, we determine the state-dependent prices so as to induce the optimal arrival rates obtained by the rate-setting problem. We propose a recursive algorithm to numerically compute the conditional expected delays at every state. Finally, we conduct numerical experiments to explore the optimality properties and some useful insights for this dynamic pricing control problem.

Full-text available at: https://ieeexplore.ieee.org/document/8272385

(2) A Learning-Based Synthesis Approach to the Supremal Nonblocking Supervisor of Discrete-Event Systems

Author: Huimin Zhang ; Lei Feng ; Zhiwu Li

Abstract

This paper presents a novel approach to synthesize supremal nonblocking supervisors of discrete-event systems (DES), when the automaton models of specifications are not available. Extending the L∗ learning algorithm, an S∗ algorithm is developed to infer a tentatively correct supervisor. If the tentatively correct supervisor is nonblocking, it is indeed the supremal nonblocking supervisor with respect to the plant and specifications. Otherwise, the blocking automaton is regarded as a new plant, and the specification is the nonblocking property. Then, the supremal nonblocking supervisor with respect to the new problem is computed using supervisory control theory of DES. Two simplification rules are introduced to the S∗ algorithm to decrease the computational cost. Finally, the S∗ algorithm is implemented based on the LearnLib framework, and experiments are performed to verify the proposed approach.

Full-text available at: https://ieeexplore.ieee.org/document/8259248

(3) Output Observability of Systems Over Finite Alphabets With Linear Internal Dynamics

Author: Donglei Fan ; Danielle C. Tarraf

Abstract

We motivate the need for a new notion of observability for systems over finite alphabets and

propose three new notions of output observability, thereby shifting our attention to the problem of state estimation for output prediction. We then consider a class of systems over finite alphabets with linear internal dynamics, finite-valued control inputs, and finitely quantized outputs. We derive a set of sufficient conditions and a set of necessary conditions for these systems to be output observable, propose an algorithmic procedure to verify one of these conditions, and construct finite memory output observers when certain conditions are met.

Full-text available at: https://ieeexplore.ieee.org/document/8258867

(4) Semismooth Potentials of Stochastic Systems With Degenerate Diffusions

Author: Xi-Ren Cao

Abstract

We prove that for a number of optimal control problems, including finite horizon, long-run average, and optimal stopping, with one-dimensional degenerate diffusion processes, the potential function (solution to Poisson equation) and, hence, the value function (solution to HJB equation) are semismooth at the degenerate points (i.e., the left- and right-hand side derivatives exist but may not be equal). This allows applying the Ito–Tanaka formula in the direct-comparison-based optimization approach, and previous results on semismooth value functions depend heavily on this property. This result will facilitate further research in stochastic optimal control.

Full-text available at: https://ieeexplore.ieee.org/document/8276226

(5) Distributed Fault Diagnosis in Discrete Event Systems via Set Intersection Refinements

Author: Christoforos Keroglou ; Christoforos N. Hadjicostis

Abstract

We extend and verify diagnosability for a class of set intersection refinement strategies, which can be used for distributed state estimation and fault diagnosis in nondeterministic finite automata that are observed at multiple observation sites. These strategies allow observation sites to (periodically) communicate their diagnostic information (i.e., possible states along with corresponding status, such as normal operation and/or fault type) to other observation sites, which subsequently fuse all available diagnostic information (via set intersection operations), and continue operation based on the refined diagnostic information. We verify diagnosability using the proposed distributed protocol, with polynomial complexity, via compositions of (extended versions of) local verifiers, which are capable of capturing the refinement of information under the set intersection operations, as well as the influence of the refinement

process on immediate or future diagnosis decisions.

Full-text available at: https://ieeexplore.ieee.org/document/8272359

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SELECTIONS OF AUTOMATICA
VOLUME: 96
OCTOBER 2018

(1) Model-based fault identification of discrete event systems using partially observed Petri nets

Author: Guanghui Zhu, Zhiwu Li, Naiqi Wu

Abstract

This paper deals with the problem of fault identification in a system. The system is originally modeled by a Petri net, called a nominal (fault-free) net, and faults are considered as unobservable transitions not contained in the nominal net. It is assumed that partial places of the nominal net are observable and the output of the system is defined as an observed evolution, i.e., a sequence involving transitions and markings of the observable places. When faults occur, the observed evolution cannot be generated by the nominal net. We provide an approach that identifies unobservable transitions by constructing and solving an Integer Linear Programming problem according to the observed evolution and the nominal net. A faulty net is obtained by adding the identified unobservable transitions to the nominal one such that it coincides with the observed evolution. In addition, two methods to ensure acyclicity of the identified subnet, i.e., a net that includes unobservable transitions only, are reported.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S0005109818303315

(2) Optimal scheduling of multiple sensors over shared channels with packet transmission constraint

Author: Shuang Wu, Xiaoqiang Ren, Subhrakanti Dey, Ling Shi

Abstract

In this work, we consider the optimal sensory data scheduling of multiple process. A remote estimator is deployed to monitor independent linear time-invariant processes. Each process is measured by a sensor, which is capable of computing a local estimate and sending its local

state estimate wrapped up in packets to the remote estimator. The lengths of the packets are different due to different dynamics of each process. Consequently, it takes different time durations for the sensors to send the local estimates. In addition, only a portion of all the sensors are allowed to transmit at each time due to bandwidth limitation. We are interested in minimizing the sum of the average estimation error covariance of each process at the remote estimator under such packet transmission and bandwidth constraints. We formulate the problem as an average cost Markov decision process (MDP) over an infinite horizon. We first study the special case when and find that the optimal scheduling policy always aims to complete transmitting the current estimate. We also derive a sufficient condition for boundedness of the average remote estimation error. We then study the case for general . We establish the existence of a deterministic and stationary policy for the optimal scheduling problem. We find that the optimal policy has a consistent property among the sensors and a switching type structure. A stochastic algorithm is designed to utilize the structure of the policy to reduce computation complexity. Numerical examples are provided to illustrate the theoretical results.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S000510981830311X

(3) Periodic event-triggered sliding mode control

Author: Abhisek K. Behera, Bijnan Bandyopadhyay, Xinghuo Yu

Abstract

In this paper, we propose the periodic event-triggering based design of sliding mode control (SMC) for the linear time-invariant (LTI) systems. In this technique, the triggering instants are generated by a triggering mechanism which is evaluated periodically at those time instants when the state measurements are available. So, the continuous state measurement, as it is usually needed in the continuous event-triggering strategy, is no longer required in this proposed triggering strategy. The main advantages of this triggering mechanism are: (1) a uniform positive lower bound for the inter event time is guaranteed and (2) this technique is more economical and realistic than its continuous counterpart due to the relaxation of continuous measurements. In this work, we use SMC to design the periodic event-triggering condition where SMC is designed in such a way that it allows periodic evaluation of triggering rule while guaranteeing the robust performance of the system. Moreover, an upper bound of the sampling period for the periodic measurements is also obtained in this design. Finally, the simulation results are given to demonstrate the design methodology and performance of the system with the proposed event-triggering strategy.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S0005109818303273

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SELECTIONS OF SYSTEMS & CONTROL LETTERS
VOLUME: 120
OCTOBER 2018

(1) The average cost of Markov chains subject to total variation distance uncertainty

Author: A.A.Malikopoulos; C.D.Charalambous ; I.Tzortzis

Abstract

This paper addresses the problem of controlling a Markov chain so as to minimize the long-run expected average cost per unit time when the invariant distribution is unknown but we know it belongs to a given uncertain set. The mathematical model used to describe this set is the total variation distance uncertainty. We show that the equilibrium control policy, which yields higher probability to the states with low cost and lower probability to the states with the high cost, is an optimal control policy that minimizes the average cost. Recognition of such a policy may be of value in practical situations with constraints consistent to those studied here when the invariant distribution is uncertain and deriving online an optimal control policy is required.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S0167691118301488
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SELECTIONS OF THE IEEE CONTROL SYSTEMS LETTERS
VOLUME: 2 ISSUE: 4
OCTOBER 2018

(1) Privacy Verification and Enforcement via Belief Abstraction

Author: Bo Wu ; Hai Lin

Abstract

Privacy is a crucial concern in many practical systems. We consider a new notion of privacy based on beliefs of the system states, which is closely related to opacity in discrete event systems. To guarantee the privacy requirement, we propose to abstract the belief space whose dynamics is shown to be mixed monotone where efficient abstraction algorithm exists. Based on the abstraction, we propose two different approaches to preserve privacy with an illustrative example.

Full-text available at: https://ieeexplore.ieee.org/document/8392381

(2) Sampled-Data Reachability Analysis Using Sensitivity and Mixed-Monotonicity

Author: Pierre-Jean Meyer ; Samuel Coogan ; Murat Arcak

Abstract

This letter over-approximates the reachable sets of a continuous-time uncertain system using the sensitivity of its trajectories with respect to initial conditions and uncertain parameters. We first prove the equivalence between an existing over-approximation result based on the sign-stability of the sensitivity matrices and a discretetime approach relying on a mixed-monotonicity property. We then present a new over-approximation result which scales at worst linearly with the state dimension and is applicable to any continuous-time system with bounded sensitivity. Finally, we provide a simulation-based approach to estimate these bounds through sampling and falsification. The results are illustrated with numerical examples on traffic networks and satellite orbits.

Full-text available at: https://ieeexplore.ieee.org/document/8387432

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SELECTIONS OF THE IEEE TRANSACTIONS ON SYSTEMS, MAN AND CYBERNETICS: SYSTEMS
VOLUME: 48 ISSUE: 10
OCTOBER 2018

(1) Decentralized Diagnosis by Petri Nets and Integer Linear Programming

Author: Xuya Cong ; Maria Pia Fanti ; Agostino Marcello Mangini ; Zhiwu Li

Abstract

This paper proposes a novel decentralized on-line fault diagnosis approach based on the solution of some integer linear programming problems for discrete event systems in a Petri net framework. The decentralized architecture consists of a set of local sites communicating with a coordinator that decides whether the system behavior is normal or subject to some possible faults. To this aim, some results allow defining the rules applied by the coordinator and the local sites to provide the global diagnosis results. Moreover, two protocols for the detection and diagnosis of faults are proposed: they differ for the information exchanged between local sites and coordinator and the diagnostic capability. In addition, a sufficient and necessary condition under which the second presented protocol can successfully diagnose a fault in the

decentralized architecture is proved. Finally, some examples are presented to show the efficiency of the proposed approach.

Full-text available at: https://ieeexplore.ieee.org/document/7999243

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Call for application – PhD student and Postdocs

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Contributed by: Qing-Shan Jia (jiaqs@tsinghua.edu.cn)

The center for intelligent and networked systems (CFINS) at Tsinghua University (Beijing, China) (http://www.cfins.au.tsinghua.edu.cn) invites applications for PhD positions in the field of control and optimization of energy Internet and smart buildings. Potential applicants with knowledge on Markov decision process, power systems, and/or building systems are especially encouraged to apply. The potential applicant should be expected to receive a Bachelor/MS degree in EE/CS/IE or related areas, or already have a Bachelor/MS degree in these fields. Applications will be reviewed immediately. All applications should be received by Oct. 30, 2018. Interested applicants, please send an email to (Samuel) Qing-Shan Jia jiaqs@tsinghua.edu.cn to know more details.