IEEE CONTROL SYSTEMS SOCIETY TECHNICAL COMMITTEE ON DISCRETE EVENT SYSTEMS

Newsletter..... April 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: 4
APRIL 2018

(1) Codiagnosability Analysis of Bounded Petri Nets

Author: Ning Ran ; Hongye Su ; Alessandro Giua ; Carla Seatzu

Abstract

In this paper, we propose a novel approach to perform codiagnosability analysis of labeled bounded Petri nets. A set of sites observe the system evolution, each one with its own observation mask. Sites do not exchange information with each other but communicate with a coordinator. The coordinator is able to detect a fault if and only if at least one site is able to do that. In a previous work by some of us, it has been proven that a necessary and sufficient condition for codiagnosability under such a framework is the absence of sequences that are “ambiguous” with respect to all sites and whose length may grow indefinitely after the occurrence of some fault. The novelties of the approach consist in using the notion of basis markings to avoid exhaustive enumeration of the set of reachable markings, and in the construction of an automaton, called Verifier, that allows one to detect the presence of ambiguous sequences. Finally, we introduce the notion of K -codiagnosability: a system is K -codiagnosable if and only if faults can be detected in the above framework within at most K observations after their occurrence. An algorithm is provided to compute the smallest value of K such that the system is K -codiagnosable.

Full-text available at: https://ieeexplore.ieee.org/document/8013799/

(2) Cooperative Q-Learning for Rejection of Persistent Adversarial Inputs in Networked Linear Quadratic Systems

Author: Kyriakos G. Vamvoudakis ; João P. Hespanha

Abstract

In this paper, a cooperative Q-learning approach is proposed to enable the agents in large networks to synchronize to the behavior of an unknown leader by each optimizing a distributed performance criterion that depends only on a subset of the agents in the network. The novel distributed Q-functions are parametrized as functions of the tracking error, control, and adversarial inputs in the neighborhood. In the proposed approach, the agents coordinate with the neighbors in order to pick their minimizing model-free policies in such a way to guarantee convergence to a graphical Nash equilibrium and also attenuation of maximizing worst case adversarial inputs. A structure of two-actors and a single-critic approximators is used for each agent in the network. This eventually solves the complexity issues that arise in Q-learning. The two-actors are used to approximate the optimal control input and the worst case adversarial input, whereas the critic approximator is used to approximate the optimal cost of each of the coupled optimizations. Effective tuning laws are proposed to solve the model-free cooperative game problem while also guaranteeing closed-loop stability with the use of rigorous Lyapunov-based stability proofs. Finally, a numerical example is used to illustrate the effectiveness of the proposed approach.

Full-text available at: https://ieeexplore.ieee.org/document/7999234/

(3) Kalman Filtering Over Gilbert–Elliott Channels: Stability Conditions and Critical Curve

Author: Junfeng Wu ; Guodong Shi ; Brian D. O. Anderson ; Karl Henrik Johansson

Abstract

This paper investigates the stability of Kalman filtering over Gilbert–Elliott channels where random packet drops follow a time-homogeneous two-state Markov chain whose state transition is determined by a pair of failure and recovery rates. First of all, we establish a relaxed condition guaranteeing peak-covariance stability described by an inequality in terms of the spectral radius of the system matrix and transition probabilities of the Markov chain. We further show that the condition can be interpreted using a linear matrix inequality feasibility problem. Next, we prove that the peak-covariance stability implies mean-square stability, if the system matrix has no defective eigenvalues on the unit circle. This connection between the two stability notions holds for any random packet drop process. We prove that there exists a critical curve in the failure-recovery rate plane, below which the Kalman filter is mean-square stable and no longer mean-square stable above. Finally, a lower bound for this critical failure rate is obtained making use of the relationship we establish between the two stability criteria, based on an approximate relaxation of the

system matrix.

Full-text available at: https://ieeexplore.ieee.org/document/7994710/

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SELECTIONS OF AUTOMATICA
VOLUME: 90
APRIL 2018

(1) On stability and convergence of optimal estimation for networked control systems with dual packet losses without acknowledgment

Author: Hong Lin, Hongye Su, Michael Z.Q.Chen, Zhan Shu, Renquan Lu, Zheng-Guang Wu

Abstract

This paper studies the optimal state estimation problem for networked control systems with control and observation packet losses but without packet acknowledgment (ACK). The packet ACK is a signal sent by the actuator to inform the estimator whether control packets are lost or not. Systems with packet ACK are usually called transmission control protocol (TCP)-like systems, and those without ACK are named user datagram protocol (UDP)-like systems. For UDP-like systems, the optimal estimator is derived and it is consisted of an exponentially increasing number of terms. By developing an auxiliary estimator, it is shown that there exists a critical observation packet arrival rate determining the stability of the expected EC (EEC), and it is identical to its counterpart for TCP-like systems. It is revealed that whether there is packet ACK or not has no effect on the stability of the EEC. Furthermore, under some conditions the EEC converges exponentially.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S0005109817306465

(2) Optimal distributed stochastic mirror descent for strongly convex optimization

Author: Deming Yuan, Yiguang Hong, Daniel W.C.Ho, Guoping Jiang

Abstract

In this paper we consider convergence rate problems for stochastic strongly-convex optimization in the non-Euclidean sense with a constraint set over a time-varying multi-agent network. We propose two efficient non-Euclidean stochastic subgradient descent algorithms based on the Bregman divergence as distance-measuring function rather than the Euclidean distances that were employed by the standard distributed stochastic projected subgradient algorithms. For distributed optimization of non-smooth and

strongly convex functions whose only stochastic subgradients are available, the first algorithm recovers the best previous known rate of (where is the total number of iterations). The second algorithm is an epoch variant of the first algorithm that attains the optimal convergence rate of , matching that of the best previously known centralized stochastic subgradient algorithm. Finally, we report some simulation results to illustrate the proposed algorithms.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S0005109817306404

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SELECTIONS OF THE IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING
VOLUME: 15 ISSUE: 2
APRIL 2018

(1) A Novel Semiparametric Hidden Markov Model for Process Failure Mode Identification

Author: Hongyang Yu

Abstract

The emitting distributions of a hidden Markov model (HMM) are normally constructed using the cross moments of the process variables. Similar to the mean of a univariate probability distribution, the cross moment is the most fundamental statistic of a multivariate probability distribution, which is not capable of capturing the high-order statistical features of process data. To alleviate this limitation, the high-order equivalence of the cross moment demonstrated in this paper, as the complete dependence structure, is used to construct the emitting distribution for HMM. The complete dependence structure among the process variables is modeled in a Gaussian copula. A semiparametric data transformation is also proposed to ensure the necessary conditions for using a Gaussian copula are met. The final emitting distribution is constructed as a finite mixture of the copula models. The proposed HMM is tested on two industrial studies for performance validation.

Full-text available at: https://ieeexplore.ieee.org/document/7828019/

(2) Automatic Segmentation of Stabilometric Signals Using Hidden Markov Model Regression

Author: Khaled Safi ; Samer Mohammed ; Ferhat Attal ; Yacine Amirat ; Latifa Oukhellou ; Mohamad Khalil ; Jean-Michel Gracies ; Emilie Hutin

Abstract

Posture analysis in quiet standing is an essential element in evaluating human balance control. Many

factors enhance the human control system's ability to maintain stability, such as the visual system and base of support (feet) placement. In contrast, many neural pathologies, such as Parkinson's disease (PD) and cerebellar disorder, disturb human stability. This paper addresses the problem of the automatic segmentation of stabilometric signals recorded under four different conditions related to vision and foot position. This is achieved for both control subjects and PD subjects. A hidden Markov model (HMM)-regression-based approach is used to carry out the segmentation between the different conditions using simple and multiple regression processes. Twenty-eight control subjects and thirty-two PD subjects participated in this study. They were asked to stand upright while recording stabilometric signals in mediolateral and anteroposterior directions under two permutations: feet apart and together with eyes open or closed. The results show high values for the correct segmentation rates, up to 98%, for the separation between the different conditions. The present findings could help clinicians better understand the motor strategies used by the patients during their orthostatic postures and may guide the rehabilitation process. The proposed method compares favorably with standard segmentation approaches.

Full-text available at: https://ieeexplore.ieee.org/document/7839989/

(3) Scheduling Cluster Tools in Semiconductor Manufacturing: Recent Advances and Challenges

Author: ChunRong Pan ; MengChu Zhou ; Yan Qiao ; NaiQi Wu

Abstract

Cluster tools are automated robotic manufacturing systems containing multiple computer-controlled process modules. They have been increasingly used for wafer fabrication. This paper reviews the modeling and scheduling methods for cluster tools with both nonrevisiting and revisiting processes. For nonrevisiting processes, we focus on the modeling and scheduling problems of cluster tools with different constraints. Then, their solution methods are reviewed and compared. For revisiting processes, this paper first discusses the scheduling problem of some general manufacturing systems with revisiting. Then, the modeling and scheduling methodologies used to solve the scheduling problems of cluster tools with revisiting processes are reviewed. Future research directions and conclusions are finally discussed.

Full-text available at: https://ieeexplore.ieee.org/document/7876736/

(4) Safety-Level Aware Bin-Packing Heuristic for Automatic Assignment of Power Plants Control Functions

Author: Mohamed Benazouz ; Jean-Marc Faure

Abstract

Finding a suitable set of controllers to which a large set of control functions with different safety levels can be assigned, while minimizing cost, is a significant task during the design of the operational control system of a critical process, such as a power plant. This task is currently performed by experts and extremely

time-consuming, which explains why its automation is a real concern. This paper shows first that the above-mentioned assignment problem can be identified as a multiple-choice vector bin packing (BP) with conflicts problem, a combination of different variants of the well-known 1-D BP problem. Such a problem is known to be strongly NP-hard and exact techniques to solve it on large-sized examples are too time and/or space-consuming because of the combinatorial explosion. To solve this problem in polynomial time, this paper proposes a fast heuristic based on a first-fit decreasing approach. Two strategies to perform this heuristic and several criteria to rank the functions before assignment are defined. These strategies and criteria are then compared on the basis of numerous experiments. These experiments show that the proposed heuristic scales well and provides results that are very close to optimum; the difference in the worst case is less than 1%.

Full-text available at: https://ieeexplore.ieee.org/document/7855714/

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SELECTIONS OF IEEE Transactions on Systems, Man, and Cybernetics: Systems
VOLUME: 48 ISSUE: 4
APRIL 2018

(1) Wafer Sojourn Time Fluctuation Analysis of Time-Constrained Dual-Arm Cluster Tools With Wafer Revisiting and Activity Time Variation

Author: Yan Qiao ; NaiQi Wu ; FaJun Yang ; MengChu Zhou ; QingHua Zhu

Abstract

A robotic cluster tool involves many activities whose time is subject to some disturbance, thus leading to the activity time variation. It results in wafer sojourn time fluctuation in a process module, which may in turn violate wafer residency time constraints. Some wafer fabrication requires a revisiting process. With wafer revisiting, the effect of activity time variation on wafer sojourn time fluctuation is so complicated that no analysis was reported to the best knowledge of the authors. It is vitally important to accurately analyze it. To do so, this paper adopts a Petri net model to describe the dynamical behavior of cluster tools. With this model, a real-time control policy is proposed to offset the effect of the activity time variation on wafer sojourn time fluctuation as much as possible. Then, the wafer sojourn time delay is analyzed and algorithms are developed to calculate its exact upper bound. With the proposed method, one can check if a given schedule is feasible under bounded activity time variation. Some practical examples are given to show the application of the proposed approach.

Full-text available at: https://ieeexplore.ieee.org/document/7562535/

(2) A Stochastic Control Approach to Maximize Profit on Service Provisioning for Mobile Cloudlet Platforms

Author: Weiwei Fang ; Xuening Yao ; Xiaojie Zhao ; Jianwei Yin ; Naixue Xiong

Abstract

The recent emergence of mobile cloud computing has enabled mobile users to offload computing tasks from mobile devices to nearby cloudlets, so as to reduce energy consumption and improve application performance. In this paper, we consider the problem of maximizing the profit of the cloudlets' managing platform that receives computing requests from mobile users and fulfils these requests by leveraging computing service of participating cloudlets. However, it is very challenging to maximize the operating profit for such a managing platform, due to unpredictable arrival of user requests, dynamic participation of mobile cloudlets, and complexity in computing resource allocations. Based on the Lyapunov optimization technique combined with the technique of weight perturbation, we introduce a new stochastic control algorithm that makes online decisions on computing request admission and dispatching, computing service purchasing, and computing resource allocation. Different from traditional techniques, this algorithm does not require any statistical knowledge of relevant system dynamics, and is efficient for implementation in practice. Theoretical analysis and simulation results have demonstrated both the profit optimality and the system stability achieved by the proposed control algorithm.

Full-text available at: https://ieeexplore.ieee.org/document/7586102/

(3) Optimal Subset Selection of Stochastic Model Using Statistical Hypothesis Test

Author: Seon Han Choi ; Tag Gon Kim

Abstract

This paper proposes an improved algorithm for the optimal subset selection of a stochastic simulation model. The algorithm uses a statistical hypothesis test based on frequentist inference to evaluate the uncertainty about the selection, and it distributes simulation resources to designs for minimizing the uncertainty in each iteration. Several experiments demonstrate the improved performance compared to the other algorithms, and the performance increases significantly as the noise of the model increases. As a result, its high robustness to noise allows the algorithm to efficiently analyze real-world problems.

Full-text available at: https://ieeexplore.ieee.org/document/7582522/

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