IEEE Control Systems Society
Technical Committee on Discrete Event Systems

Newsletter **July 2020**

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Welcome to the 2020 July issue of the newsletter, also available online at
http://discrete-event-systems.ieeecss.org/tc-discrete/newsletters

Editorial

You are welcome to submit new items to the newsletter (topics including schools, workshops, sessions, conferences, journals, books, software, positions). Also please encourage relevant colleagues and students to subscribe to this newsletter.

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Contents

1 Selections of Journal Publications

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

1.1. Discrete Event Dynamic Systems Theory and Applications

Volume: 30, Issue: 2, June 2020

- **Problematic configurations and choice-join pairs on Mono-T-Semiflow nets: towards the characterization of behavior-structural properties**
  Authors: Manuel Navarro-Gutierrez ; Jaime A. Fraustro-Valdez ; Antonio Ramirez-Trevino ; Manuel Silva
  Abstract: This work is concerned with the computation of problematic configurations and problematic choice-join pairs in timed continuous Petri nets under the infinite server semantics; those net structural objects explain possible bad/counter-intuitive behaviors of systems, such as non-monotonicities and discontinuities of the equilibrium throughput. The calculation of problematic configurations is a computationally complex task since their number grows exponentially with the input cardinality of join transitions. In order to alleviate this inconvenience, four type of reduction rules preserving the set of problematic configurations are addressed. Reduction rules are weighted versions of the macroplace, macrotransition, and fusion of transitions rules, the elimination of implicit places rule is also provided. Reduced nets are useful to better understand the net substructures leading to unexpected behaviors in the equilibrium throughput. They help to highlight that the structural objects named problematic choice-join pairs, defined in this work, are the actual responsible of these counter-intuitive throughput behaviors. The great advantage over the set of problematic configurations is that the set of problematic choice-join pairs grows polynomially in the size of the net.
- **Synthesis of least restrictive controllable supervisors for extended finite-state machines with variable abstraction**
  Authors: Robi Malik ; Marcelo Teixeira
  Abstract: This paper presents an algorithm that combines modular synthesis for extended finite-state machines (EFSM) with abstraction of variables by symbolic manipulation, in order to compute least restrictive controllable supervisors. Given a modular EFSM system consisting of several components, the proposed algorithm synthesises a separate supervisor for each specification component. To synthesise each supervisor, the algorithm iteratively selects components (plants and variables) from a synchronous composition until a least restrictive controllable solution is obtained. This improves on previous results of the authors where abstraction is only performed by the selection of components and not variables. The paper explains the theory of EFSM synthesis and abstraction and its algorithms. An example of a flexible manufacturing system illustrates how the proposed algorithm works to compute a modular supervisor.
- **Information control in networked discrete event systems and its application to battery management systems**
  Authors: Feng Lin ; Le Yi Wang ; Wen Chen ; Weilin Wang ; Fei Wang
  Abstract: Opacity is an important property in control of information flow among networked agents. In this paper, we investigate information control problems in networked discrete event systems using opacity. In a networked discrete event system, communication among agents is via a shared communication network. Since delays and losses are unavoidable in networked discrete event systems, they must be considered in investigating opacity. We call opacity under communication delays and losses network opacity. We first define three network opacities: strong network opacity, weak network opacity, and network non-opacity. We derive necessary and sufficient conditions for network opacities and develop methods to check network opacities. We then apply network opacity to solve a problem in battery management systems.
- **Modelling and control of periodic time-variant event graphs in dioids**
  Authors: Johannes Trunk ; Bertrand Cottenceau ; Laurent Hardouin ; Joerg Raisch
  Abstract: Timed Event Graphs (TEGs) can be described by time invariant (max,+) linear systems. This formalism has been studied for modelling, analysis and control synthesis for decision-free timed

Discrete Event Systems (DESs), for instance specific manufacturing processes or transportation networks operating under a given logical schedule. However, many applications exhibit time-variant behaviour, which cannot be modelled in a standard TEG framework. In this paper we extend the class of TEGs in order to include certain periodic time-variant behaviours. This extended class of TEGs is called Periodic Time-variant Event Graphs (PTEGs). It is shown that the input-output behaviour of these systems can be described by means of ultimately periodic series in a dioid of formal power series. These series represent transfer functions of PTEGs and are a convenient basis for performance analysis and controller synthesis.

- **On the computation of counterexamples in compositional nonblocking verification**
  Authors: Robi Malik ; Simon Ware
  Abstract: This paper describes algorithms to compute a counterexample when compositional nonblocking verification determines that a discrete event system is blocking. Counterexamples are an important feature of model checking that explains the cause of a detected problem, greatly helping users to understand and fix faults. In compositional verification, counterexamples are difficult to compute due to the large state space and the loss of information after abstraction. The paper explains the difficulties and proposes solutions, and experimental results show that counterexamples can be computed successfully for several industrial-scale systems.

- **Arborescent architecture for decentralized diagnosis of discrete event systems**
  Authors: Ahmed Khoumsi
  Abstract: We study decentralized diagnosis whose objective is fault detection in discrete event systems using decentralized architectures. We first identify a basic diagnosis and two virtual diagnoses as the simplest language-based decentralized diagnosis architectures. The virtual diagnoses cannot be used alone, they are provided to be combined with other diagnoses. On the other side, inference-based diagnosis generalizes several decentralized diagnoses, among which the basic and virtual diagnoses. We propose arborescent diagnosis, a diagnosis methodology that generates and uses a tree-like decentralized architecture whose all leaves are virtual diagnoses, except one specific leaf R. Each node n of the tree is a conjunction or disjunction of the diagnosis decisions of the two children of n. If inference-based diagnosis is applicable to the diagnosis objective, then R is a basic diagnosis. This means that by combining adequately virtual diagnoses and one basic diagnosis, we can realize every diagnosis objective that is realizable by inference-based diagnosis. Also, if inference-based diagnosis is unapplicable to the diagnosis objective, then the architecture of R is undetermined. In this case, we show how to find a diagnosis architecture for R by combining arborescent diagnosis with a state-based diagnosis method called multi-decision diagnosis. Complexities of arborescent and inference-based diagnoses are studied and compared.

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1.2. IEEE Transactions on Automatic Control

Volume: 65, Issue: 7, July 2020

- **Efficient Liveness Assessment for Traffic States in Open, Irreversible, Dynamically Routed, Zone-Controlled Guidepath-Based Transport Systems**
  Authors: Spyros Reveliotis ; Tomas Masopust
  Abstract: Open, irreversible, dynamically routed, zone-controlled guidepath-based transport systems model the operation of many automated unit-load material handling systems that are used in various production and distribution facilities. An important requirement for these systems is to preserve the system liveness-i.e., the ability of each system agent to reach any location of the underlying guidepath network-by blocking those traffic states that will result in deadlock and/or livelock. The remaining set of traffic states are characterized as live. The worst-case computational complexity of the decision problem of assessing the state liveness in the considered class of transport systems is an open issue. As a first contribution of this paper, we identify an extensive subclass of these traffic states, defined through the topology of an abstracting graphical representation of the traffic state concept, for which the corresponding problem of liveness assessment admits a polynomial solution, and we present the relevant algorithm for this assessment. But the development of the aforementioned results has also led to a new methodological framework for representing and

analyzing the qualitative dynamics of the considered transport systems with respect to the reachability and the liveness problems that are the focus of this paper. This framework can enable an effective and efficient (but maybe not polynomial-complexity) resolution of the state liveness even for those traffic states that do not belong in the primary state class that is considered in this paper; we highlight this additional possibility in the closing part of this paper.

- **Divergence Properties of Labeled Petri Nets and Their Relevance for Diagnosability Analysis**
  Authors: Alessandro Giua ; Stephane Lafortune ; Carla Seatzu
  Abstract: In this note, we focus on labeled Petri nets and formalize two properties, language divergence and marking divergence , discussing their relevance for diagnosability analysis. In particular, we review the results for diagnosability and K -diagnosability presented in an article entitled "A new approach for diagnosability analysis of Petri nets using verifier nets" that we coauthored. We show that these results apply to nets that are language divergence-free, an assumption that was not explicitly mentioned in that article. In addition, we also provide an alternative structural assumption-which does not require testing the behavioral property of divergence-freeness-under which the above results hold.

- **A Generalized Framework For Kullback-Leibler Markov Aggregation**
  Authors: Rana Ali Amjad ; Clemens Blochl ; Bernhard C. Geiger
  Abstract: We propose an information-theoretic Markov aggregation framework that is motivated by two objectives: 1) The Markov chain observed through the aggregation mapping should be Markov. 2) The aggregated chain should retain the temporal dependence structure of the original chain. We analyze our parameterized cost function and show that it contains previous cost functions as special cases, which we critically assess. Our simple optimization heuristic for deterministic aggregations characterizes the optimization landscape for different parameter values.

- **Risk Probability Minimization Problems for Continuous-Time Markov Decision Processes on Finite Horizon**
  Authors: Haifeng Huo ; Xianping Guo
  Abstract: This article deals with a risk probability minimization problem for finite horizon continuous-time Markov decision processes with unbounded transition rates and history-dependent policies. Only using the assumption of nonexplosion of the controlled state process as well as the finiteness of actions available at each state, we not only establish the existence and uniqueness of a solution to the corresponding optimality equation, but also prove the existence of a risk probability optimal policy. Finally, we give two examples to illustrate our results: one example shows that the value iteration algorithm is provided for computing both the value function and an optimal risk probability policy, and the other shows the differences between the conditions in this article and those in the previous literature.

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1.3. Automatica

Volume: 117 July 2020

- **Event-triggered learning**
  Authors: Friedrich Solowjow ; Sebastian Trimpe
  Abstract: The efficient exchange of information is an essential aspect of intelligent collective behavior. Event-triggered control and estimation achieve some efficiency by replacing continuous data exchange between agents with intermittent, or event-triggered communication. Typically, model-based predictions are used at times of no data transmission, and updates are sent only when the prediction error grows too large. The effectiveness in reducing communication thus strongly depends on the quality of the prediction model. In this article, we propose event-triggered learning as a novel concept to reduce communication even further and to also adapt to changing dynamics. By monitoring the actual communication rate and comparing it to the one that is induced by the model, we detect a mismatch between model and reality and trigger model learning when needed. Specifically, for linear Gaussian dynamics, we derive different classes of learning triggers solely based

on a statistical analysis of inter-communication times and formally prove their effectiveness with the aid of concentration inequalities.

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1.4. IEEE Transactions on Automation Science and Engineering

Volume: 17, Issue: 3, July 2020

- **Energy-Efficient Elevating Transfer Vehicle Routing for Automated Multi-Level Material Handling Systems**
  Authors: Zhou Fang ; Jianfeng Mao
  Abstract: We investigate an energy-efficient elevating transfer vehicle routing problem (ETVRP), in which an elevating transfer vehicle (ETV) serves a multi-level freight handling system to transport cargo containers between airside and landside in an air cargo terminal. The problem can be regarded as a special case of stacker crane problem defined on a regular grid graph constructed by uniform rectangular tiles. Even with the special grid network structure, the ETVRP is still NP-hard in general. We manage to identify a subset of the ETVRP instances that are polynomially solvable based on the condition of free-permutation. For general ETVRPs, we propose a new and more efficient exact formulation whose dimensionality does not constantly increase with the number of requests and is bounded by the size of the underlying grid network. To further enhance computational efficiency, we develop two approximation algorithms, one of which is asymptotically optimal and has the time-complexity that grows linearly with the number of requests; the other has a bounded time-complexity and works better for instances with smaller arc lengths. Combining these two algorithms can guarantee an approximation ratio of 5/3. The performances of the proposed formulation and the approximation algorithms are further examined through numerical simulations.
- **A Dynamic Programming Approach for the Decentralized Control of Energy Retrofit in Large-Scale Street Lighting Systems**
  Authors: Raffaele Carli ; Mariagrazia Dotoli
  Abstract: This article proposes a decision-making procedure that supports the city energy manager in determining the optimal energy retrofit plan of an existing public street lighting system throughout a wide urban area. The proposed decision model aims at simultaneously maximizing the energy consumption reduction and achieving an optimal allocation of the retrofit actions among the street lighting subsystems, while efficiently using the available budget. The resulting optimization problem is formulated as a quadratic knapsack problem. The proposed solution relies on a decentralized control algorithm that combines discrete dynamic programming with additive decomposition and value functions approximation. The optimality and complexity of the presented strategy are investigated, demonstrating that the proposed algorithm constitutes a fully polynomial approximation scheme. Simulation results related to a real street lighting system in the city of Bari (Italy) are presented to show the effectiveness of the approach in the optimal energy management of large-scale street lighting systems.
- **A Control Approach Based on Colored Hybrid Petri Nets and (Max, +) Algebra: Application to Multimodal Transportation Systems**
  Authors: Karima Outafraout ; Ahmed Nait-Sidi-Moh ; El Houcine Chakir El Alaoui
  Abstract: This article is devoted to the study and the control of a multimodal transportation system (MTS) modeled by colored hybrid Petri nets (CHPNs) and (max, +) algebra. The studied MTS is composed of multiple connected stations served by large capacity transportation modes (such as trains and subways) and a finite number of bus shuttles with limited capacities that ensure the exchange of passengers between these stations. The MTS is studied in this article as a hybrid dynamical system (HDS). A nonstationary linear (max, +) model based on the CHPN model representing the behavior of the MTS is developed by taking into account the delays of bus shuttles that may be caused by unpredictable incidents (such as breakdowns and accidents). Through the resultant model, we analyze the system evolution over time and evaluate arrival/departure times of transportation means to/from the various connected stations and also passengers waiting times. In addition, an optimal control approach regarding just-in-time criterion is proposed to optimize two

crucial parameters, namely: waiting times of passengers at the connected stations and the number of bus shuttles to be deployed on the network. In addition, the ability of the adapted control approach to deal with bus shuttle delays caused by unpredictable incidents and how the impact of these delays on passengers waiting times can be prevented will be studied. Finally, some relevant scenarios will be studied and discussed in order to illustrate and validate the suggested approach.

- **Parking Assignment: Minimizing Parking Expenses and Balancing Parking Demand Among Multiple Parking Lots**
  Authors: Oanh Tran Thi Kim ; Nguyen H. Tran ; Chuan Pham ; Tuan LeAnh ; My T. Thai ; Choong Seon Hong
  Abstract: Recently, a rapid growth in the number of vehicles on the road has led to an unexpected surge of parking demand. Consequently, finding a parking space has become increasingly difficult and expensive. One of the viable approaches is to utilize both public and private parking lots (PLs) to effectively share the parking spaces. However, when the parking demands are not balanced among PLs, a local congestion problem occurs where some PLs are overloaded, and others are underutilized. Therefore, in this article, we formulate the parking assignment problem with two objectives: 1) minimizing parking expenses and 2) balancing parking demand among multiple PLs. First, we derive a matching solution for minimizing parking expenses. Then, we extend our study by considering both parking expenses and balancing parking demand, formulating this as a mixed-integer linear programming problem. We solve that problem by using an alternating direction method of multipliers (ADMM)-based algorithm that can enable a distributed implementation. Finally, the simulation results show that the matching game approach outperforms the greedy approach by 8.5% in terms of parking utilization, whereas the ADMM-based algorithm produces performance gains up to 27.5% compared with the centralized matching game approach. Furthermore, the ADMM-based proposed algorithm can obtain a near-optimal solution with a fast convergence that does not exceed eight iterations for the network size with 1000 vehicles.

- **Parallel Optimal Tracking Control Schemes for Mode-Dependent Control of Coupled Markov Jump Systems via Integral RL Method**
  Authors: Kun Zhang ; Hua-guang Zhang ; Yuliang Cai ; Rong Su
  Abstract: This article is concerned with the optimal tracking control problem of the coupled Markov jump system (CMJS) by using the reinforcement learning (RL) technique. Based on the conventional optimal tracking architecture, an offline tracking iteration algorithm is first designed to solve the coupled algebraic Riccati equation that can hardly be solved by mathematical methods directly. To overcome the crucial requirements and existing shortcomings in the offline tracking method, a novel integral RL (IRL) tracking algorithm is first proposed for CMJS, which develops a transition-probability-free optimal tracking control scheme with a reconstructed augmented system and discounted cost function. Both the requirements of transition probability $\pi_{i,j}$ and system matrix Ai are avoided via the designed IRL algorithm. The stability and convergence of the novel schemes are proved by the Lyapunov theory, and the tracking objective is achieved as desired. Finally, we apply the designed algorithms in a fourth-order Markov jump control problem and the stochastic mass, spring, and damper system to track continuous sinusoidal waveforms, and the simulation results are provided to show the effectiveness and applicability.

- **Decomposition Method for New Single-Machine Scheduling Problems From Steel Production Systems**
  Authors: Ziyan Zhao ; Shixin Liu ; MengChu Zhou ; Xiwang Guo ; Liang Qi
  Abstract: Production scheduling is a crucial task in modern steel plants. The scheduling of a wire rod and bar rolling process is challenging in many steel plants, which has a direct impact on their production efficiency and profit. This article studies a new single-machine scheduling problem with sequence-dependent setup time, release time, and due time constraints originated from a wire rod and bar rolling process in steel plants. In this problem, jobs have been assigned to batches in advance. The objective is to schedule the batches and jobs on continuous time to minimize the number of late jobs. A mixed-integer program is created as a baseline model. A baseline method is used to solve this NP-hard problem by solving the baseline model. We further design a two-stage decomposition method after analyzing the characteristics of this problem. Both actual

and simulated instances with varying sizes are solved by using the proposed methods. The results demonstrate that the baseline method can only solve some small-scale cases, while the decomposition method can solve all small-scale cases and some medium-scale cases. Finally, we reveal the impacts of different instances on the performance of the proposed decomposition method.

- **A Reinforcement Learning Approach to Robust Scheduling of Semiconductor Manufacturing Facilities**
  Authors: In-Beom Park ; Jaeseok Huh ; Joongkyun Kim ; Jonghun Park
  Abstract: As semiconductor manufacturers, recently, have focused on producing multichip products (MCPs), scheduling semiconductor manufacturing operations become complicated due to the constraints related to reentrant production flows, sequence-dependent setups, and alternative machines. At the same time, the scheduling problems need to be solved frequently to effectively manage the variabilities in production requirements, available machines, and initial setup status. To minimize the makespan for an MCP scheduling problem, we propose a setup change scheduling method using reinforcement learning (RL) in which each agent determines setup decisions in a decentralized manner and learns a centralized policy by sharing a neural network among the agents to deal with the changes in the number of machines. Furthermore, novel definitions of state, action, and reward are proposed to address the variabilities in production requirements and initial setup status. Numerical experiments demonstrate that the proposed approach outperforms the rule-based, metaheuristic, and other RL methods in terms of the makespan while incurring shorter computation time than the metaheuristics considered.

- **Dynamic Resource Allocation in a Hierarchical Appointment System: Optimal Structure and Heuristics**
  Authors: Xin Pan ; Jie Song ; Bo Zhang
  Abstract: To better manage patient flows, China has promoted a referral system across the country. Patients are encouraged to receive the initial diagnosis in community hospitals (CHs), and general hospitals (GHs) manage a slot reservation process to fulfill the needs of referral patients, who are in more severe conditions. According to the system practices, however, the reservation policy usually leads to either underutilized resources or unsatisfied referrals. This article aims to investigate a more effective method of allocating resources in GHs. We formulate the referral system as an appointment booking problem, considering the notion of the patient mix and system dynamics. The decision process of the referral system is captured by a discrete-time finite-horizon Markov decision process (MDP) model under a general framework. Theoretically, we analyze the structural properties of the MDP value functions to prove the monotonic properties of the optimal dynamic policy. The properties inspire us to design a heuristic policy called advanced referrals (ARs) policy, which offers resources to high-priority referrals earlier than regular patients. We prove that the AR policy is asymptotically optimal with infinite capacity and demand rates. Finally, we compare the performance of the AR policy with the optimal dynamic policy in numerical experiments, and also show that our policy outperforms fixed-reservation and first-come-first-serve policies which are widely used in practice.

- **An MPC Scheme for Traffic Coordination in Open and Irreversible, Zone-Controlled, Guidepath-Based Transport Systems**
  Authors: Spyros Reveliotis
  Abstract: Zone-controlled, guidepath-based transport system (ZC-GBTS) is a modeling abstraction that has been used extensively for the modeling of the safe interaction of a number of agents that circulate in a constricted medium. The traffic scheduling problem in these transport systems is very hard, and in some recent work of ours, we have proposed a model predictive control (MPC) scheme for simplifying this problem. The detailed implementation of this MPC scheme depends on certain structural and operational properties of the underlying ZC-GBTS. In this article, we detail the aforementioned MPC scheme for a ZC-GBTS subclass that is characterized as open and irreversible; the presented results leverage some earlier similar developments of ours for the subclass of open and reversible ZC-GBTS.

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1.5. IEEE Transactions on Systems, Man, and Cybernetics: Systems

Volume: 50, Issue: 7, July 2020

- **Energy-Efficient Subway Train Scheduling Design With Time-Dependent Demand Based on an Approximate Dynamic Programming Approach**
  Authors: Renming Liu ; Shukai Li ; Lixing Yang ; Jiateng Yin
  Abstract: Owing to environmental concerns, the energy-efficient subway train scheduling problem is necessary in subway operation management. This paper designs an approximate dynamic programming (DP) approach for energy-efficient subway train scheduling problem with time-dependent demand. The train traffic model is proposed with the dynamic equations for the evolution of train headway, train passenger loads, and the energy consumption along the subway line. For the dynamic changing of the onboard passengers with time, the total train energy usage is modeled as the sum of energy consumptions from the traction system and auxiliary facilities. A nonlinear DP problem is formulated to generate a near optimal timetable to realize the tradeoff among the utilization of trains, passenger waiting time, service levels, and energy consumption. To overcome the curse of dimensionality in this optimization problem, we construct an approximate DP framework, where the conceptions of states, policies, state transitions, and reward function are introduced. And this algorithm is able to converge to a good solution with a short time compared to the genetic algorithm and differential evolution algorithm. Finally, the numerical experiments are given to demonstrate the effectiveness of the proposed model and algorithm.
- **Performance Optimization of Reconfigurable Real-Time Wireless Sensor Networks**
  Authors: Maroua Gasmi ; Olfa Mosbahi ; Mohamed Khalgui ; Luis Gomes ; Zhiwu Li
  Abstract: Wireless sensor networks (WSNs) can be seriously impacted by several changes in behavior. As a measure of optimality, a network should react in real-time. However, even if some reactions can make the system flexible, they can cause significant damages when they are not well-structured. Moreover, the scenarios of reconfigurations can affect several parameters within a wireless sensor network. Among these parameters it is possible to name the energy efficiency, the memory limitation within a node, the real-time constraints at the level of the nodes and the network in general. Either through the application or the transmission of the reconfiguration scenarios, some parameters are severely altered. A metamorphosis of the internal architecture of the nodes is proposed in this research work as well as a policy of communication between several nodes aiming to adapt the network to any change. The resulting proposition offers general efficiency in energy and real-time constraints. The efficiency is realized by the application of a pipelined approach, dealing with the incoming reconfiguration scenarios, and a communication protocol, based on a priority energy and deadline aware scheduling algorithm (a multicriteria scheduling algorithm). This protocol is capable of optimizing the transmission of both reconfiguration scenarios and sensed data simultaneously. The solution is tested on a network connecting several cars during an automobile journey and the results validate the efficiency of this proposition.

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2 Conferences

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

2.1 **2020 International Workshop on Discrete Event Systems**
Rio de Janeiro, Brazil, 2020 (Postponed)
https://wodes2020.eventos.ufrj.br https://codit2020.com

2.2 **2020 IEEE International Conference on Control & Automation**
Sapporo, Hokkaido, Japan, 2020 (Postponed)
http://www.ieee-icca.org

2.3 **2020 IFAC World Congress**
Berlin, Germany, July 12-17, 2020 (Virtual)
https://www.ifac2020.org

2.4 **2020 IEEE Conference on Automation Science and Engineering**
Hong Kong, China, August 20-24, 2020 (Virtual)
https://www.imse.hku.hk/case2020

2.5 **2020 IEEE Conference on Control Technology and Applications**
Montréal, Canada, August 24-26, 2020 (Virtual)
https://ccta2020.ieeecss.org

2.6 **2020 IEEE Conference on Decision and Control**
Jeju Island, Republic of Korea, December 8-11, 2020
https://cdc2020.ieeecss.org

2.7 **2021 Mediterranean Conference on Control and Automation**
Specchiolla (Carovigno), Brindisi, Italia, June 22-25, 2021.
http://med2021.poliba.it/

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3 Books

3.1 **Estimation and Inference in Discrete Event Systems — A Model-Based Approach with Finite Automata**

Author: Christoforos N. Hadjicostis

Description: Estimation and Inference in Discrete Event Systems chooses a popular model for emerging automation systems—finite automata under partial observation—and focuses on a comprehensive study of the key problems of state estimation and event inference. The text includes treatment of current, delayed, and initial state estimation. Related applications for assessing and enforcing resiliency—fault detection and diagnosis—and security—privacy and opacity—properties are discussed, enabling the reader to apply these techniques in a variety of emerging applications, among them automated manufacturing processes, intelligent vehicle/highway systems, and autonomous vehicles.

The book provides a systematic development of recursive algorithms for state estimation and event inference. The author also deals with the verification of pertinent properties such as:
• the ability to determine the exact state of a system, "detectability";
• the ability to ensure that certain classes of faults can be detected/identified, "diagnosability"; and
• the ability to ensure that certain internal state variables of the system remain "hidden" from the outside world regardless of the type of activity that is taking place, "opacity".
This book allows students, researchers and practicing engineers alike to grasp basic aspects of state estimation in discrete event systems, aspects like distributivity and probabilistic inference, quickly and without having to master the entire breadth of models that are available in the literature.

More details: https://www.springer.com/gp/book/9783030308209

3.2 **Path Planning and Control of Cooperative Mobile Robots Using Discrete Event Models**

Authors: Cristian Mahulea, Marius Kloetzer, Ramon Gonzalez
ISBN: 978-1-119-48632-9, January 2020, Wiley-IEEE Press, 240 Pages
https://bit.ly/2MYphKe

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4 Call for Papers

4.1 PID Control for Discrete-Event, Switched, and Hybrid Systems

International Journal of Robust and Nonlinear Control

Guest Editors: Dan Ma ; Silviu-Iulian Niculescu ; Lei Guo ; Jie Chen

Call for Papers: This special issue seeks to respond to the recent trends of PID control and aims to report recent analytical studies and practical applications, with a focus on the robustness, performance, optimization and analytical design. All theoretical and practical aspects central to this theme will be of interest. Particularly welcomed is the latest progress of PID control to emerging problem areas such as hybrid, event-triggered control, networked and multi-agent control, to new control design methods such as data-driven design, model predictive control, and machine learning design, for new technological advances such as cyber-physical systems, cloud-based control, and to broad application areas such as biological systems, smart grid, and micro/nano-scale networks on chip. Potential topics include, but are not limited to the following:

- Robustness and fragility of PID control
- Performance and optimization of PID controllers
- Structural and improved PID control
- PID control for nonlinear systems
- PID control for distributed parameter systems
- PID control for discrete-event, switched, and hybrid systems
- Sampled-data/event-triggered PID control
- Distributed PID control over networks
- PID control design by data-driven methods
- PID control design by machine learning methods
- Applications of PID control

Prospective authors are invited to submit manuscripts prepared as per the International Journal of Robust and Nonlinear Control guidelines, no later than December 1, 2020. Manuscripts should be submitted electronically online at: https://mc.manuscriptcentral.com/rnc-wiley. For inquiries, authors July contact one of the four guest editors below.

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5 Software Tool

5.1 IDES: An Open-Source Software Tool

IDES, the discrete-event systems software tool in Karen Rudie's lab is now available as open-source software at https://github.com/krudie/IDES. More information on IDES can also be found at https://www.ece.queensu.ca/people/K-Rudie/qdes.html#fndtn-software.

5.2 Supremica 2.6, New Version

The development team has just released a new version of Supremica, Waters/Supremica IDE 2.6.

Supremica is a DES and SCT drawing and calculation tool, that includes a multitude of efficient algorithms for modeling, verification, and synthesis of maximally permissive supervisors. In addition there are general algorithms for standard operations like synchronization, minimization, determinization, etc. Supremica also handles finite automata extended with bounded discrete variables. A feature-full simulation tool is also included.

New in this version:

- Scaling of the GUI
- Revamped configuration dialog
- New analyzer user interface
- Logging can now be done directly to file, in addition to the log output pane
- Automaton variables have been introduced, so that guards and actions can refer to the state of an automaton
- The normalizing compiler is now the default
- Plenty of bug fixes, including more graceful termination when out of memory

Supremica is free to use for education and research; for commercial use, please contact fabian@chalmers.se. Download from www.supremica.org.

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