IEEE Control Systems Society
Technical Committee on Discrete Event Systems

Newsletter **November 2020**

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Welcome to the 2020 November 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.

- To **submit a new item**, please use the following website:
  https://www.control.eng.osaka-cu.ac.jp/miscellaneous/css-tc-des/submission
  or email to kai.cai@eng.osaka-cu.ac.jp.
- To **subscribe**, please email to kai.cai@eng.osaka-cu.ac.jp.
- To **unsubscribe**, please reply to this email with the subject line UNSUBSCRIBE.

TC virtual meeting at CDC 2020:

- Date/time: December 18 (Friday), UTC 13:00—14:00
- Zoom link:
  https://list-osaka-cu-ac-jp.zoom.us/j/4899797657?pwd=NGJRQ2VHeFdHVTAydzZsaXAyNG9PUT09
  Meeting ID: 489 979 7657
  Passcode: cdc2020
- Tentative program:
  Kai Cai (chair report) 10min
  Anne-Kathrin Schmuck (co-chair report) 10min
  Eric Rutten (co-chair report) 10min
  Xiang Yin (co-chair report) 10min
  Stephane Lafortune (J-DEDS report) 10min
  Free discussions 10min

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: 4, December 2020

- **Synthesis of covert actuator attackers for free**
  Authors: Liyong Lin ; Yuting Zhu, Yuting ; Rong Su
  Abstract: In this paper, we shall formulate and address a problem of covert actuator attacker synthesis for cyber-physical systems that are modeled by discrete-event systems. We assume the actuator attacker partially observes the execution of the closed-loop system and is able to modify each control command issued by the supervisor on a specified attackable subset of controllable events. We provide straightforward but in general exponential-time reductions, due to the use of subset construction procedure, from the covert actuator attacker synthesis problems to the Ramadge-Wonham supervisor synthesis problems. It then follows that it is possible to use the many techniques and tools already developed for solving the supervisor synthesis problem to solve the covert actuator attacker synthesis problem for free. In particular, we show that, if the attacker cannot attack unobservable events to the supervisor, then the reductions can be carried out in polynomial time. We also provide a brief discussion on some other conditions under which the exponential blowup in state size can be avoided. Finally, we show how the reduction based synthesis procedure can be extended for the synthesis of successful covert actuator attackers that also eavesdrop the control commands issued by the supervisor.

- **State-based supervisory control with restrictions on the supervisor realization**
  Authors: Pedro A C F Leite ; Fabio L Baldissera ; José E R Cury
  Abstract: In this paper, we formalize and solve a state-based Supervisory Control problem with restrictions on the supervisor realization that have not been tackled by the Supervisory Control Theory (SCT) community so far. This problem was derived from the application of SCT to intervene in the dynamics of gene regulatory networks, a relevant problem in the fields of Systems and Synthetic Biology. In our framework, a plant, whose states x are represented by Boolean strings, must be driven from an initial state to a target one, by means of m state-feedback control laws $u_i = h_i(x)$. The Boolean functions h_i, though, cannot be freely chosen, but must rather belong to a (possibly strict) subset R of all the Boolean functions on x.

- **Model-checking precision agriculture logistics: the case of the differential harvest**
  Authors: Rim Saddem-yagoubi ; Olivier Naud ; Karen Godary-dejean ; Didier Crestani
  Abstract: The development, in the last decades, of technologies for precision agriculture allows the acquisition of crop data with a high spatial resolution. This offers possibilities for innovative control and raises new logistics issues that may be solved using discrete event models. In vineyards, some technologies make it possible to define zones with different qualities of grapes and sort the grapes at harvest to make different vintages. In this context, the Differential Harvest Problem (DHP) consists in finding a trajectory of the harvesting machine in the field in order to obtain at least a given quantity of higher quality grapes and minimising working time. In available literature, the DHP has been solved using Constraint Programming. In this paper, we investigate if it is possible to solve the DHP using the Cost Optimal Reachability Analysis feature of a model-checking tool such as UPPAAL-CORA. A model named DHP_PTA has been designed based on the priced timed automata formalism and the UPPAAL-CORA tool. The method made it possible to obtain the optimal trajectory of a harvesting machine for a vine plot composed of up to 14 rows. The study is based on real vineyard data. This paper is an extended version of a communication presented at WODES 2018 (Saddem-Yagoubi IFAC-PapersOnLine 51(7):57-63, 2018).

- **Model decomposition of timed event graphs under periodic partial synchronization: application to output reference control**
  Authors: Johannes Trunk ; Bertrand Cottenceau ; Laurent Hardouin ; Joerg Raisch
  Abstract: Timed Event Graphs (TEGs) are a graphical model for decision free and time-invariant Discrete Event Systems (DESs). To express systems with time-variant behaviors, a new form of

synchronization, called partial synchronization (PS), has been introduced for TEGs. Unlike exact synchronization, where two transitions t1,t2 can only fire if both transitions are simultaneously enabled, PS of transition t1 by transition t2 means that t1 can fire only when transition t2 fires, but t1 does not influence the firing of t2. This, for example can describe the synchronization between a local train and a long distance train. Of course it is reasonable to synchronize the departure of a local train by the arrival of long distance train in order to guarantee a smooth connection for passengers. In contrast, the long distance train should not be delayed due to the late arrival of a local train. Under the assumption that PS is periodic, we can show that the dynamic behavior of a TEG under PS can be decomposed into a time-variant and a time-invariant part. It is shown that the time-variant part is invertible and that the time-invariant part can be modeled by a matrix with entries in the dioid Minax γ,δ, i.e. the time-invariant part can be interpreted as a standard TEG. Therefore, the tools introduced for standard TEGs can be used to analyze and to control the overall system. In particular, in this paper output reference control for TEGs under PS is addressed. This control strategy determines the optimal input for a predefined reference output. In this case optimality is in the sense of the "just-in-time" criterion, i.e., the input events are chosen as late as possible under the constraint that the output events do not occur later than required by the reference output.

- **Model predictive scheduling of semi-cyclic discrete-event systems using switching max-plus linear models and dynamic graphs**
  Authors: Ton J J van den Boom ; Marenne van den Muijsenberg; Bart De Schutter
  Abstract: In this paper we discuss scheduling of semi-cyclic discrete-event systems, for which the set of operations may vary over a limited set of possible sequences of operations. We introduce a unified modeling framework in which different types of semi-cyclic discrete-event systems can be described by switching max-plus linear (SMPL) models. We use a dynamic graph to visualize the evolution of an SMPL system over a certain period in a graphical way and to describe the order relations of the system events. We show that the dynamic graph can be used to analyse the structural properties of the system. In general the model predictive scheduling design problem for SMPL systems can be recast as a mixed integer linear programming (MILP) problem. In order to reduce the number of optimization parameters we introduce a novel reparametrization of the MILP problem. This may lead to a decrease in computational complexity.

- **Diagnosis and Degradation Control for Probabilistic Systems**
  Authors: Nathalie Bertrand ; Serge Haddad ; Engel Lefaucheux
  Abstract: Systems prone to faults are often equipped with a controller whose aim consists in restricting the behaviour of the system in order to perform a diagnosis. Such a task is called active diagnosis. However to avoid that the controller degrades the system in view of diagnosis, a second objective in terms of quality of service is usually assigned to the controller. In the framework of stochastic systems, a possible specification, called safe active diagnosis requires that the probability of correctness of the infinite (random) run is non null. We introduce and study here two alternative specifications that are in many contexts more realistic. The notion of (γ,v)-fault freeness associates with each run a value depending on the discounted length of its correct prefix where the discounting factor is γ. The controller has to ensure that the average of this value is above the threshold v. The notion of α-resiliency requires that asymptotically, at every time step, a proportion greater than α of correct runs remain correct. From a semantic point of view, we determine the equivalences and (non) implications between the three notions of degradations both for finite and infinite systems. From an algorithmic point of view, we establish the border between decidability and undecidability of the diagnosability problems. Furthermore in the positive case, we exhibit their precise complexity and propose a synthesis of the controller which may require an infinite memory.

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1.2. IEEE Transactions on Automatic Control

Volume: 65, Issue: 11, November 2020

- **Uncertainty in Multicommodity Routing Networks: When Does It Help?**
  Authors: S. Sekar ; L. Zheng ; L. J. Ratliff ; B. Zhang
  Abstract: We study the equilibrium behavior in a multicommodity selfish routing game with uncertain users, where each user over- or underestimates their congestion costs by a multiplicative factor. Surprisingly, we find that uncertainties in different directions have qualitatively distinct impacts on equilibria. Namely, contrary to the usual notion that uncertainty increases inefficiencies, network congestion decreases when users overestimate their costs. On the other hand, underestimation of costs leads to increased congestion. We apply these results to urban transportation networks, where drivers have different estimates about the cost of congestion. In light of the dynamic pricing policies aimed at tackling congestion, our results indicate that users' perception of these prices can significantly impact the policy's efficacy, and "caution in the face of uncertainty" leads to favorable network conditions.

- **Hybrid Systems With State-Triggered Jumps: Sensitivity-Based Stability Analysis With Application to Trajectory Tracking**
  Authors: M. Rijnen ; J. J. B. Biemond ; N. v. d. Wouw ; A. Saccon ; H. Nijmeijer
  Abstract: The definition of asymptotic stability for a trajectory of a hybrid system with state-triggered jumps is not straightforward. Nearby solutions jump at close but noncoincident times, making the standard notion of closeness, based on vector difference, unsuitable to compare trajectories point-wise in time. With tracking control as ultimate goal, we propose a notion of stability and a constructive stability proof based on sensitivity analysis applicable to single-jump-flow trajectories. A key role in the analysis is played by a time-triggered linear system, associated with the discontinuous trajectory of interest, whose uniform asymptotic stability suffices to guarantee the asymptotic stability of the original discontinuous trajectory. As an illustrative example, the stability analysis is applied to guarantee closed-loop stable tracking for a trajectory with velocity jumps of a 2 DoF mechanical system with unilateral constraint.

- **Stochastic Control Approach to Reputation Games**
  Authors: N. A. Dalkiran ; S. Yuksel
  Abstract: Through a stochastic-control-theoretic approach, we analyze reputation games, where a strategic long-lived player acts in a sequential repeated game against a collection of short-lived players. The key assumption in our model is that the information of the short-lived players is nested in that of the long-lived player. This nested information structure is obtained through an appropriate monitoring structure. Under this monitoring structure, we show that, given mild assumptions, the set of perfect Bayesian equilibrium payoffs coincides with Markov perfect equilibrium payoffs, and hence, a dynamic programming formulation can be obtained for the computation of equilibrium strategies of the strategic long-lived player in the discounted setup. We also consider the undiscounted average-payoff setup, where we obtain an optimal equilibrium strategy of the strategic long-lived player under further technical conditions. We then use this optimal strategy in the undiscounted setup as a tool to obtain a tight upper payoff bound for the arbitrarily patient long-lived player in the discounted setup. Finally, by using measure concentration techniques, we obtain a refined lower payoff bound on the value of reputation in the discounted setup. We also study the continuity of equilibrium payoffs in the prior beliefs.

- **Remote State Estimation With Stochastic Event-Triggered Sensor Schedule and Packet Drops**
  Authors: L. Xu ; Y. Mo ; L. Xie
  Abstract: This article studies the remote state estimation problem of linear time-invariant systems with stochastic event-triggered sensor schedules in the presence of packet drops between the sensor and the estimator. Due to the existence of packet drops, the Gaussianity at the estimator side no longer holds. It is proved that the system state conditioned on the available information at the estimator side is Gaussian mixture distributed. The minimum-mean-square-error (MMSE) estimator can be obtained from the bank of Kalman filters. Since the optimal estimators require exponentially increasing computation and memory with time, suboptimal estimators to reduce

computational complexities by limiting the length and numbers of hypotheses are further provided. In the end, simulations are conducted to illustrate the performance of the optimal and suboptimal estimators.

- **A Forgetting Property of Reciprocal Chains**
  Authors: R. Bruce-Doust ; L. B. White
  Abstract: Reciprocal chains (RC) are a class of discrete-index, finite-state stochastic processes with a generalized Markov nearest-neighbour property. All Markov chains (MC) are RC but not conversely. It is well known that a sufficiently regular MC “forgets" its initial distribution in a geometric manner. This article addresses the issues of forgetting for RC. Using the properties of inhomogeneous products of nonnegative matrices, this article establishes that a RC forget its endpoint distributions in a more complicated manner. In particular, this article shows that the forgetting function for the initial conditions is bounded by a superposition of increasing and decreasing geometric terms. Implications for modeling using RC are then discussed. The particular case of those RC that are MC with prescribed marginal distributions on the endpoints is considered. The tightness of the forgetting bounds is illustrated with numerical examples.

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1.3. Automatica

Volume: 121 November 2020

- **Synthesis of sensor deception attacks at the supervisory layer of Cyber–Physical Systems**

  Authors: Romulo Meira-Goes ; Eunsuk Kang ; Raymond H. Kwong ; Stephane Lafortune

  Abstract: We study the security of Cyber-Physical Systems (CPS) in the context of the supervisory control layer. Specifically, we propose a general model of a CPS attacker in the framework of discrete event systems and investigate the problem of synthesizing an attack strategy for a given feedback control system. Our model captures a class of deception attacks, where the attacker has the ability to hijack a subset of sensor readings and mislead the supervisor, with the goal of inducing the system into an undesirable state. We utilize a game-like discrete transition structure, called Insertion-Deletion Attack structure (IDA), to capture the interaction between the supervisor and the environment (which includes the system and the attacker). We show how to use IDAs to synthesize three different types of successful stealthy attacks, i.e., attacks that avoid detection from the supervisor and cause damage to the system.

- **Event-triggered sliding mode control for a high-order system via reduced-order model based design**

  Authors: Kiran Kumari ; Bijnan Bandyopadhyay ; Johann Reger ; Abhisek K. Behera

  Abstract: In this paper, we propose the design of event-triggered sliding mode control (SMC) for a high-order system via a reduced-order model based design. It comprises a triggering mechanism with a reduced-order state vector and a controller based on a reduced-order model which stabilizes the (high-order) plant against perturbation. Apart from its low order synthesis of the controller, the proposed technique possesses many other advantages. The important one is the sampling pattern, which could be sparser by the use of a reduced-order vector in the event condition than with a full vector itself. This observation comes from the fact that the triggering instants explicitly depend on the state vector and its behavior over time, and thereby relaxing a few components of the state vector in the triggering mechanism may decrease its rate of the violation. Another significant outcome of this strategy is that the transmission of the reduced-order vector, particularly in a network-based implementation can outperform the full-order based design owing to the severe challenges that persistently occur in the data network. The event-triggered SMC is considered to achieve a robust performance for the closed-loop system. We show that our proposal guarantees the stability of the full-order plant with the reduced-order triggering mechanism, which does not admit a triggering sequence with Zeno behavior. The simulation results are given for a practical example to illustrate the performance and benefits of the proposed method.

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1.4. IEEE Control Systems Letter

Volume: 4, Issue: 4, November 2020

- **Compositional Quantification of Invariance Feedback Entropy for Networks of Uncertain Control Systems**
  Authors: M. S. Tomar ; M. Zamani
  Abstract: In the context of uncertain control systems, the notion of invariance feedback entropy (IFE) quantifies the state information required by any controller to render a subset Q of the state space invariant. IFE equivalently also quantifies the smallest bit rate, from the coder to the controller in the feedback loop, above which Q can be made invariant over a digital noiseless channel. In this letter, we consider discrete-time uncertain control systems described by difference inclusions and establish three results for IFE. First, we show that the IFE of a discretetime uncertain control system Σ and a nonempty set Q is upper bounded by the largest possible IFE of Σ and any member of any finite partition of Q. Second, we consider two uncertain control systems, Σ_1 and Σ_2, which are identical except for the transition function, such that the behavior of Σ_1 is included within that of Σ_2. For a given nonempty subset of the state space, we show that the IFE of Σ_2 is larger or equal to the IFE of Σ_1. Third, we establish an upper bound for the IFE of a network of uncertain control subsystems in terms of the IFEs of smaller subsystems. Further, via an example, we show that the upper bound is tight for some systems. Finally, to illustrate the effectiveness of the results, we compute an upper bound and a lower bound of the IFE of a network of uncertain, linear, discrete-time subsystems describing the evolution of temperature of 100 rooms in a circular building.
- **Compositional Construction of Control Barrier Certificates for Large-Scale Stochastic Switched Systems**
  Authors: A. Nejati , S. Soudjani , M. Zamani
  Abstract: In this letter, we propose a compositional framework for the construction of control barrier certificates for large-scale stochastic switched systems accepting multiple control barrier certificates with some dwell-time conditions. The proposed scheme is based on a notion of so-called augmented pseudo-barrier certificates computed for each switched subsystem, using which one can compositionally synthesize state-feedback controllers for interconnected systems enforcing safety specifications over a finite-time horizon. In particular, we first leverage sufficient max-type small-gain conditions to compositionally construct augmented control barrier certificates for interconnected systems. We the quantify upper bounds on exit probabilities - the probability that an interconnected system reaches certain unsafe regions - in a finite-time horizon. We employ a technique based on a counter-example guided inductive synthesis (CEGIS) approach to search for control barrier certificates of each mode while synthesizing safety controllers providing switching signals. We demonstrate our proposed results by applying them to two different case studies.
- **Sequential Markov Games With Ordered Agents: A Bellman-Like Approach**
  Authors: N. Yang ; J. J. R. Liu
  Abstract: Markov games, as a framework for multi-agent reinforcement learning, has been well investigated in the past decades. In Markov games, all agents simultaneously select actions at each state. However many situations in the real world have to be modeled as a sequential process with ordered agents, which motivates us to widen the view and concepts of Markov games so that all agents can sequentially select actions in some order. This letter studies a step in this direction where exactly two agents with general objectives select actions sequentially in an infinite horizon process. Based on the framework of Markov games, the Bellman-like operators are proposed to analyze the evolutionary process and dynamic programming algorithms are developed to derive the optimal equilibrium for the proposed sequential model. Finally, the effectiveness of the theoretical results is illustrated via numerical simulations.
- **Control Design for Risk-Based Signal Temporal Logic Specifications**
  Authors: S. Safaoui ; L. Lindemann ; D. V. Dimarogonas ; I. Shames ; T. H. Summers
  Abstract: We present a general framework for risk semantics on Signal Temporal Logic (STL) specifications for stochastic dynamical systems using axiomatic risk theory. We show that under our recursive risk semantics, risk constraints on STL formulas can be expressed in terms of risk

constraints on atomic predicates. We then show how this allows a (stochastic) STL risk constraint to be transformed into a risk-tightened deterministic STL constraint on a related deterministic nominal system, enabling the application of existing STL methods. For affine predicate functions and a (coherent) Distributionally Robust Value at Risk measure, we show how risk constraints on atomic predicates can be reformulated as tightened deterministic affine constraints. We demonstrate the framework using a Model Predictive Control (MPC) design with an STL risk constraint.

- **Initial-State Estimation of Multi-Channel Networked Discrete Event Systems**
  Authors: Y. Yao ; Y. Tong ; H. Lan
  Abstract: Initial-state estimation consists in determining the initial state of the system based on the observation from the system and the system structure. It is the basis for many problems in security applications, such as opacity, detectability and supervisory control. However, when it comes to cyber-physical systems (CPS) communication delays and losses are inevitable. In this letter, we study the initial-state estimation problem in a CPS that is modeled with a multi-channel networked discrete event system (NDES). In practice, the system is usually distributed over several locations, and the communication between the system and an agent (e.g., intruder, observer, supervisor) is carried out via a shared network, in which communication delays and losses may happen. In multi-channel NDESs, even when the first-in first-out rule is satisfied in each channel, the order of events received by the agent may still be shuffled due to random communication delays in each channel. To address these new challenges, we formalize the initial-state estimation problem in multi-channel NDESs and a networked initial-state estimator is proposed to generate the exact initial-state estimate.

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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, November 11-13, 2020 (Virtual)
https://wodes2020.eventos.ufrj.br

2.2 **2020 IEEE International Conference on Control & Automation**
Online, October 9-11, 2020 (Virtual)
http://www.ieee-icca.org

2.3 **2020 IEEE Conference on Decision and Control**
Jeju Island, Republic of Korea, December 8-11, 2020 (Virtual)
https://cdc2020.ieeecss.org

2.4 **2021 Mediterranean Conference on Control and Automation**
Bari, Italy, June 22-25, 2021 (Hybrid)
http://med2021.poliba.it/

2.5 **2021 American Control Conference**
New Orleans, Louisiana, USA, May 26-28, 2021.
http://acc2021.a2c2.org/

2.6 **2021 IEEE International Conference on Automation Science and Engineering**
Lyon Centre de Congres, Lyon, France, August 23-27, 2021
https://www.ieee-ras.org/component/rseventspro/event/1935-case-2021

2.7 **2021 IEEE Conference on Control Technology and Applications**
San Diego, August 8-11, 2021
https://ccta2021.ieeecss.org/

2.8 **2021 IEEE International Conference on Systems, Man, and Cybernetics**
South Wharf, Victoria, Australia, October 17-20, 2021
http://ieeesmc2021.org/

2.9 **2021 ACM International Conference on Hybrid Systems: Computation and Control**
Nashville, USA, May 19-21, 2021.
https://hscc.acm.org/2021/

2.10 **2021 Learning for Dynamics and Control**
ETH Zurich, Switzerland, June 7-8, 2021
https://l4dc.ethz.ch/

2.11 **2021 Chinese Control Conference**
Shanghai, China, July 26-28, 2021
https://conf2021.shu.edu.cn/index.htm

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3 Books

3.1 **Foundations of Average-Cost Nonhomogeneous Controlled Markov Chains**
Authors: Xi-Ren Cao
Description: This Springer brief addresses the challenges encountered in the study of the optimization of time-nonhomogeneous Markov chains. It develops new insights and new methodologies for systems in which concepts such as stationarity, ergodicity, periodicity and connectivity do not apply.

This brief introduces the novel concept of confluencity and applies a relative optimization approach. It develops a comprehensive theory for optimization of the long-run average of time-nonhomogeneous Markov chains. The book shows that confluencity is the most fundamental concept in optimization, and that relative optimization is more suitable for treating the systems under consideration than standard ideas of dynamic programming. Using confluencity and relative optimization, the author classifies states as confluent or branching and shows how the under-selectivity issue of the long-run average can be easily addressed, multi-class optimization implemented, and Nth biases and Blackwell optimality conditions derived. These results are presented in a book for the first time and so may enhance the understanding of optimization and motivate new research ideas in the area.

ISBN: 978-3-030-56678-4
https://www.springer.com/gp/book/9783030566777

3.2 **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

3.3 **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 Security, Privacy and Safety of Cyber-Physical Systems

Nonlinear Analysis: Hybrid Systems

Guest Editors: Kai Cai ; Maria Prandini ; Xiang Yin ; Majid Zamani

Call for Papers: Cyber-physical systems are engineered systems that are built from and depend upon the synergy of computational and physical components. They are pervasive in today's technological society. Cyber-physical systems usually involve complex interactions of continuous dynamics with discrete logic, referred to as "hybrid" behavior. The development of controller design and verification algorithms for such complex systems are crucial and challenging tasks, due in particular to the theoretical difficulties of analyzing hybrid behavior and to the computational challenges associated with the synthesis of hybrid controllers.

Ever-increasing demands for safety, privacy, security and certification of cyber-physical systems put stringent constraints on their analysis and design, and necessitate the use of formal model-based approaches. In recent years, we have witnessed a substantial increase in the use of formal techniques for the verification and design of privacy-sensitive, safety-critical cyber-physical systems.

The main objective of this special issue to gather recently developed novel approaches devoted to analysis and enforcement of security, privacy and safety of cyber-physical systems using formal techniques. We seek submissions including but not limited to the following topics:

- Security and privacy analysis of cyber-physical systems, including opacity, differential privacy, non-interference and other related notions
- Fault diagnosis, intrusion detection, and attack mitigation of cyber-physical systems
- Supervisory control for safety of discrete-event systems
- Formal methods and reactive synthesis for safety of cyber-physical systems
- Data-driven verification and synthesis of cyber-physical systems
- Distributed approaches for large scale cyber-physical systems and hybrid systems
- Algorithms and tools for verification and synthesis of safety-critical systems
- Applications in security and/or safety of manufacturing systems, transportation systems, energy systems, robotic networks, telecommunications, and computer networks.

Submission Information

- Deadline: December 31, 2020
- Website: https://www.editorialmanager.com/NAHS/default.asp
- Article type (identifier of this special issue): VSI: Security

4.2 Modeling, Analysis and Control for Cybersecurity of Discrete Event Systems

Discrete Event Dynamic Systems: Theory and Applications

Guest Editors: Rong Su ; Joao Carlos Basilio

Call for Papers: The recent advancement of information and communication technologies and Internet-of-Things infrastructure make a fully connected society a reality, leading to much improved living quality and production efficiency. However, the price paid for such unprecedented connectivity is an increase in cybercrime and violations, making cybersecurity a key research focus in many different research communities. Generally speaking, cybersecurity is the protection of computer systems and networks from the theft of or damage to their hardware, software, or electronic data, as well as from the disruption or misdirection of the services they provide. Discrete event systems (DES) are particularly vulnerable to cyber intrusions, because their enumerative and typically qualitative formal models lack of necessary details and effective representations of (temporal) correlation among data, and they heavily depend on the accuracy of data to ensure absolutely correct interpretation of actions in the system to achieve correct tracking, analysis and control, making it difficult for them to handle data corruptions. An intruder to a DES may intercept sensor and/or command signals and interrupt the execution order of events (or functions). This special topical collection focuses on two key cybersecurity concerns, i.e., cyber attacks and privacy/confidentiality breaching (including but not limited to opacity violations), and aims to report the latest DES research and application results pertinent to cybersecurity.

This special topical collection solicits papers, addressing relevant theoretical issues and important application issues related to cybersecurity, with an evident DES model and relevant technical treatments, possibly complemented with other frameworks to deal with interdisciplinary issues. A non-exhaustive list of some potential topics is provided below:

- New modeling frameworks for cyber attacks
- Analysis of impacts of attacks on closed-loop system behaviors
- Formal synthesis of attack models
- New concepts and models of resilience of supervisors
- Formal synthesis of supervisors resilient to specific attacks
- Game theoretical frameworks for analysis and resilient control
- Fault diagnosis in the presence of cyber attacks
- New modeling frameworks for privacy and confidentiality (e.g., opacity)
- New analysis methods to determine system ability of preserving privacy and confidentiality (e.g., new opacity analysis methods)
- Formal synthesis of supervisors for privacy/confidentiality preservation
- Applications of cybersecurity methods in real discrete event systems

Important Submission Dates:

- Open: July 15, 2020
- Due: December 15, 2020

Manuscript should be submitted to `http://DISC.edmgr.com` Back to the contents

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.

5.3 UltraDES 2.2 Release

UltraDES is an open-source library to the modeling, analysis and control of DES, written using C# in .NET Standard 2.0, which allows its use in multiple platforms, such as Windows, Linux, Mac, IOS, Android, so on. The library is under development at LACSED (Laboratory of Analysis and Control of Discrete Event Systems, at the Universidade Federal de Minas Gerais, Brazil) and has basic operations with automata as long as the monolithic, modular and local modular supervisory control (Alves et. al., 2017).

The main improvements of the UltraDES 2.2 version are:

- Supervisor Reduction Algorithm (Su and Wonham, 2004)
- Supervisor Localization (Cai and Wonham, 2010)
- Basic Petri Nets Functions (incidence matrix, coverability/reachability graph, Petri Net marking simulation, etc.)

Knowing that many researchers/students are not familiar with the C# language, we created an experimental python wrapper, that is less object oriented and easier to use.

Another initiative to improve the usability of UltraDES was the creation of a Web Application, developed using Blazor/WebAssembly, that allows the use of UltraDES online. This version is more limited in processing power and memory but it is useful for small examples and teaching.

We invite the community to download and contribute. Algorithms implemented may be integrated to the main distribution. Just let us know. Contact Lucas Alves lucasvra@ufmg.br or Patricia Pena ppena@ufmg.br for more information. Bugs should be informed using the UltraDES GitHub page.
Link: https://github.com/lacsed/UltraDES.

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6 Positions

6.1 PhD/Postdoc: National Institute of Informatics, Tokyo, Japan

We are seeking a postdoc researcher and 2 Ph.D. candidates who collaborate with us in the project "CyPhAI: Formal Analysis and Design of AI-intensive Cyber-Physical Systems" funded by JST. The detail of the call can be found at: https://hackmd.io/HqD7t6atQyuXzMyKuLX3UQ?view

This project aims at establishing mathematically-solid methodologies to model, verify, test, monitor, and control a cyber-physical system in which AI plays crucial role (AI-CPS), and consists of several teams with different expertise. This call is for positions in control theory team led by Masako Kishida (National Institute of Informatics, Tokyo, Japan). The contract will initially run until the end of March 2021, with the possibility of annual renewal at maximum 5 years.

Applications should be sent to application-cyphai@fos.kuis.kyoto-u.ac.jp, with the subject CREST Job Application. Please include

- your brief CV,
- short description of research interests (can be very informal and short),
- the list of papers (a dblp or Google scholar link will do, for example),
- a couple of representative papers (in pdf), and
- (preferably) the contact of two references

We will contact you for further material and interview, provided that we find sufficient relevance in your application. Starting dates are flexible. The positions will remain open until filled. The project ends in March 2026.

Inquiries should also be sent to application-cyphai@fos.kuis.kyoto-u.ac.jp, with the subject CREST Job Inquiry.