IEEE Control Systems Society
Technical Committee on Discrete Event Systems

Newsletter **October 2020**

Editor: Kai Cai
Chair, IEEE CSS Technical Committee on DES
Associate Professor
Department of Electrical and Information Engineering, Osaka City University
3-3-138 Sugimoto, Sumiyoshi-ku, Osaka 558-8585, Japan

Phone: (+81) 6-6605-2703
Email: kai.cai@eng.osaka-cu.ac.jp
Website: https://www.control.eng.osaka-cu.ac.jp

Welcome to the 2020 October 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. IEEE Transactions on Automatic Control

Volume: 65, Issue: 10, October 2020

- **Auditor Product and Controller Synthesis for Nondeterministic Transition Systems With Practical LTL Specifications**
  Authors: M. Hadi Zibaeenejad ; Jun Liu
  Abstract: Controller design for continuous systems with linear temporal logic (LTL) specifications is a computationally intensive task. Abstracting a discrete transition system from a real-world continuous-state system often results in a state machine with a large number of states and nondeterministic transitions. This makes controller synthesis for LTL specifications difficult specially when the design specification is lengthy. To reduce the complexity, we consider the specifications that are in the conjunctive form of practical LTL patterns. We use auditor product to incrementally restrict the system to satisfy the safety part of each subspecification. The control strategy, that satisfies the liveness part is then calculated by solving a generalized Buchi game on the result of the auditor product of the discrete transition system with all subspecifications. This approach has the same worst case computational complexity as GR(1) synthesis, but avoids some of the fundamental limitations involved with Assumption⇒Guarantee formulation of the problem.

- **On the Event-Triggered Controller Design**
  Authors: Mohsen Ghodrat ; Horacio J. Marquez
  Abstract: The majority of event-triggered control (ETC) literature concentrates on designing triggering rule while assuming control input to emulate an analog design. In this article, however, both state and output feedback laws are jointly synthesized with the triggering law for nonlinear Lipschitz systems. In the proposed method, the dominant eigenvalues of the linear stability matrices are assigned according to desired performance and triggering specifications. The results serve as a local framework for stability of general nonlinear ETC systems. The efficiency of design is validated through compelling examples.

- **Abstraction-Based Safety Verification and Control of Cooperative Vehicles at Road Intersections**
  Authors: Heejin Ahn ; Alessandro Colombo
  Abstract: This article considers the problem of designing a centralized controller for vehicle collision avoidance at road junctions and intersections. The controller supervises a set of vehicles, and overrides their inputs when necessary to prevent side and rear-end collisions. By supervising vehicles, rather than taking full control, we obtain a system that can work with semiautomated human-driven vehicles. The price to pay is in complexity: an override is only necessary if, without an intervention, all future input signals will result in a collision. Thus, deciding overrides requires verification of the full reachability set, rather than the computation of a single collision-free trajectory. Our approach to speeding this step up is to use an abstraction of the (concrete) system, which is suitably discretized to obtain a mixed-integer programming problem. We deduce the solution of the original verification problem (VP) from that of the abstraction-based VP by proving an approximate simulation relation between the abstract and concrete systems. The resulting supervisor provably guarantees safety of the concrete system. We also evaluate the approximation error of the supervisor due to the use of an abstraction. Computer simulations show that the supervisor exhibits computationally better performances than other existing controllers applicable to realistic intersection scenarios.

- **Learning-Based Event-Triggered Control for Synchronization of Passive Multiagent Systems Under Attack**
  Authors: Arash Rahnama ; Panos J. Antsaklis
  Abstract: In this article, we study the synchronization of a group of output passive agents that communicate with each other according to an underlying communication graph. A distributed event-triggered control framework that guarantees synchronization and reduces the required com-

munication rate is introduced. A general Byzantine attack on a multiagent system is defined and its negative effects on synchronization are characterized. The Byzantine agents are able to intelligently falsify their data and manipulate the underlying communication graph by altering their control feedback weights. Next, a decentralized decision-making and detection framework is introduced and its steady-state and transient performances are analyzed. Furthermore, a method of identifying Byzantine neighbors and a learning-based procedure for estimating the attack parameters are introduced. Finally, learning-based control frameworks to mitigate the effects of the attack are proposed.

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1.2. Automatica

Volume: 120 October 2020

- **A dynamic event-triggered approach to observer-based PID security control subject to deception attacks**
  Authors: Di Zhao ; Zidong Wang ; Guoliang Wei ; Qing-Long Han
  Abstract: In this paper, the observer-based PID security control problem is investigated for a class of linear discrete-time systems subject to deception attacks. A new index for security level is proposed to account for the effect of the randomly occurring deception attack on the closed-loop system. A dynamic event-triggered mechanism, whose threshold parameter is dynamically adjusted according to a certain rule, is exploited to modulate the transmission of data packets with hope to effectively alleviate unnecessary energy consumption. Sufficient conditions for the existence of the expected observer-based PID controller are presented to ensure the input-to-state stability of the closed-loop system while achieving the prescribed security index. Gain matrices of the desired PID controller are parameterized in terms of the solutions to certain matrix inequalities that are readily solvable. Finally, a simulation example is given to verify the effectiveness and advantages of the developed controller design approach.
- **Moving horizon estimation with non-uniform sampling under component-based dynamic event-triggered transmission**
  Authors: Lei Zou ; Zidong Wang ; Donghua Zhou
  Abstract: This paper is concerned with the moving horizon (MH) estimation problem for linear systems with non-uniform sampling under component-based dynamic event-triggered transmission (DETT) scheme. The sampling interval is allowed to be time-varying with known upper and lower bounds. A so-called component-based DETT scheme is adopted to determine the transmission instant at which an individual sensor sends the measurement to the estimator through certain communication network. Then, a time-varying MH estimator is designed with the corresponding estimation error dynamics characterized by a linear discrete time-varying system whose time-varying parts induced by the non-uniform sampling are modeled by certain norm bounded uncertainties. Sufficient conditions are derived to guarantee the ultimate boundedness of the estimation error. Moreover, within the established theoretical framework, the desired estimator parameter is calculated by solving a set of linear matrix inequalities. Finally, a simulation example is given to illustrate the effectiveness of our proposed MH estimation method.

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1.3. IEEE Transactions on Automation Science and Engineeringy

Volume: 17, Issue: 4, October 2020

- **Robust Deadlock Avoidance and Control of Automated Manufacturing Systems With Assembly Operations Using Petri Nets**
  Authors: Nan Du ; Hesuan Hu ; MengChu Zhou
  Abstract: Deadlock resolution has been an important research topic in the field of automated manufacturing systems (AMSs). Researchers generally assume that AMS resources never break down whereas only a few resolve the issues of resource failures in the discrete-event supervision of AMSs. In fact, an AMS consists of a number of numerically controlled machines interacting

with each other. The failure of resources happens unexpectedly. In this article, we allow parallel routes to use unreliable resources. Because of their powerful modeling capabilities, Petri nets are used to model the considered AMSs. By using a look-ahead control strategy, a robust supervisory control policy is developed for AMSs with assembly operations allowing resource failures. Our objective is to advance parts requiring failed resources in their remaining routes into a special position so as to release shared resources in case some unreliable resources fail. Consequently, those parts not necessarily requiring any failed resource can keep progressing all the time. The conventional methods are on the basis of monolithic and structure-oriented control specifications with centralized supervisors. Our policy can be implemented in a distributed, online, and local way. Several examples are given to elucidate our control policy clearly.

- **Human Activity Discovery and Recognition Using Probabilistic Finite-State Automata**
  Authors: Kevin Viard ; Maria Pia Fanti ; Gregory Faraut ; Jean-Jacques Lesage
  Abstract: Ambient assisted living and smart home technologies are a good way to take care of dependent people whose number will increase in the future. They allow the discovery and the recognition of human's activities of daily living (ADLs) in order to take care of people by keeping them in their home. In order to consider the human behavior nondeterminism, probabilistic approaches are used despite difficulties encountered in model generation and probabilistic indicators computing. In this article, a global method based on probabilistic finite-state automata and the definition of the normalized likelihood and perplexity is proposed to manage ADLs discovery and recognition. In order to reduce the computational complexity, some results about a simplified normalized likelihood computation are proved. A real case study showing the efficiency of the proposed method is discussed.

- **Analysis of Backward Sequence for Single-Armed Cluster Tools With Processing Time Variations**
  Authors: Jun-Ho Lee ; Hyun-Jung Kim
  Abstract: This article analyzes the backward sequence for single-armed cluster tools with processing time variations. The backward sequence is popularly used to operate a single-armed cluster tool in practice, but its performance has not been analyzed when processing time variations are introduced. To address the problem, we first define a fundamental cycle and derive a formula for cycle time analysis considering processing time variations. We then develop conditions for which the backward sequence is optimal for a certain cycle or all cycles. We also analyze the upper bound of the average cycle time with the backward sequence. Finally, the performance of the backward sequence with processing time variations is investigated experimentally.

- **Sequential Online Dispatch in Design of Experiments for Single- and Multiple-Response Surrogate Modeling**
  Authors: Mohammadkazem Sadoughi ; Chao Hu ; Behnam Moghadassian ; Anupam Sharma ; Joseph Beck ; Danielle Mathiesen
  Abstract: As parallel computing becomes increasingly important in many real-world applications, a batch sequential experimental design (BSED), which adds a batch of computer experiments per iteration and runs these simulations in parallel, is gaining popularity in surrogate modeling. This article proposes sequential online dispatch in design of experiments (SODDE) for single- and multiple-response surrogate modeling when multiple processors work in parallel but not independently. The proposed method includes several unique features: 1) it works with any popular acquisition function to select a single new sample point at each iteration; 2) it minimizes the idle time of all processors; 3) it rapidly updates the surrogate model; and 4) it dynamically reconstructs the surrogate model when a simulation process aborts, minimizing the impact incurred by the abortion. The effectiveness of SODDE is evaluated in one mathematical example and one industrial problem. The latter problem considers blade design of horizontal axis wind turbines (HAWTs). The cost of finding blade geometry that results in the desired aerodynamic behavior of HAWTs is estimated for BSED and SODDE. Relative to BSED, SODDE reduces the costs by up to approximately 31%.

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1.4. IEEE Transactions on Systems, Man, and Cybernetics: Systems— Special Issue on Recent Advances in Petri Nets, Automata, and Discrete-Event Hybrid Systems

Volume: 50, Issue: 10, October2020

- **A2G2V: Automatic Attack Graph Generation and Visualization and Its Applications to Computer and SCADA Networks**
  Authors: Alaa T. Al Ghazo ; Mariam Ibrahim ; Hao Ren ; Ratnesh Kumar
  Abstract: Securing cyber-physical systems (CPS) and Internet of Things (IoT) systems requires the identification of how interdependence among existing atomic vulnerabilities may be exploited by an adversary to stitch together an attack that can compromise the system. Therefore, accurate attack graphs play a significant role in systems security. A manual construction of the attack graphs is tedious and error-prone, this paper proposes a model-checking-based automated attack graph generator and visualizer (A2G2V). The proposed A2G2V algorithm uses existing model-checking tools, an architecture description tool, and our own code to generate an attack graph that enumerates the set of all possible sequences in which atomic-level vulnerabilities can be exploited to compromise system security. The architecture description tool captures a formal representation of the networked system, its atomic vulnerabilities, their pre-and post-conditions, and security property of interest. A model-checker is employed to automatically identify an attack sequence in the form of a counterexample. Our own code integrated with the model-checker parses the counterexamples, encodes those for specification relaxation, and iterates until all attack sequences are revealed. Finally, a visualization tool has also been incorporated with A2G2V to generate a graphical representation of the generated attack graph. The results are illustrated through application to computer as well as control (SCADA) networks.
- **A Robust Control Approach to Automated Manufacturing Systems Allowing Multitype and Multiquantity of Resources With Petri Nets**
  Authors: Xiaojun Wang ; Hesuan Hu
  Abstract: Up to now, the supervision and control of deadlock-free resource allocation has received considerable attention, particularly regarding their deadlock problems. To date, most solutions have supposed that allocated resources never fail. However, this is quite the opposite in reality since some resources may fail unexpectedly. A robust system should be resilient to such failures. In this paper, resources are divided into reliable ones and unreliable ones. On the basis of the deadlock avoidance algorithm which is proposed for the problem of deadlocks, we propose a robust control algorithm in the paradigm of systems of sequential systems with shared resources, which can acquire and release resources in a multitype and multiquantity way. It is validated to be a polynomially complex robust control algorithm by the distributivity analysis. Finally, experimental results show that the proposed approaches are effective as well as efficient in response to resource failures.
- **Robust Deadlock Prevention for Automated Manufacturing Systems With Unreliable Resources by Using General Petri Nets**
  Authors: Yanxiang Feng ; Keyi Xing ; Mengchu Zhou ; Xinnian Wang ; Huixia Liu
  Abstract: Recently, the problem of robust control for automated manufacturing systems (AMSs) with unreliable resources receives increasing attentions. Almost all the existing related works are only concerned with the failure-prone AMSs in which each part stage utilizes only one unit of resources. While, in real-world AMS, it is often necessary to use multiple units of different resources to complete a part. This paper focuses on the robust control of such complex AMSs with a type of unreliable resources. General Petri nets are used to model all the behavior of such AMSs. By adding a control place to the Petri net models for each considered siphon, we develop robust deadlock controllers for the considered AMS. Such a robust controller ensures that the parts of all types can be processed continuously through any of its processing routes, even if one of the unreliable resources fails. Finally, some examples are used to illustrate the proposed method.
- **Supervisory Control of Deadlock-Prone Production Systems With Routing Flexibility and Unreliable Resources**
  Authors: Hao Yue ; Keyi Xing ; Hesuan Hu ; Weimin Wu ; Hongye Su
  Abstract: It has been an active research area to develop robust supervisory control policies for production systems with unreliable resources. So far, most methods for robust deadlock resolution

apply only to systems without flexible routes, where each processing step of any part type requires a unique prespecified resource. In this paper, we address deadlock avoidance control problem in production systems with both failure-prone resources and flexible routings, which allow that a part has options when deciding the resource acquisition at each step. This paper presents properties that a controller with robustness must satisfy. Specifically, at any system reachable state, neither the failed resources nor part instances trapped in these resources should have too much detrimental effect on the other portions of the system. Thus, the full range of part types' production could be assured at all time. After defining the notions of reduced system and reduced state with respect to unreliable resources, we identify and prove conditions for determining whether or not the state resulting from the occurrence of an event is feasible. Subsequently, we develop a method for robust deadlock avoidance, which uses the solutions to state safety checking problem for the reduced production system with only reliable resources. An illustrative example shows the effectiveness of this method. Finally, we conduct a comparison investigation of some representative approaches in the literature about robust supervisory control for deadlock resolution in resource allocation systems with routing flexibility.

- **An Extended Object Constraint Language for Adaptive Discrete Event Systems With Application to Reconfigurable Wireless Sensor Networks**
  Authors: Hanen Grichi ; Olfa Mosbahi ; Mohamed Khalgui ; Zhiwu Li
  Abstract: This paper deals with software validation of flexible discrete-event systems. A reconfiguration scenario is any run-time adaptation of the software execution according to user requirements. Nevertheless, since several behaviors can be redundant from an execution to another, using the object constraint language (OCL) is not useful to specify all constraints that should be satisfied by a system. We propose an extension of OCL named reconfigurable OCL for improving the specification and validation of constraints related to different execution scenarios of a system. An ROCL metamodel is proposed with formal syntax and semantics. This solution gains in terms of validation time and quick expressions of constraints. We apply the proposed extended language to reconfigurable wireless sensor networks to highlight the benefits of this contribution.
- **On Methodology for the Verification of Reconfigurable Timed Net Condition/Event Systems**
  Authors: Yousra Hafidi ; Laid Kahloul ; Mohamed Khalgui ; Zhiwu Li ; Khalid Alnowibet ; Ting Qu
  Abstract: This paper deals with the formal verification of reconfigurable discrete event control systems (RDECSs) using reconfigurable timed net condition/event systems (R-TNCESs) formalism. A reconfigurable system switches from a mode to another during its working process to adapt its behavior to the related environment. By including such a feature, RDECSs become complex and their verification is often expensive in terms of computation time and memory. In this paper, a new methodology for formal verification of RDECSs is proposed in order to ensure the correctness of these systems with a reduced cost (decreasing the verification time and memory occupation). The proposed contribution includes an improved modeling and verification of RDECSs. The modeling with R-TNCESs is enriched with all reconfiguration forms, and the verification involves an improvement method that avoids any redundancy and cancels unnecessary calculations. In addition, a visual tool called Rec-AG based on the proposed methodology is developed. The performance evaluation of this paper is achieved by measuring computation time and memory for several systems and different sizes of the problem. This paper's contribution is applied to the benchmark production system FESTO.
- **A Polynomial-Time Algorithm to Obtain State Machine Cover of Live and Safe Petri Nets**
  Authors: Andrei G. Karatkevich ; Remigiusz Wisniewski
  Abstract: A method to find the minimized state machine cover of live and safe Petri nets (PNs) is proposed in this paper. It is required that a cover be obtained in some implementation methods of PN-based control algorithms and other applications such as data mining. Most of the known methods of its computation have at least exponential time and space complexity; this is true not only for the methods which guarantee a minimal cover is obtained but also for some methods of

finding approximate solutions. The proposed algorithm is an approximation algorithm and has polynomial computational complexity. The experimental verification shows a very high efficiency of the presented technique. The proposed method is especially valuable in the case of large systems where a solution is obtained hundreds of times quicker than by other methods.

- **On Hierarchical Construction of the State Space of an Automated Manufacturing System Modeled With Petri Nets**
  Authors: Oussama Karoui ; Yufeng Chen ; Zhiwu Li ; Naiqi Wu ; Mohamed Khalgui
  Abstract: State space techniques are one of the main approaches deployed for the analysis of concurrent systems. However, state space construction is stalled by a common phenomenon called the state explosion problem which makes it a tough task or even impossible when the state space computation demands prohibitive cost (time and memory). We limit general resource allocation systems (RASs) to a certain class whose state space can be hierarchically constructed, yet it comprises various enough types of real-world discrete event systems, such as automated manufacturing systems. This paper focuses on a class of RASs modeled with Petri nets (PNs), where, through pure algebraic operations, a novel method to compute the state spaces is proposed, which is motivated by the superposition property. Given a PN model of a system and a target resource configuration, we first propose a special initial marking called the initial basis marking and compute the corresponding reachability graph. Then, we increase the capacity of the resource places in an incremental way and generate the reachability graphs by taking advantage of the PN structure and the previously computed reachability graph until the capacity function of resources reaches the target resource configuration. A complete enumeration of reachable states can be obtained by a recursive scheme. Experimental studies also demonstrate the efficiency of the proposed approach in terms of computational cost and its high-potential to cope with the state-explosion problem.
- **Measurement and Computation of Profile Similarity of Workflow Nets Based on Behavioral Relation Matrix**
  Authors: Mimi Wang ; Zhijun Ding ; Guanjun Liu ; Changjun Jiang ; Mengchu Zhou
  Abstract: This paper focuses on the behavior similarity of workflow nets (WF-nets). The similarity of two WF-nets reflects their consistent degree in behaviors. It explores the behavioral relations of subsets of transitions based on the interleaving semantics, and more accurate relations are defined than the existing work. Therefore, a more accurate similarity of two WF-nets (in their behaviors) can be obtained than that in the existing work that usually do not consider the loop and complex correspondence. By refining the interleaving relation in a behavioral profile into six types, this paper proposes the notion of a relation profile based on behavioral profile. Based on the relation profile of a WF-net, behavioral relation matrix can be constructed. Additionally, we refine the complex correspondence and generate a group of behavioral relation submatrices from the behavioral relation matrix. By using them we present a new formula to measure the behavior similarity of two WF-nets. Finally, examples illustrate that our method can measure the similarity degree more accurately.
- **Efficient Approach to Scheduling of Transient Processes for Time-Constrained Single-Arm Cluster Tools With Parallel Chambers**
  Authors: FaJun Yang ; Yan Qiao ; KaiZhou Gao ; NaiQi Wu ; YuTing Zhu ; Ian Ware Simon ; Rong Su
  Abstract: In wafer manufacturing, extensive research on the operations of cluster tools under the steady state has been reported. However, with the shrinking down of wafer lot size, such tools are frequently required to switch from handling one lot of wafers to another, resulting in more transient processes, including start-up and close-down ones. Also, wafer residency time constraint is critical for many wafer fabrication processes. To cope with the transient scheduling problem of time-constrained single-arm cluster tools with parallel chambers, based on a generalized backward strategy, this paper first builds timed Petri net models for these two transient processes. Then, two linear programs are derived for the first time to search a feasible schedule with a minimal makespan. Two industrial examples are given to demonstrate the effectiveness of the obtained results at last.
- **Deadlock-Free Scheduling of Flexible Assembly Systems Based on Petri Nets and Local Search**
  Authors: JianChao Luo ; ZhiQiang Liu ; MengChu Zhou ; KeYi Xing

Abstract: Deadlock-free scheduling and control is critical for optimizing the performance of flexible assembly systems (FASs). Based on the Petri net models of FASs, this paper integrates a deadlock prevention policy with local search and develops a novel deadlock-free scheduling algorithm. A solution of the scheduling problem is coded as a chromosome representation that is a permutation with repetition of parts. By using the deadlock prevention policy, a repairing algorithm (RA) is developed to repair unfeasible chromosomes. A perturbation strategy based on estimation of distribution algorithm is developed to escape from local optima. Moreover, to improve population diversity, an acceptance criterion (AC) based on Pareto dominance is proposed. The chromosome representation, RA, perturbation strategy, and AC together support the cooperative aspect of local search for scheduling problems strongly.

- **A Distributed Control Approach to Automated Manufacturing Systems With Complex Routes and Operations Using Petri Nets**
  Authors: Yan Yang ; Hesuan Hu
  Abstract: The development of efficient solutions for deadlock problem in large-scale automated manufacturing systems (AMSs) is an issue of increasing interest in the scientific community, largely because of the nonapplicability of most existing approaches as AMS grows in size. Furthermore, much of these approaches is focused on systems with either assembly operations or flexible routes, implying that generalizing these existing results to more complex systems is difficult. As a result, we initiate on the deadlock problem of AMSs embedding assembly operations in flexible routes. By modeling AMSs as Petri nets, an innovative distributed approach is developed in this paper, which can be realized in an online, look-ahead, and dynamic way without requiring external and extra information. Beyond the value of the presented results, this paper is also intended to develop more general results which will be adaptable to a broader class of AMSs.

- **Resource Conflict Checking and Resolution Controller Design for Cross-Organization Emergency Response Processes**
  Authors: Qingtian Zeng ; Cong Liu ; Hua Duan ; MengChu Zhou
  Abstract: A group of geographically dispersed and logically collaborated emergency organizations are involved when emergency occurs. Two challenging issues are a reasonable emergency resource allocation mechanism and an efficient resource conflict checking and resolution control mechanism to ensure the conflict-free execution of global cross-organization emergency response processes. To address them, this paper proposes an approach to support emergency resource management including both intraorganization private resource management and cross-organization public resource management. The former has been fully discussed in our previous work using E-net. To cope with the latter, this paper presents a novel type of Petri net that is extended with both time and resource factors to model cross-organization emergency response processes. Then, according to the resource requirement analysis, their worst, delayed, and best cases are obtained. Next, emergency resource conflict checking and four conflict resolution strategies are proposed to resolve the detected resource conflicts for the delayed execution case. This paper shows how to use different resolution strategies to construct the conflict-free model by designing corresponding resolution controllers. Finally, their performance is evaluated by a fire emergency response example.

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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**
Puglia, Italy, June 22-25, 2021.
http://med2021.poliba.it/

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

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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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