IEEE Control Systems Society
Technical Committee on Discrete Event Systems

Newsletter **January 2021**

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 2021 January 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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  https://www.control.eng.osaka-cu.ac.jp/miscellaneous/css-tc-des/submission
  or email to kai.cai@eng.osaka-cu.ac.jp.
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1 Selections of Journal Publications

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

1.1. IEEE Transactions on Automatic Control

Volume: 66, Issue: 1, January 2021

- **Formal and Efficient Synthesis for Continuous-Time Linear Stochastic Hybrid Processes**
  Authors: L. Laurenti ; M. Lahijanian ; A. Abate ; L. Cardelli ; M. Kwiatkowska
  Abstract: Stochastic processes are expressive mathematical tools for modeling real-world systems that are subject to uncertainty. It is hence crucial to be able to formally analyze the behavior of these processes, especially in safety-critical applications. Most of the existing formal methods are not designed for continuous-time processes, and those that are typically suffering from state explosion in practice. This article introduces a theoretical framework and a scalable computational method for formal analysis and control synthesis for switched diffusions, a class of stochastic models with linear dynamics that are continuous in both time and space domains; the focus is on safety with possible extensions to other properties. The proposed framework first constructs a finite abstraction in the form of an uncertain Markov process through discretization of both time and space domains. The errors caused by the discretization in each domain are formally characterized and cast into the abstraction model. Then, a strategy that maximizes the probability of the safety property and is robust against the errors is synthesized over the abstraction model. Finally, this robust strategy is mapped to a switching strategy for the stochastic processes that guarantees the safety property. The framework is demonstrated in three case studies, including one that illustrates the tradeoff of the error contribution by the time and space discretization parameters.
- **On Passivity, Reinforcement Learning, and Higher Order Learning in Multiagent Finite Games**
  Authors: B. Gao ; L. Pavel
  Abstract: In this article, we propose a passivity-based methodology for the analysis and design of reinforcement learning dynamics and algorithms in multiagent finite games. Starting from a known, first-order reinforcement learning scheme, we show that convergence to a Nash distribution can be attained in a broader class of games than previously considered in the literature—namely, in games characterized by the monotonicity property of their (negative) payoff vectors. We further exploit passivity techniques to design a class of higher order learning schemes that preserve the convergence properties of their first-order counterparts. Moreover, we show that the higher order schemes improve upon the rate of convergence and can even achieve convergence where the first-order scheme fails. We demonstrate these properties through numerical simulations for several representative games.
- **Model-Based Dynamic Event-Triggered Control for Systems With Uncertainty: A Hybrid System Approach**
  Authors: K. Z. Liu ; A. R. Teel ; X.-M. Sun ; X.-F. Wang
  Abstract: In this article, the event-triggered control problem for linear systems with uncertainties is addressed. A model-based dynamic event-triggered transmission strategy is proposed for linear systems, and for systems that can be decomposed into interconnected subsystems, a distributed model-based dynamic event-triggered transmission strategy is also proposed with transmission delays and transmission protocols in the networks. The whole systems are modeled into a hybrid system framework by introducing storage variables. Using stability theorems of hybrid systems, explicit designs of the transmission strategies are presented and asymptotic stability is guaranteed. Finally, an example is given to show that the transmissions are significantly reduced by the transmission strategy in this article compared with the transmission strategy by zero-order-hold.

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1.2. Automatica

Volume: 123, January 2021

- **Optimal supervisory control with mean payoff objectives and under partial observation**
  Authors: Yiding Ji ; Xiang Yin ; Stéphane Lafortune
  Abstract: We investigate optimal mean payoff supervisory control problems on partially observed discrete event systems modeled as weighted finite-state automata. The event weights capture variations of a given resource (i.e., energy) expended or replenished during the operation of the system and the mean payoff is then defined as the average of the accumulative event weights. Two supervisory control problems are considered in this work. For the first, the system is equipped with a fixed amount of initial energy to support its operation and the supervised system should always have a nonnegative energy level. For the second, the limit mean payoff of any event sequence should never drop below zero in the supervised system. We further optimize the worst case limit mean payoff of infinite event sequences under both scenarios. The two problems are solved sequentially. In order to capture information on both the state estimate and the energy level of the system, we define energy information states which incorporate sufficient information for the decision making of the supervisor. Then we propose the First Cycle Energy Inclusive Controller (FCEIC) and further transfer the supervisory control problems into two-player games with properly defined objectives on the FCEIC. Finally, we perform a min–max search on the game graphs to synthesize the optimal supervisors for both scenarios.
- **On stochastic and deterministic event-based state estimation**
  Authors: Hao Yu ; Jun Shang ; Tongwen Chen
  Abstract: This paper investigates the problem of remote event-based state estimation for a linear discrete-time plant. Both stochastic and deterministic event-based transmission policies are considered for the systems implemented with smart sensors, where local Kalman filters are embedded. Based on the concept of generalized closed skew normal distributions, the exact probability density functions of the remote event-based state estimation processes are provided. With the properties of smart sensors, the explicit form of the remote event-based state estimators can be derived, without involving numerical integration. In addition, in the case of scalar plants, the estimation and transmission performances under different kinds of event-based scheduling policies are compared theoretically. An important inequality on a truncated covariance of some particular multivariate Gaussian distribution is proved, which builds a bridge between performances of the two event-based policies. Based on this inequality, it is proved that for any considered stochastic event-based transmission policy, there always exists a deterministic counterpart that leads to better estimation performance using the same communication and computational resources. Numerical simulations are provided to illustrate the theoretical results.
- **An optimal graph-search method for secure state estimation**
  Authors: Xusheng Luo ; Miroslav Pajic ; Michael M. Zavlanos
  Abstract: The growing complexity of modern Cyber-Physical Systems (CPS) and the frequent communication between their components make them vulnerable to malicious attacks. As a result, secure state estimation is a critical requirement for the control of these systems. Many existing secure state estimation methods suffer from combinatorial complexity which grows with the number of states and sensors in the system. This complexity can be mitigated using optimization-based methods that relax the original state estimation problem, although at the cost of optimality as these methods often identify attack-free sensors as attacked. In this paper, we propose a new optimal graph-search algorithm to correctly identify malicious attacks and to securely estimate the states even in large-scale CPS modeled as linear time-invariant systems The graph consists of layers, each one containing two nodes capturing a truth assignment of any given sensor, and directed edges connecting adjacent layers only. Then, our algorithm searches the layers of this graph incrementally, favoring directions at higher layers with more attack-free assignments, while actively managing a repository of nodes to be expanded at later iterations. The proposed search bias and the ability to revisit nodes in the repository and self-correct, allow our graph-search algorithm to reach the optimal assignment faster and tackle larger problems. We show that our algorithm is complete and optimal provided that process and measurement noises do not dominate the attack signal. Moreover, we provide numerical simulations that demonstrate the ability of our algorithm to correctly identify attacked sensors and securely reconstruct the state. Our simulations show that

our method outperforms existing algorithms both in terms of optimality and execution time.

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1.3. IEEE Control Systems Letter

Volume: 5, Issue: 1, January 2021

- **Towards Traffic Bisimulation of Linear Periodic Event-Triggered Controllers**
  Authors: G. d. A. Gleizer ; M. Mazo
  Abstract: We provide a method to construct finite abstractions exactly bisimilar to linear systems under a modified periodic event-triggered control (PETC), when considering as output the inter-event times they generate. Assuming that the initial state lies on a known compact set, these finite-state models can exactly predict all sequences of sampling times until a specified Lyapunov sublevel set is reached. Based on these results, we provide a way to build tight models simulating the traffic of conventional PETC. These models allow computing tight bounds of the PETC average frequency and global exponential stability (GES) decay rate. Our results are demonstrated through a numerical case study.
- **A Smooth Robustness Measure of Signal Temporal Logic for Symbolic Control**
  Authors: Y. Gilpin ; V. Kurtz ; H. Lin
  Abstract: Recent years have seen an increasing use of Signal Temporal Logic (STL) as a formal specification language for symbolic control, due to its expressiveness and closeness to natural language. Furthermore, STL specifications can be encoded as cost functions using STL's robust semantics, transforming the synthesis problem into an optimization problem. Unfortunately, these cost functions are non-smooth and non-convex, and exact solutions using mixed-integer programming do not scale well. Recent work has focused on using smooth approximations of robustness, which enable faster gradient-based methods to find local maxima, at the expense of soundness and/or completeness. We propose a novel robustness approximation that is smooth everywhere, sound, and asymptotically complete. Our approach combines the benefits of existing approximations, while enabling an explicit tradeoff between conservativeness and completeness.
- **Symbolic Models for a Class of Impulsive Systems**
  Authors: A. Swikir ; A. Girard ; M. Zamani
  Abstract: Symbolic models have been used as the basis of a systematic framework to address control design of several classes of hybrid systems with sophisticated control objectives. However, results available in the literature are not concerned with impulsive systems which are an important modeling framework of many applications. In this letter, we provide an approach for constructing symbolic models for a class of impulsive systems possessing some stability properties. We formally relate impulsive systems and their symbolic models using a notion of so-called alternating simulation function. We show that behaviors of the constructed symbolic models are approximately equivalent to those of the impulsive systems. Finally, we illustrate the effectiveness of our results through a case study.
- **Synthesis of Partially Observed Jump-Diffusion Systems via Control Barrier Functions**
  Authors: N. Jahanshahi ; P. Jagtap ; M. Zamani
  Abstract: In this letter, we study formal synthesis of control policies for partially observed jump-diffusion systems against complex logic specifications. Given a state estimator, we utilize a discretization-free approach for formal synthesis of control policies by using a notation of control barrier functions without requiring any knowledge of the estimation accuracy. Our goal is to synthesize an offline control policy providing (potentially maximizing) a lower bound on the probability that the trajectories of the partially observed jump-diffusion system satisfy some complex specifications expressed by deterministic finite automata. Finally, we illustrate the effectiveness of the proposed results by synthesizing a policy for a jet engine example.
- **Reinforcement Learning Approach to Feedback Stabilization Problem of Probabilistic Boolean Control Networks**
  Authors: A. Acernese ; A. Yerudkar ; L. Glielmo ; C. D. Vecchio

Abstract: In this letter, we study the control of probabilistic Boolean control networks (PBCNs) by leveraging a model-free reinforcement learning (RL) technique. In particular, we propose a Q-learning (QL) based approach to address the feedback stabilization problem of PBCNs, and we design optimal state feedback controllers such that the PBCN is stabilized at a given equilibrium point. The optimal controllers are designed for both finite-time stability and asymptotic stability of PBCNs. In order to verify the convergence of the proposed QL algorithm, the obtained optimal policy is compared with the optimal solutions of model-based techniques, namely value iteration (VI) and semi-tensor product (STP) methods. Finally, some PBCN models of gene regulatory networks (GRNs) are considered to verify the obtained results.

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1.4. Systems & Control Letters

Volume: 147, January 2021

- **Inventory control of a class of logistic networks**
  Authors: Berna Bou Farraa ; Rosa Abbou ; Jean Jacques Loiseau
  Abstract: This paper focuses on a prediction-based control for a class of convolution systems subject to constant input delays, also known as the reduction approach. We propose here a characterization of the D-invariance property of polytope sets for continuous-time systems. Our motivations come from production management, where a general model for a production network is considered. The system is subject to product losses and multiple delays, with bounded demand. This model is transformed into an equivalent free-delay system using Artstein reduction. The question of regulating the inventory levels of the nodes of this production network is then reduced to a pair of sub-problems, that are the regulation of the equivalent system without delay, and the relationship between the output of the system and that of the reduced system. A pair of conditions is therefore obtained, for the verification that a large class of control solutions allow to satisfy the external demand, while meeting the constraints that are imposed to the system. At the end, explicit conditions are found for an example of a supply chain with two nodes.

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1.5. Nonlinear Analysis: Hybrid Systems

Volume: 39, February 2021

- **Funnel control for fully actuated systems under a fragment of signal temporal logic specifications**
  Authors: Lars Lindemann ; Dimos V. Dimarogonas
  Abstract: Temporal logics have lately proven to be a valuable tool for various control applications by providing a rich specification language. Existing temporal logic-based control strategies discretize the underlying dynamical system in space and/or time. We will not use such an abstraction and consider continuous-time systems under a fragment of signal temporal logic specifications by using the associated robust semantics. In particular, this paper provides computationally-efficient funnel-based feedback control laws for a class of systems that are, in a sense, feedback equivalent to single integrator systems, but where the dynamics are partially unknown for the control design so that some degree of robustness is obtained. We first leverage the transient properties of a funnel-based feedback control strategy to maximize the robust semantics of some atomic temporal logic formulas. We then guarantee the satisfaction for specifications consisting of conjunctions of such atomic temporal logic formulas with overlapping time intervals by a suitable switched control system. The result is a framework that satisfies temporal logic specifications with a user-defined robustness when the specification is satisfiable. When the specification is not satisfiable, a least violating solution can be found. The theoretical findings are demonstrated in simulations of the nonlinear Lotka–Volterra equations for predator–prey models.
- **Compositional abstraction-based synthesis of general MDPs via approximate probabilistic relations**
  Authors: Abolfazl Lavaei ; Sadegh Soudjani ; Majid Zamani
  Abstract: We propose a compositional approach for constructing abstractions of general Markov decision processes (gMDPs) using approximate probabilistic relations. The abstraction framework

is based on the notion of -lifted relations, using which one can quantify the distance in probability between the interconnected gMDPs and that of their abstractions. This new approximate relation unifies compositionality results in the literature by incorporating the dependencies between state transitions explicitly and by allowing abstract models to have either infinite or finite state spaces. Accordingly, one can leverage the proposed results to perform analysis and synthesis over abstract models, and then carry the results over concrete ones. To this end, we first propose our compositionality results using the new approximate probabilistic relation which is based on lifting. We then focus on a class of stochastic nonlinear dynamical systems and construct their abstractions using both model order reduction and space discretization in a unified framework. We provide conditions for simultaneous existence of relations incorporating the structure of the network. Finally, we demonstrate the effectiveness of the proposed results by considering a network of four nonlinear dynamical subsystems (together 12 dimensions) and constructing finite abstractions from their reduced-order versions (together 4 dimensions) in a unified compositional framework. We benchmark our results against the compositional abstraction techniques that construct both infinite abstractions (reduced-order models) and finite MDPs in two consecutive steps. We show that our approach is less conservative than the ones available in the literature.

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1.6. IEEE/CAA Journal of Automatica Sinica

Volume: 51, Issue: 1, January 2021

- **Parametric transformation of timed weighted marked graphs: applications in optimal resource allocation**
  Authors: Z. He ; Z. Ma ; Z. Li ; A. Giua
  Abstract: Timed weighted marked graphs are a subclass of timed Petri nets that have wide applications in the control and performance analysis of flexible manufacturing systems. Due to the existence of multiplicities (i.e., weights) on edges, the performance analysis and resource optimization of such graphs represent a challenging problem. In this paper, we develop an approach to transform a timed weighted marked graph whose initial marking is not given, into an equivalent parametric timed marked graph where the edges have unitary weights. In order to explore an optimal resource allocation policy for a system, an analytical method is developed for the resource optimization of timed weighted marked graphs by studying an equivalent net. Finally, we apply the proposed method to a flexible manufacturing system and compare the results with a previous heuristic approach. Simulation analysis shows that the developed approach is superior to the heuristic approach.

- **Computation of an emptiable minimal siphon in a subclass of Petri nets using mixed-integer programming**
  Authors: S. Wang ; W. Duo ; X. Guo ; X. Jiang ; D. You ; K. Barkaoui ; M. Zhou
  Abstract: Deadlock resolution strategies based on siphon control are widely investigated. Their computational efficiency largely depends on siphon computation. Mixed-integer programming (MIP) can be utilized for the computation of an emptiable siphon in a Petri net (PN) . Based on it, deadlock resolution strategies can be designed without requiring complete siphon enumeration that has exponential complexity. Due to this reason, various MIP methods are proposed for various subclasses of PNs. This work proposes an innovative MIP method to compute an emptiable minimal siphon (EMS) for a subclass of PNs named S4PR. In particular, many particular structural characteristics of EMS in S4PR are formalized as constraints, which greatly reduces the solution space. Experimental results show that the proposed MIP method has higher computational efficiency. Furthermore, the proposed method allows one to determine the liveness of an ordinary S4PR.

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2 Conferences

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

2.1 **2021 ACM International Conference on Hybrid Systems: Computation and Control**
Nashville, USA, May 19-21, 2021.
https://hscc.acm.org/2021/

2.2 **2021 American Control Conference**
New Orleans, Louisiana, USA, May 26-28, 2021.
http://acc2021.a2c2.org/

2.3 **2021 Learning for Dynamics and Control**
ETH Zurich, Switzerland, June 7-8, 2021
https://l4dc.ethz.ch/

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

2.5 **2021 Chinese Control Conference**
Shanghai, China, July 26-28, 2021
https://conf2021.shu.edu.cn/index.htm

2.6 **2021 IEEE Conference on Control Technology and Applications**
San Diego, August 8-11, 2021
https://ccta2021.ieeecss.org/

2.7 **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

2.8 **2021 IEEE International Conference on Systems, Man, and Cybernetics**
South Wharf, Victoria, Australia, October 17-20, 2021
http://ieeesmc2021.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 **Discrete-Time and Discrete-Space Dynamical Systems**
Authors: Kuize Zhang, Lijun Zhang, Lihua Xie
Description: The book's perspective is primarily based on topological properties though it also employs semi tensor-product and graph-theoretic methods where appropriate. It presents a series of fundamental results: invertibility, observability, detectability, reversibility, etc., with applications to systems biology.

ISBN: 978-3-030-25971-6
https://link.springer.com/book/10.1007/978-3-030-25972-3

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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

- Extended deadline: January 31, 2021 (no further extension)
- 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
- Extended deadline: January 15, 2021

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

5 Software Tools

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.

5.4 **DESpot 1.10.0 Released**

DESpot is a discrete-event system (DES) software, research tool. It supports both flat projects (collection of plant and supervisor DES), and Hierarchical Interface-Based Supervisory Control (HISC) projects.

DESpot 1.10.0 supports a number of new Features:

- DESpot now targets version 4.8.7 of the Qt libraries, RedHat Enterprise Linux 7.x, and MS Windows 10 with MS Visual Studios 2019.
- Support for defining template DES, and then instantiating multiple copies for flat or HISC projects.
- Now includes curved transition arrows for DES diagrams, and the ability to export DES diagrams to EPS.
- Support for verification of timed controllability, including BDD-based algorithms.
- Support for Fault-Tolerant (FT) Supervisory Control, including both timed and untimed controllability and nonblocking BDD-based algorithms, for several fault scenarios.
- Support for specifying decentralized supervisory control structure for a project, and verifying co-observability.

To find out more information and to download a copy, see: http://www.cas.mcmaster.ca/~leduc/DESpot.html

DESpot is open source software, released under the GNU General Public license (GPL), version 2.

DESpot is written in C++ and uses the QT GUI libraries. At the moment, DESpot is available as source code and as a Windows' installer. It runs under Linux, and Windows.