IEEE Control Systems Society
Technical Committee on Discrete Event Systems

Newsletter **September 2023**

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Welcome to the 2023 September issue of the newsletter, also available online at
https://ieeecss.org/tc/discrete-event-systems/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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1 Selections of Journal Publications

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

1.1. Discrete Event Dynamic Systems Theory and Applications

Volume: 33, Issue: 2, June 2023

- **On comparison of steady-state infinitesimal perturbation analysis and likelihood ratio derivative estimates**
  Authors: Jian-Qiang Hu ; Teng Lian
  Abstract: In this paper, we compare the infinitesimal perturbation analysis (IPA) and likelihood ratio (LR) derivative estimators for the steady-state system time of the M/M/1 queue. We derive the explicit formulas for the variances of both estimators. We then show IPA has smaller variance, which is often considered as a rule-of-thumb in the simulation literature. This is the first theoretical result that proves IPA has smaller variance than LR for steady-state performance measures.
- **Supervisory control to maximize mean time to failure in discrete event systems**
  Authors: Feng Lin ; Caisheng Wang ; Masoud H. Nazari ; Wenyuan Li
  Abstract: In this paper, we investigate the use of supervisory control to maximize mean time to failure in a discrete event system framework. A complex engineering system is modeled as a discrete event system. Some of the states of the system are essential to the functionality of the system and are called required states. Some other states represent failures in the system and are called failure states. The control objective is to maximize the mean time to failure (MTTF) while allowing the system to visit all required states. The control is achieved by a supervisor that disables some controllable events based on monitoring the observable events as in classical supervisory control. To design such a supervisor, the MTTF of a supervised system is calculated by converting a discrete event system into a Markov chain having the same MTTF. Based on MTTF, two algorithms are developed that together allow us to design an optimal supervisor. The theoretical results are applied to power systems by investigating the maintenance management of equipment such as transformers.
- **A novel fully adaptive neural network modeling and implementation using colored Petri nets**
  Authors: Rosângela Albuquerque ; Corneli Júnior ; Giovanni Barroso ; Guilherme Barreto
  Abstract: Artificial neural networks (ANNs) comprise parallel and distributed computational tools that can learn from data and make inferences (i.e., predictions) for highly nonlinear systems. By its turn, Petri nets (PNs) consist of well established modeling tools for parallel and distributed discrete event systems with a number of successful contributions to automation and control of complex industrial tasks. Thus, motivated by a long lasting interest in using the formalism of PNs either to emulate or to design neural network architectures, we revisit this research topic by resorting to the powerful modeling framework of hierarchical timed colored PNs (HTCPNs) to introduce a novel approach that builds a fully adaptive one-hidden-layered multilayer perceptron (MLP) model trained by the famed backpropagation algorithm. The resulting proposed model is called HTCPN-MLP and consists of a general structure capable of handling classification and regression tasks. In order to develop the HTCPN-MLP model, a perceptron-like colored PN (perceptron-CPN) model is first built upon a novel McCulloch-Pitts colored PN (McCulloch-Pitts-CPN) model of a neuron, this being another contribution of the current work. A pedagogical set of experiments is presented in order to highlight the learning capability of the proposed HTPCN-MLP model and its advantages with respect to alternative models available in the literature.
- **Dynamics of products of matrices in max algebra**
  Authors: Shrihari Sridharan ; Sachindranath Jayaraman ; Yogesh Kumar Prajapaty
  Abstract: The aim of this manuscript is to understand the dynamics of matrix products in a max algebra. A consequence of the Perron-Fröbenius theorem on periodic points of a nonnegative matrix is generalized to a max algebra setting. The same is then studied for a finite product associated to a p-lettered word on N letters arising from a finite collection of nonnegative matrices, with each member having its maximum circuit geometric mean at most 1.

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1.2. IEEE Transactions on Automatic Control

Volume: 68, Issue: 9, September 2023

- **On Detectability of a Class of Hybrid Systems**
  Authors: Feng Lin ; Le Yi Wang ; George Yin ; Michael P. Polis ; Wen Chen
  Abstract: In this article, we model a hybrid system by using a hybrid machine consisting of an automaton and a set of continuous-variable subsystems. We investigate the problem of determining the (current) discrete state of the hybrid system. Extending the terminologies in discrete-event systems, a hybrid system is detectable if its discrete state can be uniquely determined. We derive conditions for a hybrid system to be detectable. If a hybrid system is detectable, we determine its current discrete state using a two-level approach. At the discrete-event level, we construct a discrete-event observer to obtain a discrete state estimate that consists of all possible discrete states that the hybrid system may be in. At the continuous-variable level, a set of continuous-variable observers are constructed, if necessary, to uniquely determine the discrete state. An example of a dc microgrid is used to illustrate the theoretical results.
- **Zero-Sum Games for Finite-Horizon Semi-Markov Processes Under the Probability Criterion**
  Authors: Xiangxiang Huang ; Xianping Guo ; Xin Wen
  Abstract: This study discusses a two-person zero-sum game for finite-horizon semi-Markov processes, where the concerned criterion is the probability that the total payoff produced by a system during a finite horizon exceeds a prescribed goal. We establish the Shapley equation and the existence of a saddle point under a suitable condition. Moreover, we develop a value iterative algorithm to compute an ε-saddle point and approach the value of the game by solving a series of matrix games. The construction of the ε-saddle point and the convergence of the algorithm are also shown. Finally, we demonstrate the application of our main results by an example on an inventory system.
- **A Framework for Output-Feedback Symbolic Control**
  Authors: Mahmoud Khaled ; Kuize Zhang ; Majid Zamani
  Abstract: Symbolic control is an abstraction-based controller synthesis approach that provides, algorithmically, certifiable-by-construction controllers for cyber-physical systems. Symbolic control approaches usually assume that full-state information is available, which is not suitable for many real-world applications with partially observable states or output information. This article introduces a framework for output-feedback symbolic control. We propose relations between original systems and their symbolic models based on outputs. They enable designing symbolic controllers and refining them to enforce complex requirements on original systems. We provide an example methodology to synthesize and refine output-feedback symbolic controllers.
- **Opacity Enforcement via Attribute-Based Edit Functions in the Presence of an Intended Receiver**
  Authors: Rongjian Liu ; Jianquan Lu ; Christoforos N. Hadjicostis
  Abstract: The enforcement of opacity, a security property concerning information-flow, has been investigated using edit functions, which are capable of manipulating the output of the system via insertion, replacement, and erasure operations on its symbols, in order to ensure that an outside observer (the intruder) does not gain access to critical system information. In this article, we consider situations where an intended receiver may be present and develop attribute-based edit functions, which not only obfuscate the output for the intruder, but also allow the intended receiver (who is assumed to have access to specific additional information) to recover the original output behavior. In our developed edit mechanism, edit functions modify the output by only performing insertion or replacement operations under a carefully chosen replacement regulation. Moreover, the outside observer that satisfies the intended-receiver attribute (i.e., the identity of the observer is the intended receiver) is able to recover the unedited output sequence using its ability to distinguish inserted/replaced symbols, and its knowledge of the replacement regulation. We provide an algorithmic procedure, based on a backtracking technique, to obtain suitable replacement regulations for the attribute-based edit function and the intended receiver.
- **Abstraction Refinement for Attractivity Controllers Using Quantitative Synthesis**

Authors: W. Alejandro Apaza-Perez ; Antoine Girard
Abstract: Attractivity specifications consist in driving the state of a system to a target region and to keep it in that region afterward. In this article, we develop an approach to controller synthesis for attractivity specifications based on iterative refinements of symbolic abstractions. We compute iteratively sequences of least-violating attractivity controllers and of associated attractors. The current controller is used to restrict possible control actions at the next iteration where a new abstraction is used following a local refinement applied inside the current attractor. The approach results in a nested sequence of attractors that are closer to the target region at each iteration. To illustrate the effectiveness of our approach, we show an application to a marine vessel system.

- **Stationary Strong Stackelberg Equilibrium in Discounted Stochastic Games**
Authors: Víctor Bucarey López ; Eugenio Della Vecchia ; Alain Jean-Marie ; Fernando Ordoñez
Abstract: In this work, we study Stackelberg equilibria for discounted stochastic games. We consider two solution concepts for these games: stationary strong Stackelberg equilibrium (SSSE) and fixed point equilibrium (FPE) solutions. The SSSE solution is obtained by explicitly solving the Stackelberg equilibrium conditions, whereas the FPE can be computed efficiently using value or policy iteration algorithms. However, previous work has overlooked the relationship between these two different solution concepts. Here, we investigate the conditions for existence and equivalence of these solution concepts. Our theoretical results prove that the FPE and SSSE exist and coincide for important classes of games, including myopic follower strategy and team games. This, however, does not hold in general, and we provide numerical examples where one of SSSE or FPE does not exist, or when they both exist, they differ. Our computational results compare the solutions obtained by value iteration, policy iteration, and a mathematical programming formulations for this problem. Finally, we present a discounted stochastic Stackelberg game for a security application to illustrate the solution concepts and the efficiency of the algorithms studied.

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1.3. Automatica

Volume: 155, September 2023

- **Verifying weak and strong k-step opacity in discrete-event systems**
Authors: Jií Balun ; Tomá Masopust
Abstract: Opacity is an important system-theoretic property expressing whether a system may reveal its secret to a passive observer (an intruder) who knows the structure of the system but has only limited observations of its behavior. Several notions of opacity have been discussed in the literature, including current-state opacity, k-step opacity, and infinite-step opacity. We investigate weak and strong k-step opacity, the notions that generalize both current-state opacity and infinite-step opacity, and ask whether the intruder is not able to decide, at any time instant, when respectively whether the system was in a secret state during the last observable steps. We design a new algorithm verifying weak k-step opacity, the complexity of which is lower than the complexity of existing algorithms and does not depend on the parameter k, and show how to use it to verify strong k-step opacity by reducing strong k-step opacity to weak k-step opacity. The complexity of the resulting algorithm is again better than the complexity of existing algorithms and does not depend on the parameter k.

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1.4. Control Engineering Practice

Volume: 138, September 2023

- **Optimal multi-robot path planning for cyclic tasks using Petri nets**
Authors: Peng Lv ; Guangqing Luo ; Ziyue Ma ; Shaoyuan Li ; Xiang Yin
Abstract: IIn this paper, we investigate the problem of optimal multi-robot path planning for cyclic tasks represented by a particular type of linear-temporal logic (LTL) formulae. Specifically, the team of robot needs to fulfill a given LTL formula and at the same time, accomplishes some particular tasks infinitely often. To avoid the state-space explosion when the number of robot increases, we use Petri nets to model the team of multi-robot. Our goal is to find an optimal

infinite sequence in the prefix-suffix form for each robot such that the average cost per task is minimized. We propose an efficient planning method based on the notion of basis reachability graph, which is a compact representation of the reachability space of the PN. We demonstrate the computational efficiency and scalability of our method through illustrative examples. The proposed methods have also been implemented in real-world experiments.

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1.5. IEEE Transactions on Cybernetics

Volume: 53, Issue: 9, September 2023

- **Supervised Learning of Multievent Transition Matrices in Fuzzy Discrete-Event Systems**
  Authors: Feng Lin ; Hao Ying
  Abstract: In this article, supervised learning of fuzzy discrete-event systems (FDES) is investigated. A learning algorithm that performs supervised learning for multievent transition matrices of a sequence of fuzzy discrete events is derived. FDES can be used to describe a large class of practical systems that consist of fuzzy discrete states, fuzzy discrete events, and transitions among fuzzy discrete states via fuzzy discrete events. Because fuzzy discrete states, fuzzy discrete events, and fuzzy transitions are well defined in FDES, the FDES model is highly explainable, which is important in many applications, especially in biomedical applications. Based on this explainable model, the proposed learning algorithm can be used to learn events and event sequences in the model. Hence, it allows system developers to build an explainable model for a complex system based on the data available. Simulations using MATLAB are conducted to verify the effectiveness of the proposed algorithm.
- **Total-Activity Conservation Analysis and Design of Boolean Networks**
  Authors: Qi Chen ; Haitao Li ; Xinrong Yang
  Abstract: The law of conservation of mass, represented in Boolean networks (BNs) as total-activity conservation, is one of the typical properties of biological networks. This article analyzes the total-activity conservation of BNs based on the algebraic state-space representation (ASSR) approach. First, the total-activity-conservative matrix is defined and a matrix-based criterion is proposed to verify the total-activity conservation of BNs. Meanwhile, when function perturbation is considered, robust total-activity conservation is investigated. Second, by means of the pseudo-Boolean function generated by total-activity conservation, a constructive design procedure of the Boolean dynamics is given to achieve the total-activity conservation. Third, the total-activity conservation of switched Boolean networks (SBNs) under arbitrary switching signal is studied, which together with network aggregation achieves the total-activity conservation of large-scale BNs.

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1.6. IEEE/CAA Journal of Automatica Sinica

Volume: 10, Issue: 9, September 2023

- **Innovative Services for Electric Mobility Based on Virtual Sensors and Petri Nets**
  Authors: Agostino Marcello Mangini ; Michele Roccotelli
  Abstract: About 60% of emissions into the earth's atmosphere are produced by the transport sector, caused by exhaust gases from conventional internal combustion engines. An effective solution to this problem is electric mobility, which significantly reduces the rate of urban pollution. The use of electric vehicles (EVs) has to be encouraged and facilitated by new information and communication technology (ICT) tools. To help achieve this goal, this paper proposes innovative services for electric vehicle users aimed at improving travel and charging experience. The goal is to provide a smart service to allow drivers to find the most appropriate charging solutions during a trip based on information such as the vehicle's current position, battery type, state of charge, nearby charge point availability, and compatibility. In particular, the drivers are supported so that they can find and book the preferred charge option according to time availability and the final cost of the charge points (CPs). To this purpose, two virtual sensors (VSs) are designed, modeled and simulated

in order to provide the users with an innovative service for smart CP searching and booking. In particular, the first VS is devoted to locate and find available CPs in a preferred area, whereas the second VS calculates the charging cost for the EV and supports the driver in the booking phase. A UML activity diagram describes VSs operations and cooperation, while a UML sequence diagram highlights data exchange between the VSs and other electromobility ecosystem actors (CP operator, EV manufacturer, etc.). Furthermore, two timed Petri Nets (TPNs) are designed to model the proposed VSs, functioning and interactions as discrete event systems. The Petri Nets are synchronized by a single larger TPN that is simulated in different use cases and scenarios to demonstrate the effectiveness of the proposed VSs.

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2 Call for Participants

2.1 Workshop at CDC'23 Singapore: Formal Methods in System Resilience: From Analysis to Control

Dear colleagues,

We would like to bring your attention to the workshop on the topic of **"Formal Methods in System Resilience: From Analysis to Control" at IEEE CDC 2023, to take place in Singapore, December 12, 2013**, organized by Rong Su (Nanyang Technological University), and Xiang Yin (Shanghai Jiao Tong University).

The workshop will feature invited talks from Alessandro Abate (University of Oxford), Alessandro Giua (University of Cagliari), Christoforos Hadjicostis (University of Cyprus), Zhiwu Li (Macau University of Science and Technology), Rong Su (Nanyang Technological University), Xiang Yin (Shanghai Jiao Tong University), and Majid Zamani (University of Colorado, Boulder); as well as a panel discussion.

For more details on the talks will be updated at https://sites.google.com/view/cdc23workshop.

Registration information of the workshop can be found at https://cdc2023.ieeecss.org/registration.

3 Conferences

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

3.1 **2023 IEEE International Conference on Systems, Man, and Cybernetics (SMC)**
Maui, Hawaii, October 14, 2023.
https://ieeesmc2023.org/

3.2 **2023 IEEE Conference on Decision and Control (CDC)**
Singapore, December 13-15, 2023.
https://cdc2023.ieeecss.org/

3.3 **2024 IFAC Workshop on Discrete Event Systems (WODES)**
Rio de Janeiro, Brazil, April 29-May 1, 2024.
https://wodes2024.eventos.ufrj.br

3.4 **2024 IFAC Conference on Analysis and Design of Hybrid Systems (ADHS)**
Boulder, Colorado, July 1-3, 2024.
https://www.colorado.edu/conference/adhs2024/

3.5 **2024 American Control Conference (ACC)**
Toronto, Canada, July 8-12, 2024.
https://acc2024.a2c2.org/

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4 Books

4.1 Safe Autonomy with Control Barrier Functions: Theory and Applications

Authors: Wei Xiao, Christos G. Cassandras, and Calin Belta

Description: The book presents the concept of Control Barrier Function (CBF), which captures the evolution of safety requirements during the execution of a system and can be used to enforce safety. Safety is central to autonomous systems since they are intended to operate with minimal or no human supervision. The book includes both theoretical and application perspectives on how safety can be guaranteed. It explains how the CBF approach is computationally efficient and can easily deal with nonlinear models and complex constraints used in a wide spectrum of applications, including autonomous driving, robotics, and traffic control. Safety guarantees can be integrated into the operation of such autonomous systems, including typical safety requirements that involve collision avoidance, technological system limitations, and bounds on real-time executions. Adaptive and event-driven approaches for safety are also discussed for time-varying execution bounds and noisy dynamics, as well as for systems with unknown dynamics.

Additional information on the book can be found at
https://link.springer.com/book/10.1007/978-3-031-27576-0
where an eBook version can also be downloaded (free for some educational institutions).

4.2 Analysis and Control for Resilience of Discrete Event Systems

Authors: Joao Carlos Basilio, Christoforos N. Hadjicostis and Rong Su

Description: System resilience captures the ability of the system to withstand a major disruption within acceptable performance degradation and to recover within an acceptable time frame. In this monograph we consider two possible sources of major disruptions, i.e., component faults and cyber intrusions. A component fault is an indigenous activity that renders unavailability or inaccessibility of certain functions within a component, either permanently or temporarily. It typically generates safety and performance concerns. Cyber intrusion on the other hand is an exogenous activity that tampers privacy, confidentiality, availability, or integrity of the system. These two sources are not always independent from each other. For example, a cyber intrusion may trigger a component fault, whereas a component fault may open a door for cyber intrusion, e.g., by keeping it undetected. For cyber intrusion, we will focus on opacity, which describes the systems ability to hide certain secrets from an external observer (or eavesdropper), and sensor and actuator attacks that exploit the systems existing controller to generate undesirable behaviours.

In this monograph, we provide a detailed account of most recent research outcomes on fault diagnosis, opacity analysis and enhancement, and cyber security analysis and enforcement, within suitable discrete event system modelling frameworks. In each case, we describe basic problem statements and key concepts, and then point out the key challenges in each research area. After that, we present a thorough review of state-of-the-art techniques, and discuss their advantages and disadvantages. Finally, we highlight key research directions for further exploration.

ISBN: 978-1-68083-856-5
https://www.nowpublishers.com/article/Details/SYS-024

4.3 Introduction to Discrete Event Systems (Third Edition)

Authors: Christos Cassandras and Stéphane Lafortune

Description: Christos Cassandras and Stéphane Lafortune are happy to announce the publication of the third edition of their textbook, Introduction to Discrete Event Systems, by Springer in November 2021. The first two editions of this popular textbook were published in 1999 (Kluwer Academic Publishers) and 2008 (Springer), respectively. This unique textbook comprehensively introduces the field of discrete event systems, offering a breadth of coverage that makes the material accessible to readers of varied backgrounds. The book emphasizes a unified modeling framework that

transcends specific application areas, linking the following topics in a coherent manner: language and automata theory, supervisory control, Petri net theory, Markov chains and queueing theory, discrete-event simulation, and perturbation analysis and concurrent estimation techniques. The third edition is a superset of the second one, with new material added based on our teaching of discrete event systems courses at Boston University and at the University of Michigan, and they reflect active research trends in discrete event systems since the publication of the second edition.

Topics and features:
- detailed treatment of automata and language theory in the context of discrete event systems, including application to state estimation and diagnosis
- comprehensive coverage of centralized and decentralized supervisory control
- timed models, including timed automata and hybrid automata - stochastic models for discrete event systems and controlled Markov chains
- discrete event simulation - an introduction to stochastic hybrid systems
- sensitivity analysis and optimization of discrete event and hybrid systems
- new in the third edition: opacity properties, enhanced coverage of event diagnosis and of supervisory control under partial observation, overview of latest software tools, updated treatment of Infinitesimal Perturbation Analysis and of concurrent estimation

This proven textbook is essential to students and researchers in a variety of disciplines where the study of discrete event systems is relevant: control, communications, computer engineering, computer science, manufacturing engineering, transportation networks, operations research, and industrial engineering. This book is available through SpringerLink as an e-book (PDF and EPUB formats) or as a print-on-demand hard cover at https://link.springer.com/book/10.1007/978-3-030-72274-6 The e-book is available for free download at Springer subscribing institutions.

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4.4 Hybrid Dynamical Systems – Fundamentals and Methods

Authors: Hai Lin and Panos Antsaklis

Description: This book is based on courses on hybrid systems, cyber-physical systems, and formal methods taught by the authors in the past years. It is a graduate level textbook and provides an accessible and comprehensive introduction to the theory of hybrid systems with a balanced treatment on fundamentals and methods from both control theory and computer science. It also serves as a reference book for researchers in the fields of hybrid dynamical systems, cyber-physical systems, formal methods and robotics.

More information may be found at the books Springer webpage:

https://link.springer.com/book/10.1007/978-3-030-78731-8

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5 Software Tools

5.1 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.

5.2 Eclipse ESCET™ version 0.10 release

The Eclipse Supervisory Control Engineering Toolkit (Eclipse ESCET) project provides a model-based approach and toolkit for the development of supervisory controllers. It includes the languages CIF, Chi and ToolDef. ESCET, initially developed by Eindhoven University of Technology, is since January 2020 an Eclipse Foundation open-source project. More information can be found on the toolkits website at https://www.eclipse.org/escet/.

In June 2023, ESCET version 0.10 has been released and can be downloaded from https://www.eclipse.org/escet/download.html. The main changes in this version are

- Switch expressions with only a single case or else are now deprecated. Furthermore, several previously deprecated features are now removed from the CIF language. See full release notes for these cases and supported alternatives.
- The CIF data-based synthesis tool has a new Edge granularity option to configure the granularity of edges to use during synthesis. The new edge granularity has been shown to reduce both the memory usage and time required to perform synthesis, but this may depend on the model being synthesized.
- The CIF data-based synthesis tool has a new Fixed-point computations order option to configure the order in which the fixed-point computations are to be performed during synthesis. This may significantly improve synthesis performance, but the effect greatly depends on the model being synthesized.
- Several CIF command line script fixes preventing crashes.
- The CIF data-based synthesis tool no longer prints the number of states in the controlled system as part of its debug output. Instead, this information is now one of the statistics of the Statistics options.

The full ESCET release notes, including links to the language specific release notes and release notes from previous versions, are available from https://www.eclipse.org/escet/release-notes.html.

5.3 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.

5.4 MDESops

MDESops is an open-source tool written in Python for analysis and control of discrete event systems modeled as finite-state automata. It includes a growing set of operations on automata, including: (i) manipulation of models (e.g., parallel composition, observer); (ii) diagnosis and opacity verification; (iii) common supervisory control functions (e.g., computation of supremal controllable and normal sublanguages); and (iv) more advanced functions on synthesis of attackers and of resilient supervisors in the presence of sensor deception attacks. The repository is a Git server maintained by the EECS Department at the University of Michigan, USA. Download from https://gitlab.eecs.umich.edu/M-DES-tools/desops.

5.5 Supremica 2.7, New Version

The development team has just released a new version of Supremica, Waters/Supremica IDE 2.7.

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:

- Conditional blocks or IF statements can now be created in the components list or on label blocks to allow conditional compilation of automata or events. They can also be used as an alternative to guard/action blocks.
- Update to Log4j 2.17.1 to avoid the Log4shell vulnerability.

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

5.6 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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