IEEE Control Systems Society
Technical Committee on Discrete Event Systems

Newsletter **April 2023**

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Welcome to the 2023 April 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. IEEE Transactions on Automatic Control

Volume: 68, Issue: 4, April 2023

- **Codiagnosability Enforcement in Labeled Petri Nets**
  Authors: Ning Ran ; Tingting Li ; Zhou He ; Carla Seatzu
  Abstract: This article aims to enforce codiagnosability in labeled Petri nets, which are monitored by a series of sites. A labeled Petri net is codiagnosable with respect to a certain fault, if the occurrence of such a fault could be detected by at least one of the sites. We assume that codiagnosability is imposed to a noncodiagnosable system by appropriately positioning additional sensors. In particular, the goal is that of minimizing the cost of the new sensors. The enumeration of the whole state space is avoided, thanks to the notions of basis markings and minimal explanations. An automaton, called unfolded verifier, is introduced to verify codiagnosability. Finally, the set of optimal labeling functions is obtained solving an integer nonlinear programming problem.
- **A Specification-Guided Framework for Temporal Logic Control of Nonlinear Systems**
  Authors: Yinan Li ; Zhibing Sun ; Jun Liu
  Abstract: This article proposes a specification-guided framework for control of nonlinear systems with linear temporal logic (LTL) specifications. In contrast with well-known abstraction-based methods, the proposed framework directly characterizes the winning set, i.e., the set of initial conditions from which a given LTL formula can be realized, over the continuous state space of the system via a monotonic operator. Following this characterization, an algorithm is proposed to practically approximate the operator via an adaptive interval subdivision scheme, which yields a finite-memory control strategy. We show that the proposed algorithm is sound for full LTL specifications, and robustly complete for specifications recognizable by deterministic Büchi automaton (DBA), the latter in the sense that control strategies can be found whenever the given specification can be satisfied with additional bounded disturbances. Without having to compute and store the abstraction and the resulting product system with the DBA, the proposed method is more memory efficient, which is demonstrated by complexity analysis and performance tests. A preprocessing stage is also devised to reduce computational cost via a decomposition of the specification. We show that the proposed method can effectively solve real-world control problems, such as jet engine compressor control and motion planning for manipulators and mobile robots.
- **Invariant Subspace Approach to Boolean (Control) Networks**
  Authors: Daizhan Cheng ; Lijun Zhang ; Dongyao Bi
  Abstract: A logical function can be used to characterize a property of states of a Boolean network (BN), which is considered as an aggregation of states. The dynamics of a set of logical functions are called the dual dynamics of the set. To illustrate the dual dynamics of a given set, which characterizes our concerned properties of a BN, the invariant subspace containing the set of logical functions is proposed, and its properties are investigated. Then, the invariant subspace of Boolean control network (BCN) is also proposed, and its dynamics are obtained. Finally, using outputs as the set of logical functions, the minimum output based dual dynamics is considered and proposed as the minimum realization of BCNs. The minimum realization might have much smaller size, which provides a possible solution to overcome the computational complexity of large scale BNs/BCNs. As an example, the proposed approaches for both BN and BCN are applied to an opinion dynamic network to demonstrate the efficiency of the technique proposed in this article.

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1.2. Automatica

Volume: 150, April 2023

- **Privacy-preserving co-synthesis against sensoractuator eavesdropping intruder**
  Authors: Ruochen Tai ; Liyong Lin ; Yuting Zhu ; Rong Su

Abstract: In this work, we investigate the problem of privacy-preserving supervisory control against an external passive intruder via co-synthesis of a dynamic mask, an edit function, and a supervisor. We attempt to achieve the following goals: (1) the system secret cannot be inferred by the intruder, i.e., opacity of secrets against the intruder, and the existence of the dynamic mask and the edit function should not be discovered by the intruder, i.e., covertness of dynamic mask and edit function against the intruder; (2) some safety and nonblockingness requirement should be satisfied. We assume the intruder can eavesdrop both the sensing information generated by the sensors and the control commands issued to the actuators. Our approach is to model the co-synthesis problem as a distributed supervisor synthesis problem in the RamadgeWonham supervisory control framework, and we propose an incremental synthesis heuristic to incrementally synthesize a dynamic mask, an edit function and a supervisor. The effectiveness of our approach is illustrated on an example about location privacy.

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1.3. Control Engineering Practice

Volume: 133, April 2023

- **Synthesis-based engineering of supervisory controllers for ROS-based applications**
  Authors: E. Torta ; M. Reniers ; J. Kok ; J.M. van de Mortel-Fronczak ; M.J.G. van de Molengraft
  Abstract: An ever-increasing number of robotic applications is being created based on the functionalities and the communication facilities offered by the Robotic Operating System (ROS). When applications involve contact with humans, such as in some transportation tasks, a robot supervisory controller shall guarantee that in every possible circumstance safety and task requirements are satisfied. There is no framework provided by ROS to specify supervisory controllers with formal guarantees about the satisfaction of requirements. This is problematic when the complexity of the controller increases, and it is not viable to test every possible scenario during the validation stage of the robotic application. This paper presents novel work that aims at enabling supervisory controller synthesis for ROS-based applications by (a) proposing a novel mapping between concepts from supervisory control theory and ROS, (b) demonstrating that a supervisory control modeling language exists that can be used to describe plant models and to specify requirements and (c) presenting generic finite-state automata models of ROS components, regarded as plant models, which are input for the synthesis procedure. The approach is demonstrated by synthesizing the controller to coordinate state-of-the-art mobile robot navigation modules. Simulations and real-life experiments show that the generated supervisory controller guarantees the correctness of the model with respect to the requirements and that the execution time of a control loop, including the binding code between the supervisory controller and ROS, is on average short enough to be deployed in high-level control loops. The paper is accompanied by a public code repository that contains the implementation of all methods presented in the paper including simulation environments to ease the replication of the results presented.

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1.4. International Journal of Control

Volume: 96, Issue: 4, April 2023

- **Fault-tolerant supervisory control with permanent faults**
  Authors: Aos Mulahuwaish ; Ryan J. Leduc
  Abstract: In our earlier work, we introduced a discrete-event system-based fault-tolerance approach designed to handle intermittent faults. This approach is different from the typical fault-tolerant methodology as the approach does not rely on detecting faults and switching to a new supervisor; it requires a supervisor to be designed that works correctly under normal and fault conditions. This is a passive approach that relies upon inherent redundancy in the system being controlled. This is also a foundation method that should allow a wide variety of existing fault approaches to be modelled but still allow controllability and nonblocking properties to be verified. Permanent faults could be modelled in this framework, but the current method was onerous. In this paper, we introduce a new modelling approach for permanent faults that is easy to use, as well

as a set of new permanent fault-tolerant definitions. They are designed to capture several types of permanent fault scenarios (generic situations such as at most one fault occurs) and to ensure that our system remains controllable and nonblocking in each scenario. New definitions and scenarios were required as the previous ones were incompatible with the new permanent fault modelling approach. Finally, we present algorithms to verify these properties, followed by complexity analyses and correctness proofs of the algorithms. An example is then provided to illustrate our approach.

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1.5. Systems & Control Letters

Volume: 174, April 2023

- **Further results on observability verification of Boolean control networks**
  Authors: Caixia Wang ; Jun-e Feng ; Yongyuan Yu
  Abstract: This paper investigates observability of Boolean control networks (BCNs) and gives some novel criteria on observability. Firstly, the observability, the strong observability and the super-strong observability are discussed via the augmented approach. Based on the constructed logical control system, these three kinds of observability are converted into the consistent and any-input sequence reachability. Subsequently, the minimum steps to determine corresponding observability are discussed. Then, by constructing finite-time convergent matrix sequences, a non-augmented approach, which can determine observability via the limit matrix in the minimum steps if the system is with corresponding observability, is presented to testify three types of observability. Finally, examples are worked out to illustrate the obtained results.
- **Duality between large deviation control and risk-sensitive control for Markov decision processes**
  Authors: Yanan Dai ; Jinwen Chen
  Abstract: This paper studies the dual relation between large deviations control of maximizing up-side chance probability and risk-sensitive control for Markov Decision Processes. To derive the desired duality, we apply a non-linear extension of the KrenRutman Theorem to characterize the optimal risk-sensitive value and prove that an optimal policy exists which is stationary and deterministic. Benchmarks in the up-side chance probability which make the duality hold are characterized. It is proved that the optimal policy for the up-side chance probability can be approximated by the optimal one for the risk-sensitive control. The right-hand derivative of the optimal risk-sensitive value function plays an important role, and a variational formula for the optimal risk-sensitive value is applied to characterize it. Some essential differences between these two types of optimal control problems are presented.

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

Volume: 53, Issue: 4, April 2023

- **Reinforcement Learning-Based Feedback and Weight-Adjustment Mechanisms for Consensus Reaching in Group Decision Making**
  Authors: Hossein Hassani ; Roozbeh Razavi-Far ; Mehrdad Saif ; Enrique Herrera-Viedma
  Abstract: The number of discussion rounds and harmony degree of decision makers are two crucial efficiency measures to be considered in the design of the consensus-reaching process for the group decision-making problems. Adjusting the feedback parameter and importance weights of the decision makers in the recommendation mechanism has a great impact on these efficiency measures. This work aims to propose novel and efficient reinforcement learning-based adjustment mechanisms to address the tradeoff between the aforementioned measures. To employ these adjustment mechanisms, we propose to extract the dynamics of state transition from consensus models based on the distributed trust functions and Z-Numbers in order to convert the decision environment into a Markov decision process. Two independent reinforcement learning agents are then trained via a deep deterministic policy gradient algorithm to adjust the feedback parameter and importance weights of decision makers. The first agent is trained toward reducing the number of discussion

rounds while ensuring the highest possible level of harmony degree among the decision makers. The second agent merely speeds up the consensus reaching process by adjusting the importance weights of the decision makers. Various experiments are designed to verify the applicability and scalability of the proposed feedback and weight-adjustment mechanisms in different decision environments.

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2 Call for Participants & Registrations

2.1 2023 Virtual Talk Series on Discrete Event Systems

Dear members of the TC and previous participants,

We are excited to announce the 2023 edition of the Virtual Talk Series on Discrete Event Systems for which we invite everyone to register here:
https://tc-des.mpi-sws.org/registration-2023/

As in previous years, registration is free and only required for security reasons. Please feel free to forward this announcement to any interested person! We think that this year's series compasses an exciting and diverse program again.

In January and February the VTS will feature a Virtual Workshop on Control Software Synthesis for CPS happening Wednesdays, January 18th 2023 and February 15th 2023 at 1pm UTC. From March to December the VTS will host two PhD forums and multiple 'classical' talks, happening, as usual, Thursdays 1pm UTC with confirmed speakers being:

- Laurent Hardouin, University of Angers, France
- Cristian Mahulea, University of Zaragoza, Spain
- Tomas Masopust, Faculty of Science, Palacky University in Olomouc, Czechia
- Anca Muscholl, LaBRI, Univ. of Bordeaux, France
- Sophie Pinchinat, Univ. Rennes, France

We are still in the process of finalizing the program of the VTS and will circulate the website with the final program when it is available.

One last remark: You will see that the virtual workshop mentioned above also has a separate registration site. If you register to the VTS, you do NOT need to register for the workshop separately. If you plan to ONLY attend the workshop, we kindly ask you to register on the workshop registration site.

We are looking forward to your active participation.

Kind regards,

Anne-Kathrin Schmuck on behalf of all TC co-chairs

2.2 ECC23 Workshop on Formal Methods for Data-Driven Control Systems

Dear colleagues,

We would like to bring your attention to the workshop on the topic of Formal methods for data-driven control systems at ECC 2023, to take place in Bucharest (Romania), June 13, 2013, organized by Antoine Girard (CNRS), Raphael Jüngers (UCLouvain), and Manuel Mazo Jr (TU Delft).

The workshop will feature invited talks from Alessandro Abate (U. Oxford), Pierre-Jean Meyer (Univ. Gustave Eiffel), Adnane Saoud (CentraleSupélec), Sofie Haesaert (TU Eindhoven), Raphael Jungers (UCLouvain), Maryam Kamgarpour (EPFL), and Calin Belta (Boston Univ.); as well as a panel discussion.

For more details on the talks, and registration please look at https://sites.google.com/site/antoinesgirard/miscellaneous/ecc-2023-workshop.

We hope to see many of you in Bucharest on June 13th.

Antoine, Raphael, and Manuel

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3 Conferences

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

3.1 **2023 ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS)**
San Antonio, USA, May 9-12, 2023
https://iccps.acm.org/2023/

3.2 **2023 IEEE International Conference on Robotics and Automation (ICRA)**
London, United Kingdom, May 29-June 02 2023, 2023
https://www.icra2023.org/

3.3 **2023 American Control Conference (ACC)**
San Diego, USA, May 31 - June 2, 2023
https://acc2023.a2c2.org/

3.4 **2023 IFAC World Congress (IFAC)**
Yokohama, Japan, July 9-14, 2023
https://www.ifac2023.org/

3.5 **2023 IEEE Conference on Control Technology and Applications (CCTA)**
Bridgetown, Barbados, August 16-18, 2023.
https://ieeeccta.org/

3.6 **2023 IEEE International Conference on Automation Science and Engineering (CASE)**
Auckland, New Zealand, August 26-29, 2023.
https://case2023.org/

3.7 **2023 IEEE International Conference on Systems, Man, and Cybernetics (SMC)**
Maui, Hawaii, October 14, 2023.
https://ieeesmc2023.org/

3.8 **2023 IEEE Conference on Decision and Control (CDC)**
Singapore, December 13-15, 2023.
https://cdc2023.ieeecss.org/

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4 Books

4.1 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

4.2 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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https://doi.org/10.1007/978-3-030-72274-6

4.3 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

4.4 A New Framework for Discrete-Event Systems

Author: Kuize Zhang

Description: Real-world problems are often formulated as diverse properties of different types of dynamical systems. Hence property verification and synthesis have been long-standing research interests. The supervisory control framework developed in the 1980s provides a closed-loop property enforcement framework for discrete-event systems which usually consist of discrete states and transitions between states caused by spontaneous occurrences of labeled events. In this comprehensive review, the author develops an open-loop property enforcement framework for discrete event systems which scales better and can be implemented in more models. The author demonstrates the practicality of this framework using a tool called concurrent composition, and uses this tool to unify multiple inference-based properties and concealment-based properties in discrete-event systems. In the second part, the author introduces a new model called labeled weighed automata over monoids (LWAMs). LWAMs provide a natural generalization of labeled finite-state automata in the sense that each transition therein carries a weight from a monoid, the weight of a run is the product of the weights of the runs transitions. This book introduces the reader to a new paradigm in discrete event dynamic systems. It provides researchers, students and practitioners with the basic theory and a set on implementable tools that will have a significant impact on systems of the future.

More information may be found at the books publisher webpage:

https://www.nowpublishers.com/article/Details/SYS-028

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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 0.9 released

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 March 2023, ESCET version 0.9 has been released and can be downloaded from https://www.eclipse.org/escet/download.html. The main changes in this version are

- Eclipse ESCET is now released for the both the x86_64 and aarch64 architectures of macOS. This should result in a significant performance improvement for users with the M1 and M2 chips.
- The CIF data-based synthesis tool variable ordering configuration has been generalized and extended. This includes the addition of a new BDD advanced variable ordering option. It offers much more flexibility in configuring variable ordering, including configuration of the order in which to apply various algorithms, and configuration of the settings to use per algorithm. As a result of the changes, the debug output has been changed considerably. See the documentation of the new option for more information.
- The CIF data-based synthesis tool options that influence the variable ordering have some new defaults. The DCSH variable ordering algorithm is no longer considered experimental, and is now enabled by default. The BDD hyper-edge creation algorithm option has a new default value that is set by default. It uses the linearized hyper-edges for the FORCE and sliding window algorithms, while for all other variable orderers the legacy hyper-edges are still used. These changes to the default variable ordering configuration have been shown to improve the out-of-the-box performance of data-based synthesis in many cases, especially for models that take longer to synthesize or require more memory to synthesize. However, the effect greatly depends on the model being synthesized, and for some models synthesis using default settings may now be slower.
- The CIF data-based synthesis tool now has a State requirement invariant enforcement option, adding an alternative second approach to apply state requirement invariants during synthesis. Both

approaches have potential benefits and drawbacks, making for a trade-off between their various effects. Which approach is most efficient depends on the model. The default has not been changed.

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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6 Open Positions

6.1 Open PhD position in the cyber-physical systems lab @UCLouvain

The department of applied mathematics at UCLouvain is recruiting a PhD Student in the framework of the ERC project L2C-Learning to control. The PhD will be under the supervision of Prof. Raphael Jungers. The goal of the thesis is to develop machine learning techniques for smart symbolic control of cyber-physical systems, and implement them within our dedicated platform in the language Julia. The ideal background of the applicant would feature control engineering and software implementation. The contract duration is 4 years, and conditions are good; please contact raphael.jungers@uclouvain.be for more information. Starting date between august and october 2023.

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