IEEE Control Systems Society
Technical Committee on Discrete Event Systems

Newsletter **November 2023**

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Welcome to the 2023 November 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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Contents

1 Selections of Journal Publications

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

1.1. IEEE Transactions on Automatic Control

Volume: 68, Issue: 11, November 2023

- **Error- and Tamper-Tolerant State Estimation for Discrete Event Systems Under Cost Constraints**
  Authors: Yuting Li ; Christoforos N. Hadjicostis ; Naiqi Wu ; Zhiwu Li
  Abstract: This article deals with the state estimation problem in discrete-event systems modeled with nondeterministic finite automata, partially observed via a sensor measuring unit whose measurements (reported observed symbols) may be vitiated by a malicious attacker. The attacks considered in this article include arbitrary deletions, insertions, or substitutions of observed symbols by taking into account a bounded number of attacks or, more generally, a total cost constraint (assuming that each deletion, insertion, or substitution bears a positive cost to the attacker). We provide a characterization of the sequences of symbols that match the received sequence of possibly corrupted symbols, and subsequently use them to recursively perform tamper-tolerant state estimation subject to cost constraints. Each step of the recursive state estimation procedure has complexity of $O(|X||\Sigma|C)$, where $|X|(|\Sigma|)$ is the number of states (events) of the given finite automaton and C is the maximum total cost that is allowed for all deletions, insertions, and substitutions.
- **Multitask Synthesis of Hybrid Systems via Temporal Logic**
  Authors: Yuhua Yao ; Jitao Sun ; Yu Zhang
  Abstract: In this note, we propose a unified framework for the study of hybrid systems, where the tasks of the systems are encoded as signal temporal logic (STL) specifications. First, we establish the mathematical expression of a class of hybrid systems consisting of continuous and logical parts. Then, we introduce the concept of locally finite time interval dwell, which matches the conditions to satisfy such the STL specifications. After that, combining the semi-tensor product and Lyapunov-like methods, we obtain the sufficient conditions to satisfy the given STL specifications. This approach can be used to study temporal tasks and properties of hybrid systems, such as practical stability and finite-time stability. Furthermore, we consider a special class of hybrid systems with control. Based on the theoretical analysis, a controller design algorithm that enables the system to fulfill the most tasks is provided. Finally, the effectiveness of the method is illustrated by an example.
- **Hierarchical Motion Planning Under Probabilistic Temporal Tasks and Safe-Return Constraints**
  Authors: Meng Guo ; Tianjun Liao ; Junjie Wang ; Zhongkui Li
  Abstract: Safety is crucial for robotic missions within an uncertain environment. Common safety requirements such as collision avoidance are only state-dependent, which can be restrictive for complex missions. In this article, we address a more general formulation as safe-return constraints, which require the existence of a return policy to drive the system back to a set of safe states with high probability. The robot motion is modeled as a Markov decision process with probabilistic labels, which can be highly nonergodic. The robotic task is specified as linear temporal logic formulas over these labels, such as surveillance and transportation. We first provide theoretical guarantees on the reformulation of such safe-return constraints, and a baseline solution based on computing two complete product automata. Furthermore, to tackle the computational complexity, we propose a hierarchical planning algorithm that combines the feature-based symbolic and temporal abstraction with constrained optimization. It synthesizes simultaneously two dependent motion policies: the outbound policy minimizes the overall cost of satisfying the task with a high probability, while the return policy ensures the safe-return constraints. The problem formulation is versatile regarding the robot model, task specifications, and safety constraints. The proposed hierarchical algorithm is more efficient and can solve much larger problems than the baseline solution, with only a slight loss of optimality. Numerical validations include simulations and hardware experiments of a search-and-rescue mission and a planetary exploration mission over various system sizes.

- **Necessary and Sufficient Conditions for Pareto Optimal Solution of Backward Stochastic System With Application**
  Authors: Panpan Nie ; Guangchen Wang ; Yu Wang
  Abstract: In this article, we are interested in studying a new kind of Pareto cooperative differential game of backward stochastic differential equation. Based on the characterizations of Pareto optimal solution, the game problem is transformed into a set of single objective optimal control problems with constraints of backward stochastic differential equations. In the first place, a necessary condition for Pareto optimal strategy is established by virtue of Ekeland's variational principle, and then, it is proved that the necessary condition is also sufficient under certain convex assumption. To shed light on the application of the abovementioned theoretical results, a linearquadratic game and a kind of optimal portfolio and consumption selection problem are also solved explicitly.
- **Opacity Enforcement in Discrete Event Systems Using Extended Insertion Functions Under Inserted Language Constraints**
  Authors: Xiaoyan Li ; Christoforos N. Hadjicostis ; Zhiwu Li
  Abstract: Opacity is a confidentiality property capturing the fact that certain secret behavior of a system cannot be revealed under any system evolution. Current-state opacity can be enforced by using an extended insertion mechanism, which is capable of inserting fake symbols before and after an actual output, in real time as the system evolves. This article studies the enforcement of current-state opacity for systems modeled by finite state automata using an extended insertion strategy under constraints on the way symbols can be inserted before and after an actual symbol generated by the system (e.g., constraints on the type, order, and number of inserted symbols). More specifically, we consider inserted language constraints captured by the notion of (L_b, L_a)-enforceability, where L_b is the set of strings that can be inserted before, and L_a is the set of strings that can be inserted after an observed event. If L_b and L_a are regular languages, a verifier is constructed to derive a necessary and sufficient condition for opacity enforceability, and also to formulate an extended insertion strategy (if viable).
- **Algorithmic Minimization of Uncertain Continuous-Time Markov Chains**
  Authors: Luca Cardelli ; Radu Grosu ; Kim Guldstrand Larsen ; Mirco Tribastone; Max Tschaikowski; Andrea Vandin
  Abstract: The assumption of perfect knowledge of rate parameters in continuous-time Markov chains (CTMCs) is undermined when confronted with reality, where they may be uncertain due to lack of information or because of measurement noise. Here, we consider uncertain CTMCs (UCTMCs), where rates are assumed to vary nondeterministically with time from bounded continuous intervals. A UCTMC can be, therefore, seen as a specific type of Markov decision process for which the analysis is computationally difficult. To tackle this, we develop a theory of minimization, which generalizes the notion of lumpability for CTMCs. Our first result is a quantitative and logical characterization of minimization. Specifically, we show that the reduced UCTMC model has a macrostate for each block of a partition of the state space, which preserves value functions and logical formulae whenever rewards are equal within each block. The second result is an efficient minimization algorithm for UCTMCs by means of partition refinement. As an application, we show that reductions in a number of CTMC benchmark models are robust with respect to uncertainties in original rates.
- **Constrained Control of Large Graph-Based MDPs Under Measurement Uncertainty**
  Authors: Ravi N. Haksar ; Mac Schwager
  Abstract: We consider controlling a graph-based Markov decision process (GMDP) with a control capacity constraint given only uncertain measurements of the underlying state. We also consider two special structural properties of GMDPs, called anonymous influence and symmetry. Large-scale spatial processes such as forest wildfires, disease epidemics, opinion dynamics, and robot swarms are well-modeled by GMDPs with these properties. We adopt a certainty-equivalence approach and derive efficient and scalable algorithms for estimating the GMDP state given uncertain measurements, and for computing approximately optimal control policies given a maximum-likelihood state estimate. We also derive suboptimality bounds for our estimation and control algorithms. Unlike prior work, our methods scale to GMDPs with large state-spaces and explicitly enforce a control

constraint. We demonstrate the effectiveness of our estimation and control approach in simulations of controlling a forest wildfire using a model with 10^{1192} total states.

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1.2. Automatica

Volume: 157, November 2023

- **Exactly optimal Bayesian quickest change detection for hidden Markov models**
  Authors: Jason J. Ford ; Jasmin James ; Timothy L. Molloy
  Abstract: This paper considers the quickest detection problem for hidden Markov models (HMMs) in a Bayesian setting. We construct an augmented HMM representation of the problem that allows the application of a dynamic programming approach to prove that Shiryaevs rule is an (exact) optimal solution. This augmented representation highlights the problems fundamental information structure and suggests possible relaxations to more exotic change event priors not appearing in the literature. Finally, this augmented representation allows us to present an efficient computational method for implementing the optimal solution.
- **Attraction domain analysis for steady states of Markovian open quantum systems**
  Authors: Shikun Zhang ; Guofeng Zhang
  Abstract: This article concerns the attraction domain analysis for steady states in Markovian open quantum systems, which are mathematically described by Lindblad master equations. The central question is proposed as: given a steady state, which part of the state space of density operators does it attract and which part does it not attract? We answer this question by presenting necessary and sufficient conditions that determine, for any steady state and initial state, whether the latter belongs to the attraction domain of the former. Furthermore, it is found that the attraction domain of a steady state is the intersection between the set of density operators and an affine space which contains that steady state. Moreover, we show that steady states without uniqueness in the set of density operators have attraction domains with measure zero under some translation invariant and locally finite measures. Finally, an example regarding an open Heisenberg XXZ spin chain is presented. We pick two of the systems steady states with different magnetization profiles and analyse their attraction domains.

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1.3. Nonlinear Analysis: Hybrid Systems

Volume: 50, November 2023

- **Approximate current state observability of discrete-time nonlinear systems under cyber-attacks**
  Authors: Giordano Pola ; Elena De Santis ; Maria Domenica Di Benedetto
  Abstract: Widespread use of the Internet and other means of communication has increased the risk of cyber-attacks that can affect the warranted operation of a system. To prevent damages from attacks, an assessment of its security plays an important role in providing fast and reliable solutions. This paper focuses on state estimation of nonlinear systems under attacks. We consider a plant represented by a discrete-time nonlinear system and an attacker modeled as a finite state machine. We propose a novel notion of observability, called approximate current state observability under attacks, which corresponds to the possibility of identifying the current state of the plant after a given transient despite the malicious action of an attacker that can replace the plant output symbols in the communication network infrastructure. To provide conditions for this property to hold, we resort to the use of formal methods and in particular, of symbolic models. Symbolic models provide an abstract description of purely continuous systems, where a symbolic state corresponds to an aggregate of continuous states in the original system. The approach we propose is particularly useful when dealing with cyber-security of continuous processes in that it offers a framework to deal with the heterogeneous models of the plant and the attacker. An academic example showing the applicability of the results presented is included.
- **Safety verification for Regime-Switching Jump Diffusions via barrier certificates**
  Authors: Kairong Liu ; Zhikun She

Abstract: It is well known that for a stochastic hybrid system, if its failure probability does not exceed a given safety threshold, the safety of the system can be guaranteed. Thus, in this paper, we concern with the upper bound of failure probability for failure analysis of a class of nonautonomous stochastic hybrid systems, denoted as Regime-Switching Jump Diffusions (RSJDs). We start with the definition of RSJDs, which contain not only continuous flows described by stochastic differential equations, but also instantaneous behavior described by Markovian switching and instantaneous behavior described by Lévy jump. Then we decompose the failure probability of RSJDs in $[t_0, +\infty)$ into two segments: one is defined over $[T, +\infty)$, and the other is defined over $[t_0, T]$. For failure probability over $[T, +\infty)$, by utilizing multiple vectorial barrier certificates, an asymptotically decreasing bound of failure probability with respect to T is established, where a general nonnegative matrix is used instead of a special nonnegative matrix defined by the exponent of essentially nonnegative matrix for a broader applicability. For failure probability over $[t_0, T]$, a generalized c-martingale condition is adopted to obtain a T-dependent failure probability bound, in which two non-negative scalar functions are utilized to relax the conservativeness of infinitesimal generators. Finally, for rational RSJDs, we transform the decomposed failure analysis problems into two semi-definite programming (SDP) problems, and then solve them via sum of squares programming. The applicabilities and effectiveness of our computable decomposition methodology are illustrated through three examples.

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

Volume: 53, Issue: 11, November 2023

- **A Robust Control Approach to AMSs by Using the Implementation of Strong and Weak Robustness**
  Authors: Xiaojun Wang ; Hesuan Hu
  Abstract: In automated manufacturing systems, the completion of all essential products must be guaranteed. Hence, each process of a system should have outputs. This outcome requires assurance that a system composed of a set of processes with shared and dedicated resources will operate smoothly. Shared resources can introduce deadlock problems through circular waits. In most methods to investigate the deadlock issues, shared and dedicated resources are assumed to never fail. However, the failure of one resource may cause the real crash of an entire system such that no finished products can output. Systems with unreliable resources are classified in this article into three types: 1) nonrobust systems; 2) weakly robust systems; and 3) strongly robust systems. A robust control method based on this classification is necessary for a system. Two approaches to robust control are developed. First, systems of sequential systems with shared and copied resources (S^4CRs), which is a new type of petri nets, is designed to strengthen the robustness of systems. It ensures that processes with unreliable resources complete their products. In addition, based on a deadlock-avoidance algorithm, a robustness algorithm is proposed. This ensures a system can operate without disruption under any situations.
- **Controllability of Cartesian Product Signed Networks**
  Authors: Bo Liu ; Mengjie Hu ; Junjie Huang ; Housheng Su
  Abstract: A necessary and sufficient algebraic condition is obtained for the controllability of a composite signed network consisting of two factor networks by Cartesian product, which reveals how the controllability of the higher-dimensional Cartesian product network is affected by the controllability of its smaller-scale low-dimensional factor networks. Furthermore, the structural balance of the Cartesian product network can be judged by the structural balance of its factor networks, which can greatly reduce amount of calculation to some extent. And the agents state evolution trajectories of Cartesian product networks can also be predicted by those of their factor networks. Moreover, the controllability of general signed networks is considered. Algorithms and numerical examples are exhibited to demonstrate the validity of our methods.

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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.

2.2 Invited Session at WODES'23–Resilience and Security of Discrete Event Systems

Organizer

- Romulo Meira-Goes, Assistant Professor, Penn State University, romulo@psu.edu
- Ilya Kovalenko, Assistant Professor, Penn State University, iqk5135@psu.edu
- Xiang Yin, Associate Professor, Shanghai Jiao Tong University, yinxiang@sjtu.edu.cn

Summary Statement

Driven by the needs of many different application domains, the field of Discrete Event Systems (DESs) has shown success in modeling and analyzing complex systems. In DES, the operation of systems is modeled in an event-based manner and only important details are considered in analyzing their operation. Recently, the field of DES has been used in engineering systems that combine physical processes controlled by computational infrastructures, denoted as Cyber-Physical Systems (CPS). The methods developed in DES were shown to help provide the necessary safety, security, and resilience guarantees for CPS. However, the ever-increasing demands for these properties in critical CPS put stringent constraints on their analysis and design. This invited session aims to tackle these challenges for the important class of CPS that can be modeled by DESs. This class of CPS includes applications in the areas of manufacturing systems, transportation systems, chemical systems, software engineering, etc.

The main objective for this invited session is to gather recently developed novel approaches devoted to the analysis, design, and enforcement of security and resilience properties using DES models. We seek submissions including but not limited to the following topics:

- Modeling and analysis of cyber-security of DES
- Applications of DES-based modeling and control for CPS resilience and security
- Analysis and design of DES under cyber-attacks
- Supervisory control and fault-tolerant control of networked DES
- Opacity, diagnosability, observability analysis of DES

Submission Code: 3afg1

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3 Conferences

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

3.1 **2023 IEEE Conference on Decision and Control (CDC)**
Singapore, December 13-15, 2023.
https://cdc2023.ieeecss.org/

3.2 **2024 IFAC Workshop on Discrete Event Systems (WODES)**
Rio de Janeiro, Brazil, April 29-May 1, 2024.
https://wodes2024.eventos.ufrj.br

3.3 **2024 IFAC Conference on Analysis and Design of Hybrid Systems (ADHS)**
Boulder, Colorado, July 1-3, 2024.
https://www.colorado.edu/conference/adhs2024/

3.4 **2024 American Control Conference (ACC)**
Toronto, Canada, July 8-12, 2024.
https://acc2024.a2c2.org/

3.5 **2024 International Conference on Automation Science and Engineering (CASE)**
Bari, Italy, August 28-September 1, 2024.
https://2024.ieeecase.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 1.0 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 September 2023, ESCET version 1.0 has been released and can be downloaded from https://www.eclipse.org/escet/download.html. The main changes in this version are

- The Eclipse ESCET project has graduated. The project has left the 'incubation' phase, and has entered the 'mature' phase. In honor of this occasion, we leave the '0.x' version numbering behind. All indications of the incubation phase have been removed. This also leads to changes in download filenames.
- The CIF language now features annotations that can be used to annotate elements of the specification with extra information. The CIF toolset now comes bundled with the doc annotation. Annotations are currently an experimental work-in-progress language feature. Their design may change in a backward incompatible manner.
- The CIF controller checker had a performance regression since version 0.7 in case finite response is checked and confluence is not checked. This performance regression has been fixed.
- The CIF to Supremica transformation now correctly transforms multiple guards on an edge. Multiple guards are now combined into a single conjunction.
- The CIF data-based synthesis tools workset algorithm now has improved edge selection heuristics, improving the performance of the workset algorithm. Its documentation has been improved to better explain when to use and not to use the workset algorithm. Also, the workset algorithm is no longer considered experimental.

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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