IEEE Control Systems Society
Technical Committee on Discrete Event Systems

Newsletter **June 2023**

Editor: Xiang Yin
Chair, IEEE CSS Technical Committee on DES
Associate Professor
Department of Automation, Shanghai Jiao Tong University
SEIEE Building 2-443, Dongchuan Rd 800, Shanghai, 200240, China

Phone: (+86) 021-34204022
Email: yinxiang@sjtu.edu.cn
Website: http://xiangyin.sjtu.edu.cn

Welcome to the 2023 June 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: 6, June 2023

- **Reactive Symbolic Planning and Control in Dynamic Adversarial Environments**
  Authors: Laya Shamgah ; Tadewos G. Tadewos ; Abdullah Al Redwan Newaz ; Ali Karimoddini; Albert C. Esterline
  Abstract: Satisfying both safety and reachability requirements in dynamic adversarial environments is very challenging, particularly when little or no information about the dynamics and intentions of the adversarial objects is available. Therefore, this article addresses the problem of path planning and control of autonomous vehicles in a dynamic adversarial reachavoid scenario with two noncooperative vehicles and their competitive objectives: 1) "reaching a target and avoiding the other vehicle" for one of them, called attacker, and 2) "protecting the target and capturing the opponent vehicle" for the other one, called defender. In the proposed solution, first, a discrete version of the problem is formulated and solved using linear temporal logic, temporal games, and μ-calculus to construct winning discrete strategies that guarantee safety and reachability. A comprehensive discussion on the existence, correctness, and complexity analysis of the solution is also provided. Finally, a novel correct-by-design hybrid controller is designed to generate smooth control signals that preserve the satisfaction of safety and reachability.
- **Synthesis of the Supremal Covert Attacker Against Unknown Supervisors by Using Observations**
  Authors: Ruochen Tai ; Liyong Lin ; Yuting Zhu ; Rong Su
  Abstract: In this article, we consider the problem of synthesizing the supremal covert damage-reachable attacker, in the setup where the model of the supervisor is unknown to the adversary but the adversary has recorded a (prefix-closed) finite set of observations of the runs of the closed-loop system. The synthesized attacker needs to ensure both the damage-reachability and the covertness against all the supervisors, which are consistent with the given set of observations. There is a gap between the de facto supremality, assuming the model of the supervisor is known, and the supremality that can be attained with a limited knowledge of the model of the supervisor, from the adversary's point of view. We consider the setup where the attacker can exercise sensor replacement/deletion attacks and actuator enablement/disablement attacks. The solution methodology proposed in this article is to reduce the synthesis of the supremal covert damage-reachable attacker, given the model of the plant and the finite set of observations, to the synthesis of the supremal safe supervisor for certain transformed plant, which shows the decidability of the observation-assisted covert attacker synthesis problem. The effectiveness of our approach is illustrated on a water tank example adapted from the literature.
- **Maximally Permissive Supervisors for Nonblocking Similarity Control of Nondeterministic Discrete-Event Systems**
  Authors: Jinglun Li ; Shigemasa Takai
  Abstract: This article investigates a nonblocking similarity control problem for nondeterministic discrete-event systems, which is a problem of synthesizing a nonblocking supervisor such that the supervised system is simulated by the given specification. In this article, the state of the system is not required to be observable, and the event occurrence is allowed to be partially observed. We propose an algorithm that computes a nonblocking supervisor from a possibly blocking one by iteratively removing certain states. Then, we identify two key properties of input supervisors, named state-unmergedness and strong maximal permissiveness, which together guarantee the maximal permissiveness of output nonblocking supervisors. The algorithm is applied to a supervisor with these two properties to obtain a maximally permissive nonblocking supervisor. In addition, we show that a nonblocking supervisor is generated by the algorithm if and only if there exists a solution to the nonblocking similarity control problem.
- **Receding Horizon Control With Online Barrier Function Design Under Signal Tem-**

poral Logic Specifications
Authors: Maria Charitidou ; Dimos V. Dimarogonas
Abstract: Signal temporal logic (STL) has been found to be an expressive language for describing complex, time-constrained tasks in several robotic applications. Existing methods encode such specifications by either using integer constraints or by employing set invariance techniques. While in the first case this results in a mixed integer linear program (MILP), control problems, in the latter case, designer-specific choices may induce conservatism in the robot's performance and the satisfaction of the task. In this article, a continuous-time receding horizon control scheme (RHS) is proposed that exploits the tradeoff between task satisfaction and performance costs such as actuation and state costs, traditionally considered in RHS schemes. The satisfaction of the STL tasks is encoded using time-varying control barrier functions that are designed online, thus avoiding the integer expressions that are often used in literature. The recursive feasibility of the proposed scheme is guaranteed by the satisfaction of a time-varying terminal constraint that ensures the satisfaction of the task with predetermined robustness. The effectiveness of the method is illustrated in a multirobot simulation scenario.

- **Smoother Entropy for Active State Trajectory Estimation and Obfuscation in POMDPs**
Authors: Timothy L. Molloy ; Girish N. Nair
Abstract: In this article, we study the problem of controlling a partially observed Markov decision process (POMDP) to either aid or hinder the estimation of its state trajectory. We encode the estimation objectives via the smoother entropy , which is the conditional entropy of the state trajectory given measurements and controls. Consideration of the smoother entropy contrasts with previous approaches that instead resort to marginal (or instantaneous) state entropies due to tractability concerns. By establishing novel expressions for the smoother entropy in terms of the POMDP belief state, we show that both the problems of minimizing and maximizing the smoother entropy in POMDPs can surprisingly be reformulated as belief-state Markov decision processes with concave cost and value functions. The significance of these reformulations is that they render the smoother entropy a tractable optimization objective, with structural properties amenable to the use of standard POMDP solution techniques for both active estimation and obfuscation. Simulations illustrate that optimization of the smoother entropy leads to superior trajectory estimation and obfuscation compared to alternative approaches.
- **On Liveness Enforcement of Distributed Petri Net Systems**
Authors: Daniel Clavel ; Cristian Mahulea ; Manuel Silva
Abstract: In this article, we consider the liveness enforcement problem in a class of Petri nets (PNs) modeling distributed systems. They are called synchronized sequential processes . The presented design algorithm is based on the construction of a control PN, an abstraction of the relations of the T-semiflows, and buffers of the original nonstructurally live PN. The control PN evolves in parallel with the system, avoiding the firing of transitions that may lead the system to nonliveness. Four algorithms are presented, one allowing for the computation of the control PN and three ensuring its liveness.
- **The Model Matching Problem for Max-Plus Linear Systems: A Geometric Approach**
Authors: Davide Animobono ; David Scaradozzi ; Elena Zattoni ; Anna Maria Perdon ; Giuseppe Conte
Abstract: Linear systems over the max-plus algebra provide a suitable formalism to model discrete-event systems where synchronization, without competition, is involved. In this article, we consider a formulation of the model matching problem for systems of such class, in which the output of a given system, called the plant, is forced, by a suitable input, to track exactly that of a given model. A necessary and sufficient condition for its solvability is obtained by making a suitable use of geometric methods in the framework of systems over the max-plus algebra.

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1.2. Automatica
Volume: 152, June 2023

- **Differential privacy for symbolic systems with application to Markov Chains**

Authors: Bo Chen ; Kevin Leahy ; Austin Jones ; Matthew Hale
Abstract: Data-driven systems are gathering increasing amounts of data from users, and sensitive user data requires privacy protections. In some cases, the data gathered is non-numerical or symbolic, and conventional approaches to privacy, e.g., adding noise, do not apply, though such systems still require privacy protections. Accordingly, we present a novel differential privacy framework for protecting trajectories generated by symbolic systems. These trajectories can be represented as words or strings over a finite alphabet. We develop new differential privacy mechanisms that approximate a sensitive word using a random word that is likely to be near it. An offline mechanism is implemented efficiently using a Modified Hamming Distance Automaton to generate whole privatized output words over a finite time horizon. Then, an online mechanism is implemented by taking in a sensitive symbol and generating a randomized output symbol at each timestep. This work is extended to Markov chains to generate differentially private state sequences that a given Markov chain could have produced. Statistical accuracy bounds are developed to quantify the accuracy of these mechanisms, and numerical results validate the accuracy of these techniques for strings of English words.

- **Formal methods to comply with rules of the road in autonomous driving: State of the art and grand challenges**
Authors: Noushin Mehdipour ; Matthias Althoff ; Radboud Duintjer Tebbens ; Calin Belta
Abstract: We provide a review of recent work on formal methods for autonomous driving. Formal methods have been traditionally used to specify and verify the behavior of computer programs and digital circuits. Enabled by abstraction techniques for dynamical systems and the availability of verification and synthesis tools for finite systems, they have been adopted by the control and robotics communities. In particular, in autonomous driving, recent research proposes formal languages such as temporal logics to specify driving behaviors ranging from safety, such as collision avoidance, to compliance with complex rules of the road. Our review focuses on formal verification, monitoring, and synthesis techniques enabling autonomous vehicles to adhere to such specifications. We only consider works about system-level methods that have an ego-centric perspective, i.e., we focus on the behavior of an autonomous vehicle in its entirety, rather than specific software code within the vehicle or traffic networks consisting of multiple vehicles. This paper also identifies the main remaining challenges.

- **Assessment of initial-state-opacity in live and bounded labeled Petri net systems via optimization techniques**
Authors: Francesco Basile ; Gianmaria De Tommasi ; Carlo Motta
Abstract: Opacity is a property of discrete event systems (DES) that is related to the possibility of hiding a secret to external observers, the so called intruders. If the secret is the system initial state, then the related opacity problem is referred to as Initial State Opacity (ISO). This paper gives a necessary and sufficient condition to check ISO in DES modeled as bounded and live labeled Petri nets (PNs). The proposed approach relies on both the algebraic representation of labeled PNs dynamic, and on their structural representation in terms of minimal support T-invariants. The proposed necessary and sufficient condition enables ISO assessment by means of the solution of Integer Linear Programming problems, which can be efficiently solved nowadays by means of off-the-shelf optimization tools.

- **Polynomial-time verification for bisimilarity control of partially observed nondeterministic discrete event systems with deterministic specifications**
Authors: Shigemasa Takai
Abstract: We consider a bisimilarity control problem for partially observed nondeterministic discrete event systems. It requires us to synthesize a supervisor that works under partial observation so that the supervised system is bisimilar to the specification. The computational complexity of verifying the known necessary and sufficient condition for the existence of such a supervisor is exponential in the numbers of states of the system and the specification. We show that, in a special case where the specification is deterministic, the existence of a supervisor that solves the bisimilarity control problem is polynomially verified.

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1.3. IEEE Control Systems Letter
Volume: 7, Issue: 5, June 2023

- **Removing Two Fundamental Assumptions in Verifying Strong Periodic (D-)Detectability of Discrete-Event Systems**
  Authors: Kuize Zhang
  Abstract: In this letter, in discrete-event systems modeled by labeled finite-state automata (LFSAs), we show new thinking on the tools of detector and concurrent composition and derive two new algorithms for verifying strong periodic detectability (SPD) without any assumption that run in NL ; we also reconsider the tool of observer and derive a new algorithm for verifying strong periodic D-detectability (SPDD) without any assumption that runs in PSPACE. These results strengthen the NL upper bound on verifying SPD and the PSPACE upper bound on verifying SPDD for deadlock-free and divergence-free LFSAs in the literature. In our algorithms, the two assumptions are removed by verifying the negations of these properties.

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1.4. Systems & Control Letters
Volume: 176, June 2023

- **Probabilistic verification of diagnosability for a certain class of timed stochastic systems**
  Authors: Dimitri Lefebvre ; Christoforos N. Hadjicostis
  Abstract: This paper addresses diagnosability for a class of timed stochastic discrete event systems that are modeled with labeled continuous time Markov models. A large variety of fault patterns is considered and the paper aims to define and propose conditions for weak notions of diagnosability of fault patterns in a time stochastic framework. The proposed approach is based on a state isolation perspective. Logical and probabilistic verifiers that result by first taking the product of the system with the fault pattern, followed by the parallel composition of the resulting structure with its logical observer are designed in this perspective. The advantage of this schema is to separate explicitly the system from the pattern we are interested in, as well as from the sensoring and observational aspects. Consequently, the verifiers allow the explicit tracking of the information about the first occurrence of a fault pattern and the preservation of not only the logical information provided by the labeling function but also the timing aspects imposed by the dynamics of the system.

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1.5. IEEE Transactions on Cybernetics
Volume: 53, Issue: 6, June 2023

- **Maximum-Likelihood State Estimators in Probabilistic Boolean Control Networks**
  Authors: Mitsuru Toyoda ; Yuhu Wu
  Abstract: This study addresses state estimation problems for probabilistic Boolean control networks (PBCNs). Compared with deterministic Boolean networks, PBCNs have the stochastic switching in logical update functions in the state equation. Consequently, statistical analysis is required to estimate unavailable states, which induces an optimization problem called maximum-likelihood estimation. This article mainly focuses on two scenarios: 1) state estimation from partially measured state and 2) state estimation from output data, meaning observer design. The resulting optimization problems are solved using efficient algorithms based on dynamic programming. Concurrently, Dijkstra-type algorithms, which solve equivalent shortest path problems, are also proposed using best-first search. Furthermore, both the proposed algorithms derive novel observer design methods for PBCNs. The proposed algorithms are evaluated with practical estimation problems aiming to the sensor reduction and applied to gene regulatory networks of apoptosis and Lac operon.

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1.6. IEEE Transactions on Systems, Man, and Cybernetics: Systems
Volume: 53, Issue: 6, June 2023

- **An Efficient Scheduling Method for Single-Arm Cluster Tools With Multifunctional Process Modules**
  Authors: WenQing Xiong ; Jie Li ; Yan Qiao ; LiPing Bai ; BaoYing Huang; NaiQi Wu
  Abstract: Nowadays, cluster tools are extensively used for many wafer manufacturing processes, such as coating, lithograph, developing, etching, deposition, and testing. Traditional process modules in cluster tools can execute a single operation only. With the rapid development of equipment design, multifunctional process modules (MPMs) are equipped to serve for processing multiple operations together just like a single operation. With different wafer processing parameters, MPMs may be set for processing multiple operations together or processing just a single operation to form different schedules so as to maximize the productivity. Thus, it is highly desired to find an efficient scheduling method to quickly adapt to wafer processing parameter changes for productivity maximization by taking the advantages of MPMs. To tackle this issue, a deadlock-free Petri net (PN) model is developed to describe the behavior of a single-arm cluster tool. Based on the evolving mechanism of the PN model, two algorithms are developed to calculate the makespan for completing a given number of wafers. Then, an adaptive scheduling method is presented to set the functions of MPMs to minimize the makespan. Finally, experimental results show the efficiency and effectiveness of the proposed method.
- **On Quantitative Properties Preservation in Reconfigurable Generalized Stochastic Petri Nets**
  Authors: Samir Tigane ; Laid Kahloul ; Nadia Hamani ; Mohamed Khalgui ; Masood Ashraf Ali
  Abstract: Generalized stochastic Petri nets (GSPNs) have been extended to several dynamic-structure formalisms providing suitable tools for the modeling and verification of reconfigurable discrete-event systems (R-DESs). However, analyzing the performance of large-complex R-DESs remains a big challenging issue. Indeed, dynamic-structure GSPNs still rely on old-fashioned techniques often causing the state-space explosion problem. In this article, we present a new technique for the quantitative analysis of a dynamic-structure formalism called reconfigurable GSPNs without computing the whole state space. This work describes new reconfiguration forms used to preserve desired quantitative properties of parts of interest after each reconfiguration. Therefore, it is only required to verify the examined properties at an initial configuration. The proposed technique is proven to effectively reduce the state space and shorten the computation time in such cases. Finally, some experimental results are provided to illustrate that, from a computational perspective, the developed approach outperforms the existing tools.
- **Immediate Transitions in Timed Continuous Petri Nets: Performance Evaluation and Control**
  Authors: Carlos Renato Vazquez ; Enrique Aguayo-Lara
  Abstract: Timed continuous Petri nets (TCPNs) are continuous-state dynamical systems that were originally defined to approximate the behavior of timed discrete event systems. In particular, it has been shown in the literature that TCPNs approximate the average marking and throughput of a class of generalized stochastic Petri nets (GSPNs), a well-known model used for the performance evaluation analysis of manufacturing, communication, logistic and traffic systems, among others. In this work, the TCPN model is enriched with immediate transitions, which represent very fast events, resulting in a new model denoted as TCPN+I. Then, a fast simulation algorithm for TCPN+Is is introduced. Nevertheless, the introduction of continuous immediate transitions leads to ill-conditioned problems when analyzing the TCPN+I model. For such reason, a couple of procedures are, here, introduced to transform a TCPN+I model into a set of dynamically equivalent TCPNs, by removing the immediate transitions, allowing, thus, the application of analysis techniques and methods already proposed in the literature for TCPN systems. The application of the results introduced in this work for performance evaluation and model predictive control is illustrated through a manufacturing example.

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2 Conferences

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

2.1 **2023 IFAC World Congress (IFAC)**
Yokohama, Japan, July 9-14, 2023
https://www.ifac2023.org/

2.2 **2023 IEEE Conference on Control Technology and Applications (CCTA)**
Bridgetown, Barbados, August 16-18, 2023.
https://ieeeccta.org/

2.3 **2023 IEEE International Conference on Automation Science and Engineering (CASE)**
Auckland, New Zealand, August 26-29, 2023.
https://case2023.org/

2.4 **2023 IEEE International Conference on Systems, Man, and Cybernetics (SMC)**
Maui, Hawaii, October 14, 2023.
https://ieeesmc2023.org/

2.5 **2023 IEEE Conference on Decision and Control (CDC)**
Singapore, December 13-15, 2023.
https://cdc2023.ieeecss.org/

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3 Books

3.1 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

3.2 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

3.3 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

3.4 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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4 Software Tools

4.1 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.

4.2 Eclipse ESCET™ version 0.9 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 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.

4.3 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.

4.4 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.

4.5 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.

4.6 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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5 Open Positions

5.1 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.

5.2 Open PhD position in Centre Automatique et Systemes (MINES Paris, France) and IFPEN (Lyon, France)

PhD Title: Control strategies for a wind farm based on a simplified dynamical wake modeling for optimal management of energy management and fatigue mitigation

Department: Digital Science and Technology Division, in Solaize (Lyon, France)

FPEN advisors:

- Main advisor: COLLET David (david.collet@ifpen.fr), control, signal, and systems department
- Co-advisors:
  Olivier Lepreux, PhD, solid mechanics department
  Frédéric Blondel, PhD, fluid mechanics department

Academic advisors:

- Florent Di Meglio, HDR, Head of Centre Automatique et Systèmes, MINES Paris PSL (florent.di$_m$*eglio@minesparis.psl.eu*)
- Delphine Bresch-Pietri, Professor at Centre Automatique et Systèmes, MINES Paris PSL (delphine.bresch-pietri@minesparis.psl.eu)

IFP Energies nouvelles (IFPEN) is a major research and training player in the fields of energy, transport and the environment. From research to industry, technological innovation is central to all its activities, structured around three strategic priorities: sustainable mobility, new energies and responsible oil and gas.

In the field of wind energy, operators are now focusing on using wind turbines located in wind farms in the best possible way, to either produce the maximum energy possible, or produce the right amount of energy at the right time, to meet power grid requirements while limiting the wind turbine mechanical stress, in order to eventually minimize the cost of energy. It is possible to limit the interactions between a turbine wake and the downwind turbines by controlling its yaw angle and power produced, and thus alleviating the production losses and mechanical fatigue. In this context, our central question will be How to robustly minimize a wind farm cost of energy via a control algorithm using a dynamic wind farm flow model, and how to implement it in real world?. Indeed, the implementation in real world, dynamic wind farm flow model and cost of energy minimization aspect of things are very important.

On one hand, most of current works focus on cases where the farm is operated in normal conditions, whereas it is of primal importance to detect and manage cases where the farm is in abnormal operating conditions, for a robust real-world implementation.

On the other hand, most of the works are using steady state models for wind farm control. Therefore, the capacity to derive an optimal control problem, relying on innovative dynamic wind farm flow models, constitutes an important contribution of the thesis.

Eventually, some recent works had as an objective to either maximize energy production, either regulate power production with wind turbines load alleviation as secondary objective. However, very few

contributions focused on the explicit minimization of energy cost, which is one of the main drivers for operators.

The PhD results will contribute to three majors advances:

1. Develop wind farm control strategies based on a time-varying wake modeling and evaluate their added value;
2. Define a cost criterion allowing to efficiently minimize the cost of energy over long time horizons. to the implementation and deployment of the developed control algorithms and prove and illustrate their robustness and efficiency.

The candidate must be graduated of a master's degree in mathematics or mechanical engineering with a preferred specialization in automatic, optimization or signal processing.

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