IEEE Control Systems Society
Technical Committee on Discrete Event Systems

Newsletter November 2022

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Editorial

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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: 67, Issue: 11, November 2022

- **On Observability of Hybrid Systems**
  Authors: Feng Lin ; Le Yi Wang ; Wen Chen ; Michael P. Polis
  Abstract: Observability of a hybrid system is defined as the ability to determine the continuous state of the system. Whether a hybrid system is observable or not depends on which events can be disabled, which events can be forced, and the connectivity of the discrete states, as well as its continuous dynamics. We model a hybrid system using a hybrid machine that takes into consideration both continuous variables and discrete events. We classify hybrid systems into four classes based on their discrete-event parts. For each class, conditions are derived to check observability. If a hybrid system is not observable, then we check if a weaker version of observability, called B-observability, is satisfied. B-observability requires that a hybrid system become observable after some finite occurrences of events. Conditions are derived to check B-observability. These conditions involve both the discrete-event and continuous-variable parts of hybrid systems. If the continuous-variable part of a system has a constant-A matrix, then the conditions for the continuous-variable part can be simplified. We illustrate the results by an example of a battery management system of an electric vehicle.
- **Observability Criteria for Boolean Networks**
  Authors: Yongyuan Yu ; Min Meng ; Jun-e Feng ; Ge Chen
  Abstract: This article investigates observability of Boolean control networks (BCNs) and probabilistic Boolean networks (PBNs). First, weak observability of BCNs is discussed via the nonaugmented approach. The obtained result is then applied to determine (asymptotic) observability of PBNs. Finally, complexity of algorithms based on new criteria is analyzed. Compared with existing ones, time and space complexity do not get worse, even are improved under some mild conditions.
- **Quotients of Probabilistic Boolean Networks**
  Authors: Rui Li ; Qi Zhang ; Tianguang Chu
  Abstract: A probabilistic Boolean network (PBN) is a discrete-time system composed of a collection of Boolean networks between which the PBN switches in a stochastic manner. This article focuses on the study of quotients of PBNs. Given a PBN and an equivalence relation on its state set, we consider a probabilistic transition system that is generated by the PBN; the resulting quotient transition system then automatically captures the quotient behavior of this PBN. We therefore describe a method for obtaining a probabilistic Boolean system that generates the transitions of the quotient transition system. Applications of this quotient description are discussed, and it is shown that for PBNs, controller synthesis can be performed easily by first controlling a quotient system and then lifting the control law back to the original network. A biological example is given to show the usefulness of the developed results.

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1.2. Automatica

Volume: 145, November 2022

- **Online verification of K-step opacity by Petri nets in centralized and decentralized**
  Authors: Guanghui Zhu ; Zhiwu Li ; Naiqi Wu
  Abstract: This paper presents an online approach to deal with the problem of state-based K-step opacity of a discrete event system modeled with labeled Petri nets. The secret states can be described by a set of either markings or generalized mutual exclusion constraints (GMECs), which is more general than the existing approaches in which the secret states are characterized by GMECs only. We formulate an integer linear programming (ILP) model to find a marking outside the set of secret states from each of the *K-delayed state estimates*, avoiding a complete enumeration of reachability set. Based on the ILP model, an online algorithm is developed to verify K-step opacity

of an observation (i.e., an observed sequence). As an extension of K-step opacity, we define the notion of *joint K-step opacity* in a decentralized structure with two local sites and extend the proposed algorithm to verify the joint -step opacity of an observation. In addition, the relationship between joint K-step opacity and K-step opacity is formally discussed.

- **Compositional construction of control barrier functions for continuous-time stochastic hybrid systems**
  Authors: Ameneh Nejati ; Sadegh Soudjani ; Majid Zamani
  Abstract: In this work, we propose a compositional framework for the construction of control barrier functions for networks of continuous-time stochastic hybrid systems enforcing complex logic specifications expressed by finite-state automata. The proposed scheme is based on a notion of so-called *pseudo-barrier functions* computed for subsystems, by employing which one can synthesize hybrid controllers for interconnected systems enforcing complex specifications over a finite-time horizon. Particularly, we first leverage sufficient small-gain type conditions to compositionally construct control barrier functions for interconnected systems based on the corresponding pseudo-barrier functions computed for subsystems. Then, using the constructed control barrier functions, we provide probabilistic guarantees on the satisfaction of given complex specifications in a bounded time horizon. In this respect, we decompose the given complex specification to simpler reachability tasks based on automata representing the complements of original finite-state automata. We then provide systematic approaches to solve those simpler reachability tasks by computing corresponding pseudo-barrier functions. Two different systematic techniques are provided based on (i) the sum-of-squares (SOS) optimization program and (ii) counter-example guided inductive synthesis (CEGIS) to search for pseudo-barrier functions of subsystems while synthesizing local controllers. We demonstrate the effectiveness of our proposed results by applying them to a *fully-interconnected* Kuramoto network of 100 nonlinear oscillators with Markovian switching signals.

- **Robust approximate symbolic models for a class of continuous-time uncertain nonlinear systems via a control interface**
  Authors: Pian Yu ; Dimos V. Dimarogonas
  Abstract: Discrete abstractions have become a standard approach to assist control synthesis under complex specifications. Most techniques for the construction of a discrete abstraction for a continuous-time system require timespace discretization of the concrete system, which constitutes property satisfaction for the continuous-time system non-trivial. In this work, we aim at relaxing this requirement by introducing a control interface. Firstly, we connect the continuous-time uncertain concrete system with its discrete deterministic state-space abstraction with a control interface. Then, a novel stability notion called η-approximately controlled globally practically stable, and a new simulation relation called robust approximate simulation relation are proposed. It is shown that the uncertain concrete system, under the condition that there exists an admissible control interface such that the augmented system (composed of the concrete system and its abstraction) can be made η-approximately controlled globally practically stable, robustly approximately simulates its discrete abstraction. The effectiveness of the proposed results is illustrated by two simulation examples.

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1.3. Annual Reviews in Control

Volume: 54, November 2022

- **Online control of discrete-event systems: A survey**
  Authors: Richard Hugh Moulton ; Karen Rudie
  Abstract: In control theory, as in other areas of engineering research, there is an inherent tension between the breadth of a techniques applicability and its mathematical tractability. For the area of discrete-event systems (DES), this manifested itself in a theory of supervisory control that originally provided correct-by-construction guarantees for offline solutions to a restricted kind of deterministic process. Follow-on work extended the reach of these techniques to a number of new settings, notably the development of online control without sacrificing any of the original DES performance guarantees. The ability to enact online control opened the door to applying DES techniques to the

adaptive control processes presented by modern technologies: processes with dynamic and time-varying natures, whose characteristics may be understood poorly or not at all. Although many works have built on the seminal work of online control in DES, we believe that these ideas have not reached their full potential due to the difficulty in translating them to adjacent fields. In this survey, we look back at 30 years of research concerning the online control of DES and closely related limited lookahead policies with an eye to making the works accessible to practitioners in the broader control theory and artificial intelligence communities. We conclude with some thoughts on future research directions for the further development and application of online DES control techniques to problems requiring intelligent control in our modern world.

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1.4. IEEE Transactions on Control Systems Technology

Volume: 30, Issue: 6, November 2022

- **A Discrete-Event System Approach for Modeling and Mitigating Power System Cascading Failures**

  Authors: Wasseem Al-Rousan ; Caisheng Wang ; Feng Lin

  Abstract: A power system cascading failure can propagate through sequential tripping of components in the network. As a result, a complete or partial shutdown may occur. In this article, we develop a new systematic approach to identify and prevent cascading failures in power systems using supervisory control of discrete-event systems (DESs). We build the DES model for a power system in a modular fashion by first modeling its components as (small) automata and then combining these automata using parallel composition. To overcome state explosion, we use online lookahead control that can significantly reduce the number of states to be considered. Since some events such as line trips cannot be disabled but can be preempted by forcing some forcible events such as load shedding, we extend supervisory control of DES to include forcible events. This extension allows us to control power systems effectively. The proposed control is implemented in an implementation platform that we build in MATLAB. The platform uses MATPOWER to simulate a power system and then control it using the proposed DES controller. Simulation studies are carried out for IEEE 6-, 30-, and 118-bus systems. The results verify the effectiveness of the proposed approach.

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1.5. IEEE Transactions on Automation Science and Engineering

Volume: 19, Issue: 4, November 2022

- **Decentralized Failure Prognosis of Stochastic Discrete-Event Systems and a Test Algorithm**

  Authors: Weihua Cao ; Fuchun Liu ; Rui Zhao

  Abstract: Recently, the study of fault diagnosis and prognosis of discrete-event systems (DESs) has received considerable attention. This article aims to investigate the decentralized fault prognosis of stochastic DESs (SDESs). The notion of m-step stochastic-coprognosability, called S_m-coprognosability, is formalized to capture the capability of stochastic systems to predict a fault at least m steps in advance under the decentralized framework. The verifier is constructed from the stochastic decentralized system, in which n local prognosers are deployed to send the local prognostic decisions to a coordinator for calculating the final prognostic decision. In particular, a necessary and sufficient condition of S_m-coprognosability of stochastic systems is derived, and an algorithm for testing S_m-coprognosability is given, which is polynomial to the number of states and events but exponential to the number of local sites. Furthermore, the maximum number of m for making the given SDES to be S_m-coprognosable is discussed.

  Note to Practitioners: This article extends the fault prognosis methods of SDESs from centralized framework to decentralized framework, such that for many technologically complex systems whose information collection is scattered in physically separated different sites, every local site makes decision based on information collected by own sensors, without communicating with other local sites, which is more appropriate than the centralized method.

- **Robustness Analysis of Automated Manufacturing Systems With Unreliable Resources Using Petri Nets**
  Authors: Benyuan Yang ; Hesuan Hu
  Abstract: This paper studies the maximally permissive robustness analysis of automated manufacturing systems (AMSs) with unreliable resources in the paradigm of Petri nets (PNs). Two types of robust markings, i.e., strongly robust markings and weakly robust markings, are defined in this paper. We propose robustness equivalence and non-robustness equivalence to characterize the markings that exhibit the same robustness and non-robustness, respectively. Reachability graph (or RG hereafter) is directly used to determine the robustness of markings; however, it is difficult to use in large-scale systems due to formidable computational difficulty. As an alternative, we present a reduced reachability graph (or R2G hereafter) based necessary and sufficient condition to check the robustness of markings, in terms of the liveness analysis of markings in R2G. We show that all safe markings of an R2G correspond to strongly robust markings of the corresponding RG, and deadlock markings as well as their bad markings and livelock markings as well as their bad markings of an R2G correspond to non-robust markings and weakly robust markings of the corresponding RG, respectively. Hence, the robustness of markings in an RG can be determined effectively and efficiently through the liveness analysis of markings in the corresponding R2G.
  Note to Practitioners: In practical manufacturing scenarios, it is urgent to analyze and control the automated manufacturing systems (AMSs) so as to ensure their continual production against any resource failure. If the failures of an AMS are not handled gracefully, the whole system may fall into a blocking. As a consequence, system production does not meet rapid manufacturing goals and objectives. In this paper, we focus on the maximally permissive robustness analysis of AMSs with unreliable resources in the paradigm of Petri nets. We define two types of robustness in terms of markings, i.e., strong robustness and weak robustness. From the viewpoint of reachability graph, we propose robustness equivalence and non-robustness equivalence among markings and present the procedures to check the robustness of markings. Furthermore, a set of necessary and sufficient conditions are established to provably ensure that the robustness of markings can be determined through liveness analysis in a reduced reachability graph. Therefore, the robustness of markings can be determined in a computationally efficient way.
- **Maximally Permissive Deadlock and Livelock Avoidance for Automated Manufacturing Systems via Critical Distance**
  Authors: Benyuan Yang ; Hesuan Hu
  Abstract: The problem under consideration in this paper is how to avoid deadlocks and livelocks in the paradigm of Petri nets (PNs). Although deadlock and livelock avoidance has been extensively studied in existing literature, fewer results can be applied to practical automated manufacturing systems (AMSs) due to expensive computations and reduced permissiveness. In this paper, we propose an efficient and maximally permissive control scheme to avoid deadlocks and livelocks by using critical distance. From the perspective of the reachability graph of a PN, critical distance is equal to the maximum number of transitions among all transition sequences from any critical state to its corresponding deadlock or livelock state. First, we show how to calculate the critical distance of a PN in an efficient way by using a portion of reachable states. Then, local reachability graphs are established based on critical distance to avoid deadlocks and livelocks. The provided policy is maximally permissive since only the necessary minimum number of illegal transitions are forbidden at each state. Several representative examples are presented to illustrate our approach.
  Note to Practitioners: Deadlock and livelock avoidance is a crucial problem in automated manufacturing systems (AMSs). Various methods have been proposed to deal with deadlocks and livelocks by researchers and practitioners. However, there exist fewer works that focus on deep exploration regarding how long a deadlock or livelock will occur from a safe state. As a consequence, the existing works suffer from the disadvantages of being too aggressive or conservative, i.e., checking the whole state space or forbidding many acceptable states when avoiding deadlocks and livelocks. Through the analysis of a partial of reachable states, this paper derives the critical distance of Petri nets modeling AMSs, which is equal to the maximum number of transitions among all transition sequences from any critical marking to its corresponding deadlock or livelock marking. All deadlocks and livelocks, if exist, can be detected at any given marking within the

critical distance. Our approach not only is maximally permissive but also explores only a partial of states, thereby mitigating state explosion problem.

- **Data-Driven Fault Detection in Industrial Batch Processes Based on a Stochastic Hybrid Process Model**
  Authors: Stefan Windmann
  Abstract: This paper presents a novel fault detection approach for industrial batch processes. The batch processes under consideration are characterized by the interaction between discrete system modes and non-stationary continuous dynamics. Therefore, a stochastic hybrid process model (SHPM) is introduced, where process variables are modeled as time-variant Gaussian distributions, which depend on hidden system modes. Transitions between the system modes are assumed to be either autonomous or to be triggered by observable events such as on/off signals. The model parameters are determined from training data using expectation-maximization techniques. A new fault detection algorithm is proposed, which assesses the likelihoods of sensor signals on the basis of the stochastic hybrid process model. Evaluation of the proposed fault detection system has been conducted for a penicillin production process, with the results showing a significant improvement over the existing baseline methods.
  Note to Practitioners: Automatic fault detection makes it possible to limit the effects of faults by taking countermeasures at an early stage. In this work, a data-driven fault detection method for industrial batch processes is proposed, in which the underlying process model is learned from training data. The proposed fault detection system can be used for various industrial batch processes without the need for complex and error-prone manual configuration. In contrast to many other data-driven approaches such as neural networks, only a few process cycles are required to create a robust process model. It should be noted that in data-driven fault detection methods, the training data should cover a large part of the process states that occur during error-free process cycles. The developed method is therefore particularly suitable for cyclical processes, which, however, can have alternative process paths and variability between the process cycles.

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1.6. Nonlinear Analysis: Hybrid Systems

Volume: 46, November 2022

- **Robust stability of Switched Boolean Networks with function perturbation**
  Authors: Jiahao Wu ; Yang Liu ; Qihu Ruan ; Jungang Lou
  Abstract: In genetic regulatory networks, gene mutations are one of natural phenomena, which attract much attention by biological researchers. In modeling gene networks using switched Boolean networks (SBNs), gene mutations can be described by function perturbations, which is a meaningful issue in analyzing function perturbation of SBNs. This paper studies robust stability of SBNs with function perturbation. With the help of semi-tensor product (STP) of matrices, one equivalent algebraic form of SBNs is established. By constructing two state sets, a criterion for global stability of SBNs under arbitrary switching signals is proposed. In order to relax the conditions of global stability, pointwise stabilizability and consistent stabilizability of SBNs are further considered. Based on state reachable sets, several criteria are established for the proposed kinds of stability. Finally, the obtained results are verified by two examples and lac operon in the Escherichia coli, respectively.

- **Efficient simulation of general stochastic hybrid systems**
  Authors: Avinash Malik
  Abstract: General Stochastic Hybrid System (SHS) are characterised by Stochastic Differential Equations (SDEs) with discontinuities and Poisson jump processes. SHS are useful in model based design of Cyber-Physical System (CPS) controllers under uncertainty. Industry standard model based design tools such as Simulink/Stateflowő are inefficient when simulating, testing, and validating SHS, because of dependence on fixed-step EulerMaruyama (EM) integration and discontinuity detection. We present a novel efficient adaptive step-size simulation/integration technique for general SHSs modelled as a network of Stochastic Hybrid Automatons (SHAs). We propose a simulation algorithm where each SHA in the network executes synchronously with the other, at an

integration step-size computed using adaptive step-size integration. Ito multi-dimensional lemma and the inverse sampling theorem are leveraged to compute the integration step-size by making the SDEs and Poisson jump rate integration dependent upon discontinuities. Existence and convergence analysis along with experimental results show that the proposed technique is substantially faster than Simulink/Stateflowőwhen simulating general SHSs.

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

Volume: 52, Issue: 11, November 2022

- **Diagnosability of Unambiguous Max-Plus Automata**
  Authors: Aiwen Lai ; Jan Komenda ; Sébastien Lahaye
  Abstract: This article investigates diagnosability and T-diagnosability for discrete-event systems modeled by unambiguous max-plus automata (UMPAs). More precisely, diagnosability requires that the occurrence of any fault can be detected within a finite number of events after the fault has occurred. T-diagnosability requires that the occurrence of any fault can be detected within a delay of at most T time units after its occurrence. First, we propose a polynomial-time algorithm based on the construction of a nondeterministic finite automaton over a weighted alphabet for diagnosability verification of a UMPA. Second, we prove that T-diagnosability of a UMPA can be studied by reducing it to the problem of diagnosability. Third, we introduce an approach to calculate the upper on the time needed for detecting fault occurrence for a diagnosable UMPA, and its complexity is of sixth order in the number of states of the UMPA.

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2 Conferences

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

2.1 **2022 IEEE International Conference on Systems, Man, and Cybernetics (SMC)**
Prague, Czech Republic, October 9-12, 2022
https://ieeesmc2022.org/

2.2 **2022 IEEE Conference on Decision and Control (CDC)**
Cancun, Mexico, December 6-9, 2022
https://cdc2022.ieeecss.org/

2.3 **2023 ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS)**
San Antonio, USA, May 9-12, 2023
https://iccps.acm.org/2023/

2.4 **2023 American Control Conference (ACC)**
San Diego, USA, May 31 - June 2, 2023
https://acc2023.a2c2.org/

2.5 **2023 IFAC World Congress (IFAC)**
Yokohama, Japan, July 9-14, 2023
https://www.ifac2023.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

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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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

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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 0.7 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 2022, ESCET version 0.7 has been released and can be downloaded from https://www.eclipse.org/escet/download.html. The main changes in this version are

- The CIF controller property checker can now also check whether controllers satisfy the confluence property.
- The CIF examples contain a new bridge example to showcase the real-world usage of CIF for synthesis-based engineering. Furthermore, two new CIF benchmarking models have been added.
- The CIF event-based language equivalence check tool now produces correct counter examples.
- The CIF to Supremica transformation precondition check has improved output and no longer crashes on reporting certain precondition violations. The preconditions themselves have not changed.
- The CIF text editor now has theming support, and comes with a dark theme in addition to the existing light theme. The text editor now automatically uses its dark theme when the Eclipse built-in dark theme is used, and uses a light theme otherwise.

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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