IEEE Control Systems Society
Technical Committee on Discrete Event Systems

Newsletter **October 2021**

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Welcome to the 2021 October issue of the newsletter, also available online at
http://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.

- To **submit a new item**, please use the following website:
  https://www.control.eng.osaka-cu.ac.jp/miscellaneous/css-tc-des/submission
  or email to kai.cai@eng.osaka-cu.ac.jp.
- To **subscribe**, please email to kai.cai@eng.osaka-cu.ac.jp.
- To **unsubscribe**, please reply to this email with the subject line UNSUBSCRIBE.

TC virtual meeting at CDC 2021:

- Date/time: December 13 (Monday), UTC 12:30—13:30
- Zoom link:
  https://list-osaka-cu-ac-jp.zoom.us/j/81146424855?pwd=MmZQUHJyUjFoUHdFQllQeUViS0I3UT09
  Meeting ID: 811 4642 4855
  Passcode: 672439
- Tentative program:
  Kai Cai (chair report) 10min
  Anne-Kathrin Schmuck (co-chair report) 10min
  Michel Reniers (co-chair report) 10min
  Xiang Yin (co-chair report) 10min
  Free discussions 20min

Contents

1 Selections of Journal Publications

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

1.1. Discrete Event Dynamic Systems Theory and Applications

Volume: 31, Issue: 3, October 2021

- **Compositional coordinator synthesis of extended finite automata**
  Authors: Martijn A. Goorden ; Martin Fabian ; Joanna M. van de Mortel-Fronczak ; Michel A. Reniers ; Wan J. Fokkink ; Jacobus E. Rooda
  Abstract: To avoid the state-space explosion problem, a set of supervisors may be synthesized using divide and conquer strategies, like modular or multilevel synthesis. Unfortunately, these supervisors may be conflicting, meaning that even though they are individually non-blocking, they are together blocking. Abstraction-based compositional nonblocking verification of extended finite automata provides means to verify whether a set of models is nonblocking. In case of a blocking system, a coordinator can be synthesized to resolve the blocking. This paper presents a framework for compositional coordinator synthesis for discrete-event systems modeled as extended finite automata. The framework allows for synthesis of a coordinator on the abstracted system in case compositional verification identifies the system to be blocking. As the abstracted system may use notions not present in the original model, like renamed events, the synthesized coordinator is refined such that it will be nonblocking, controllable, and maximally permissive for the original system. For each abstraction, it is shown how this refinement can be performed. It turns out that for the presented set of abstractions the coordinator refinement is straightforward.
- **A mean field absorbing control model for interacting objects systems**
  Authors: M. Elena MartÃŋnez-Manzanares ; J. Adolfo MinjÃąrez-Sosa
  Abstract: We study a class of discrete-time stochastic systems composed of a large number of N interacting objects, which are classified in a finite number of classes. The behavior of the objects is controlled by a central decision-maker as follows. At each stage, once the configuration of the system is observed, the controller takes a decision; then a cost is incurred and there is a positive probability the process stops, otherwise the objects move randomly among the classes according to a transition probability. That is, with positive probability, the system is absorbed by a configuration that represents the death of the system, and there it will remain without incurring cost. Due to the large number of objects, the control problem is studied according to the mean field theory. Thus, instead of analyzing a single object, we focus on the proportions of objects occupying each class, and then we study the limit as N goes to infinity.
- **On computing the supremal right-closed control invariant subset of a right-closed set of markings for an arbitrary petri net**
  Authors: Roshanak Khaleghi ; Ramavarapu S. Sreenivas
  Abstract: A set of non-negative integral vectors is said to be right-closed if the presence of a vector in the set implies all term-wise larger vectors also belong to the set. A set of markings is control invariant with respect to a Petri Net (PN) structure if the firing of any uncontrollable transition at any marking in this set results in a new marking that is also in the set. Every right-closed set of markings has a unique supremal control invariant subset, which is the largest subset that is control invariant with respect to the PN structure. This subset is not necessarily right-closed. In this paper, we present an algorithm that computes the supremal right-closed control invariant subset of a right-closed of markings with respect to an arbitrary PN structure. This set plays a critical role in the synthesis of Liveness Enforcing Supervisory Policies (LESPs) for a class of PN structures, and consequently, the proposed algorithm plays a key role in the synthesis of LESPs for this class of PN structures.
- **Contention-resolving model predictive control for an intelligent intersection traffic model**
  Authors: Ningshi Yao ; Fumin Zhang
  Abstract: We address the problem of optimally scheduling automated vehicles crossing an intelligent intersection by assigning vehicles with priorities and desired speed. An idealized intersection

traffic model is established for the development and verification of the required algorithms. We formulate the intersection scheduling problem as a mixed integer programming (or MIP) problem which co-designs the priority and traveling speed for each vehicle. The co-design aims to minimize the vehicle waiting time at the intersection area, under a set of safety constraints. We derived a contention-resolving model predictive control (or MPC) algorithm to dynamically assign priorities and compute the vehiclesâĂŹ traveling speeds. A branch cost formulation is proposed for the decision tree constructed by contention-resolving MPC based on time instants when collisions might occur among vehicles. Based on the priority assignments, a decentralized control law is designed to control each vehicle to travel with an optimal speed given a specific priority assignment. The optimal priority assignment can be determined by searching the lowest cost path in the decision tree. The solution computed by contention-resolving MPC is proved to be optimal given the condition of immediate access (or CIA) required in real-time scheduling. The effectiveness of the proposed method is verified through simulation and compared with the first-come-first-serve (or FCFS) and highest-speed-first (or HSF) scheduling strategies.

- **Hierarchical scheduling learning optimisation of two-area active distribution system considering peak shaving demand of power grid**
  Authors: Hao Tang ; Chang Liu ; Yonglun Cao ; Kai Lv ; Qianli Zhang
  Abstract: Aiming at industrial parks and business parks equipped with photovoltaic (PV) power plants and vanadium redox battery energy storage devices, this work studies the collaborative scheduling optimisation problem of real-time response of two-area active distribution system to the random peak shaving demand of large power grids. Firstly, considering the randomness of source and load, the stochastic dynamic changes of PV output, various load demands and the grid peak shaving demand are described as Gauss-Markov processes. Secondly, the hierarchical dynamic control mode is used to transform the collaborative dynamic scheduling problem of two-area active distribution system into a two-layer scheduling optimisation model. The upper layer considers the total cost of operation as the optimal goal and resolves problems related to the task assignment of peak shaving demand for active distribution systems in each area. Meanwhile, the lower-layer areas are optimised to complete the peak shaving task assigned by the upper layer and realise the economic operation of the active distribution system in each area. This study proposes a corresponding model-independent double-layer Q learning algorithm to optimise the hierarchical scheduling strategy. A simulation is conducted to verify the effectiveness of this algorithm. These results indicate that the hierarchical scheduling optimisation mechanism and double-layer Q learning algorithm can effectively solve the collaborative scheduling problem of two-area active distribution systems considering the peak shaving demand of the power grid.

- **A receding horizon event-driven control strategy for intelligent traffic management**
  Authors: Walter Lucia ; Giuseppe FranzÃĺ ; Domenico Famularo
  Abstract: In this paper, the intelligent traffic management within a smart city environment is addressed by developing an ad-hoc model predictive control strategy based on an event-driven formulation. To this end, a constrained hybrid system description is considered for safety verification purposes and a low-demanding receding horizon controller is then derived by exploiting set-theoretic arguments. Simulations are performed on the train-gate benchmark system to show the effectiveness and benefits of the proposed methodology.

Back to the contents

1.2. IEEE Transactions on Automatic Control

Volume: 66, Issue: 10, October 2021

- **Synthesis of Supervisors Robust Against Sensor Deception Attacks**
  Authors: RÃťmulo Meira-GÃşes ; StÃŀphane Lafortune ; HervÃŀ Marchand
  Abstract: We consider feedback control systems where sensor readings may be compromised by a malicious attacker intending on causing damage to the system. We study this problem at the supervisory layer of the control system, using discrete event systems techniques. We assume that the attacker can edit the outputs from the sensors of the system before they reach the supervisory controller. In this context, we formulate the problem of synthesizing a supervisor that is robust

against the class of edit attacks on the sensor readings and present a solution methodology for this problem. This methodology blends techniques from games on automata with imperfect information with results from supervisory control theory of partially observed discrete event systems. Necessary and sufficient conditions are provided for the investigated problem.

- **On the Structural Target Controllability of Undirected Networks**
  Authors: Jingqi Li ; Ximing Chen ; SÃĺrgio Pequito ; George J. Pappas ; Victor M. Preciado
  Abstract: In this article, we study the target controllability problem of networked dynamical systems,in which we are tasked to steer a subset of network nodes toward a desired objective. More specifically, we derive necessary and sufficient conditions for the structural target controllability of linear time-invariant (LTI) systems with symmetric state matrices, such as those representing undirected dynamical networks with unknown link weights. To achieve our goal, we first characterize the generic rank of symmetrically structured matrices , as well as the modes of any numerical realization. Subsequently, we provide graph-theoretic necessary and sufficient conditions for the structural target controllability of undirected networks with multiple control nodes. In addition, we show that these results can be extended and lead to a necessary and sufficient condition of the structural output controllability. However, different from structural target controllability, we prove that verifying the proposed conditions on structural output controllability in undirected networks is NP-hard.

Back to the contents

1.3. Automatica

Volume: 132, October 2021

- **Fault diagnosis in labelled Petri nets: A FourierâĂŞMotzkin based approach**
  Authors: Ahmed Al-Ajeli ; David Parker
  Abstract: We propose techniques for fault diagnosis in discrete-event systems modelled by labelled Petri nets, where fault events are modelled as unobservable transitions. The proposed approach combines an offline and an online algorithm. The offline algorithm constructs a diagnoser in the form of sets of inequalities that capture the legal, normal and faulty behaviour. To implement the offline algorithm, we adopt the FourierâĂŞMotzkin method for elimination of variables from these sets of inequalities. Upon observing an event, the diagnoser is used to determine whether a fault occurred or might have occurred. The occurrence of a fault can be verified by checking the observed sequence against the sets of inequalities. This approach has the advantage that the tradeoff between the size of the diagnoser and the time for computing the diagnosis is achieved. In addition, fault diagnosis in both bounded and unbounded Petri nets can be addressed.

Back to the contents

1.4. Control Engineering Practice

Volume: 115, October 2021

- **Supervisory control synthesis for large-scale systems with isomorphisms**
  Authors: L. Moormann ; J.M. van de Mortel-Fronczak ; W.J. Fokkink ; P. Maessen ; J.E. Rooda
  Abstract: The complexity of the design of supervisory controllers for todayâĂŹs high-tech systems is ever increasing with the rise in demands for higher safety and functionality. Supervisory control synthesis enables the design engineer to automatically generate a supervisory controller from a model of the plant and a model of the controller requirements. Although supervisory control theory is an active research area, the number of industrial applications remains relatively low. One of the main reasons for this is the lack of guidelines for practical applications of supervisory control theory, especially in case of large-scale systems with numerous components and complex dependencies. In this paper, guidelines are given for the process of obtaining and validating a supervisory controller, more specifically for large-scale systems with isomorphisms. Systems with isomorphisms are systems with a high degree of symmetry and repetitiveness in their components, such as manufacturing lines with parallel processing lines or infrastructural systems with repeating modules. This paper shows how coordination between the steps in obtaining a supervisory controller for a large-scale system

improves the efficiency of the process and quality of the end result, and how the isomorphism of components in the system can be exploited in these steps. This process is demonstrated in this paper by a case study related to the Eerste Heinenoordtunnel, a road tunnel in the Netherlands. The case study shows the steps of modeling the plant and the controller requirements, performing model reduction based on isomorphisms in the system, synthesizing the supervisory controller, and validating the controller by means of simulation.

- **Distributed synchronous diagnosis of discrete event systems modeled as automata**
  Authors: Maria Z.M.Veras ; Felipe G.Cabral ; Marcos V.Moreira
  Abstract: Recently, the decentralized synchronous diagnosis (DESD) method has been proposed for Discrete-Event Systems composed of several modules or subsystems, where the size of the local diagnosers grows linearly with the size of the fault-free behavior models of the system components. Thus, the memory space required to implement the local diagnosers in a computer is reduced in comparison with traditional diagnosis strategies that are based on the composed system model, which may grow exponentially with the number of system modules. The main drawback of the DESD strategy is the possibility of acceptance of an exceeding language as part of the fault-free system behavior by the diagnosis scheme. This exceeding language can be associated with non-detectable faults or an increase in the diagnosis delay bound. In this paper, we propose a distributed synchronous diagnosis (DISD) architecture, where the local diagnosers are implemented considering a specific communication protocol that refines the state estimate of the fault-free behavior of the system modules, leading to a smaller exceeding language accepted as fault-free by the DISD scheme in comparison with the DESD scheme. As in the DESD, in the DISD, the local diagnosers do not grow exponentially with the number of system modules, requiring smaller memory space for implementation than traditional methods. We also define the property of distributed synchronous diagnosability, and propose a verification method.

Back to the contents

1.5. Systems & Control Letters

Volume: 156, October 2021

- **Optimal control of multi-task Boolean control networks via temporal logic**
  Authors: Yuhua Yao ; Jitao Sun
  Abstract: Boolean control networks (BCNs) with temporal logic specifications have great potential to deal with multiple tasks or complex environments. We first express the tasks of BCNs with temporal logic specifications, and transform these specifications into finite time sets dwell problems. By using the semi-tensor product (STP), some results that satisfying the specifications of temporal logic through time-varying control are obtained. Our method provides a unified framework for studying the stabilizability, synchronizability, path planning and other issues of BCNs. The controller design algorithms are then proposed to generate state sequences that fulfill the given tasks as much as possible while minimizing the cost function. Finally, two examples are given to verify the effectiveness of the theoretical results.
- **Distributional observability of probabilistic Boolean networks**
  Authors: Rui Li ; Qi Zhang ; Jianlei Zhang ; Tianguang Chu
  Abstract: A probabilistic Boolean network (PBN) is a discrete network composed of a family of Boolean networks together with a set of probabilities governing the selection of a Boolean network at each time step. We introduce in this paper a novel observability problem for PBNs. Specifically, we assume that the values of the initial state of the PBN are not known with certainty, but can be described by probability distributions. We ask ourselves under which conditions it is possible to uniquely determine the probability distribution of initial states when giving only knowledge of the evolution of the probability distributions of network outputs. We propose a complete answer to this problem using a linear algebra approach. Several examples, both artificial and real-world, are given and illustrate the viability of the proposed theoretical results.

Back to the contents

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

Volume: 51, Issue: 10, October 2021

- **Scheduling of Flexible Manufacturing Systems Subject to No-Wait Constraints via Petri Nets and Heuristic Search**

  Authors: Xinnian Wang ; Keyi Xing ; Yanxiang Feng ; Yunchao Wu

  Abstract: This article addresses the scheduling problem of deadlock-prone flexible manufacturing systems subject to no-wait constraints for the first time, and develops a new scheduling algorithm based on the place-timed Petri net (PN) model and heuristic search. The considered problem can be solved by two procedures: 1) timetabling and 2) sequencing. The timetabling is to translate a given job sequence into a feasible schedule that satisfies the deadlock-free and no-wait constraints. A novel timetabling algorithm based on the controlled PN model is then proposed for solving it. The goal of sequencing is to find a job sequence so that the makespan of the corresponding schedule is the minimum. To this end, a hybrid heuristic search (HHS) is developed by combining the A^* algorithm and dynamic window. Two new heuristic functions are designed to guide the search, and the dynamic window is used to limit the searched space. The performance of HHS with different heuristic functions and deadlock controllers is evaluated by ten instances. The computational results demonstrate that through the proposed approach, optimal or suboptimal feasible schedules can be obtained within a reasonable time.

- **Hidden Markov Model Based Fault Detection for Networked Singularly Perturbed Systems**

  Authors: Xiongbo Wan ; Tizhuang Han ; Jianqi An ; Min Wu

  Abstract: Based on a hidden Markov model (HMM), the issue of fault detection (FD) is investigated for singularly perturbed systems with their measurements transmitted over a bandwidth-limited communication network. A homogeneous Markov chain is adopted to model packet dropouts and time delays simultaneously, whose mode transition probabilities are assumed to be partially unknown. The discrepancies between the Markov modes and their observed ones have been noted, which are reflected by a hidden Markov process. An HMM-based FD filter (FDF) is aimed to be designed such that the stochastic stability and prescribed H_∞ performance are ensured for the resulting filtering error dynamics of FD. A new LyapunovâĂŞKrasovskii functional is constructed, which is with the Markov mode and the singular perturbation parameter (SPP). With the aid of up-to-date techniques in handing time delays, a sufficient condition based on linear matrix inequalities (LMIs) is derived which provides a design scheme of such an FDF. The FDF parameters are given and the SPPâĂŹs admissible bounds are evaluated when the LMIs have feasible solutions. The performance of the designed FDF is demonstrated by two examples.

Back to the contents

2 Conferences

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

2.1 **2021 IEEE International Conference on Systems, Man, and Cybernetics**
South Wharf, Victoria, Australia, October 17-20, 2021
http://ieeesmc2021.org/

2.2 **2021 IEEE Conference on Decision and Control**
Austin, Texas, USA. December 13-15, 2021
https://cdc2021.ieeecss.org

2.3 **2022 IEEE Conference on Robotics and Automation**
Philadelphia, USA, May 23-27, 2022
https://www.icra2022.org/

2.4 **2022 American Control Conference**
Atlanta, Georgia, USA, June 8-10, 2022
https://acc2022.a2c2.org/

2.5 **2022 International Workshop on Discrete Event Systems**
Prague, Czechia, September 7-9, 2022
https://wodes2022.math.cas.cz

Back to the contents

3 Books

3.1 Analysis and Control for Resilience of Discrete Event Systems

Authors: JoÃčo 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 systemâĂŹs ability to hide certain secrets from an external observer (or eavesdropper), and sensor and actuator attacks that exploit the systemâĂŹs 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

Back to the contents

4 Positions

4.1 Post-Doctoral Positions at ACCESS Laboratory

The Autonomous Cooperative Control of Emergent Systems of Systems (ACCESS) Laboratory at NC A&T State University, invites applications for two full-time, post-doctoral research associate positions in the following areas:

1. **Fault Tolerant Control Systems** (Position number: 009736): This position will carry out research on modeling and control of autonomous vehicles under faulty and normal conditions to enhance the safety of vehicles.
Application link: https://jobs.ncat.edu/postings/22884

2. **Formal Methods for Autonomous Systems** (Position Number: 009774): This position will carry out research on Model Checking and Formal Methods for verification and control of autonomous vehicles for Urban Air Mobility (UAM) applications.
Application link: https://jobs.ncat.edu/postings/22885

The applicants are expected to have a strong theoretical and experimental background with evidence of skills related to discrete event systems, formal methods, and their applications to robotic systems. The ideal candidate should have also experience with related software tools for model checking, modeling, and control of robotic systems, as well as good programming skills in Python, C++, and ROS.

These two positions are non-tenure-track, year-to-year appointment, renewable annually for up to two years subjected to satisfactory performance, availability of resources, and the needs of the Lab. The candidate will enjoy a dynamic and collaborative working environment, supporting projects through conducting original research, collaboration with other team members, development external and internal evaluation of reports, facilitating the research meetings within the team, mentoring of students, and technically overseeing projectsâĂŹ milestones. The employee will also contribute to additional proposal efforts, thereby strengthening North Carolina A & T State UniversityâĂŹs ability to attract external funding.

If interested, please apply by submitting Cover Letter, Curriculum Vitae, Research Statement, Copy of PhD transcripts via the provided application links and send a copy of your CV to Dr. Karimoddini (akarimod@ncat.edu). Please feel free to contact Dr. Karimoddini (akarimod@ncat.edu) for any questions about these positions. Back to the contents

5 Call for Papers

5.1 Advanced Robotics: Special Issue on Control Technology for Networked and Distributed Robotics

Guest Editors:

- Prof. Masaaki Nagahara (The University of Kitakyushu, Japan)
- Prof. Kai Cai (Osaka City University, Japan)
- Prof. Takeshi Hatanaka (Tokyo Institute of Technology, Japan)
- Prof. Yutaka Hori (Keio University, Japan)
- Prof. Hideaki Ishii (Tokyo Institute of Technology, Japan)

Lead Guest Editor

- Prof. Debasish Chatterjee (Indian Institute of Technology Bombay, India)
- Prof. Nikhil Chopra (The University of Maryland, USA)
- Prof. Daniel E. Quevedo (Queensland University of Technology, Australia)
- Prof. Michel Reniers (Eindhoven University of Technology, Netherlands)

Publication in Vol. 37, Issue 1 (January 2023)

Submission deadline: 28 February 2022

Control technology is one of the fundamental disciplines of robotics. The technology has been developed for more than 100 years and expanded in many research areas. In particular, control technology for networked and distributed robotics has been recently emerging thanks to the development of embedded systems and wireless communications. An example of networked and distributed robotics is a drone light show, which was presented in the opening ceremony of Tokyo Olympic Games 2020, where multiple drones are operated from the main computer located on the ground that controls multiple drones through wireless networks. The purpose of this special issue is to present recent theory and practice of control technology that can be effectively applied to networked and distributed robotics. It aims at collecting a representative body of innovative theoretical contributions that have potential applications to networked and distributed robotics as well as applicative robotics researches that show successful implementation of recent theory of networked and distributed control. Prospective contributed papers are invited to cover, but are not limited to, theoretical and applicative researches on the following topics

- control of multi-agent systems (e.g. consensus control, coverage control, formation)
- networked control systems
- discrete-event systems and hybrid systems
- resource-aware control (e.g. event-triggered control, sparse control)
- secure, resilient, and safe control
- machine learning and data driven methods for networked robotics
- human-in-the-loop and human-machine interaction

The full-length manuscript (either PDF or Microsoft Word file) should be sent to the office of Advanced Robotics, Robotics Society of Japan, through its homepage at: https://www.rsj.or.jp/pub/ar/submission.html. Templates for the manuscript as well as instructions for the Authors are available at the homepage.

Further information will be provided via the following website: (to be opened soon)

5.2 IEEE Control Systems Letters
Fragility and Resiliency in Cyber-Physical Discrete Event Systems

Guest Editors:

- Prof. Christoforos N. Hadjicostis (University of Cyprus, Cyprus)
- Prof. StÃľphane Lafortune (University of Michigan, USA)
- Prof. Carla Seatzu (University of Cagliari, Italy)

The proliferation of digital technologies and interconnectivity has led to emergence of cyber-physical systems (CPS) in numerous applications, ranging from automated manufacturing systems and chemical processes to traffic networks and healthcare/information systems. CPS typically involve computation, networking and physical processes, by increasingly deploying sensors and actuators into âĂIJsmartâĂİ feedback loops that connect the cyber and physical worlds to a multitude of computing and storage devices. These approaches have revolutionized numerous aspects of the scientific and commercial worlds (e.g., smart grids and microgrids, traffic networks, automated or autonomous transportation systems, water networks, etc.), and have led to systems (with discrete, continuous, or hybrid dynamics) of unprecedented interconnectivity. Apart from challenges due to the sheer size, complexity, and distributed nature of CPS, some of the most pressing open questions are issues of fragility and resiliency. Fragility is a term used to characterize situations where cumulative mild abnormalities (e.g., certain combinations of sensor failures, delays/losses in the transmission of sensory information and actuation commands, and/or malicious actions) result in large degradation in system performance or even unacceptable violations of system requirements. Resiliency is the ability of the system to cope with such abnormalities. Fragility analysis and resiliency provision are particularly important in CPS that involve critical infrastructures where human lives may be at risk.

The focus of this special issue is on models that comprise (compositions of) discrete event systems (DES), such as finite automata and Petri nets. In more detail, the goal of the special issue is that of collecting contributions that address fundamental research challenges that directly influence fragility and resiliency, such as losses, delays or malicious manipulations of sensory information or control commands. The primary aspect of any contribution should be novelty and originality. Also, the results should be presented in a mathematical language, according to the L-CSS standard. Specific topics of interest for this special issue include, but are not limited to:

- Cyber-physical DES fragility analysis
- Cyber-physical DES resiliency provision
- Supervisory control
- State estimation
- Detectability analysis
- Detectability analysis
- Opacity verification and enforcement
- Prognosability analysis

Submission Information

- Submission for the special issue start: December 20, 2021
- Submission deadline: January 20, 2022

Submission instructions can be found in the L-CSS website at http://ieee-cssletters.dei.unipd.it/Page_authors.php?p=1

Back to the contents

6 Software Tools

6.1 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.

6.2 Supremica 2.6, New Version

The development team has just released a new version of Supremica, Waters/Supremica IDE 2.6.

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:

- Scaling of the GUI
- Revamped configuration dialog
- New analyzer user interface
- Logging can now be done directly to file, in addition to the log output pane
- Automaton variables have been introduced, so that guards and actions can refer to the state of an automaton
- The normalizing compiler is now the default
- Plenty of bug fixes, including more graceful termination when out of memory

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

6.3 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.

6.4 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.

Back to the contents