IEEE CONTROL SYSTEMS SOCIETY
TECHNICAL COMMITTEE ON DISCRETE EVENT SYSTEMS

Newsletter..... August 2019

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1. Editorial

Welcome to the 2019 August issue of the newsletter,
also available electronically at
http://discrete-event-systems.ieeecss.org/tc-discrete/newsletters

To subscribe, please email to kai.cai@eng.osaka-cu.ac.jp.
To unsubscribe, please reply to this email with the subject line UNSUBSCRIBE.

1.1. You are welcome to submit new items to the newsletter (topics including schools,
workshops, sessions, conferences, journals, books, software, positions).
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.

1.2. Slides for technical meeting held at ACC'19 are posted at
http://discrete-event-systems.ieeecss.org/tc-discrete/events

2. Selections of Journal Publications

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

2.1. Selections of Automatica
VOLUME: 106, August 2019

(1) Feedback control strategies for multi-agent systems under a fragment of signal temporal logic tasks

Authors: Lars Lindemann ; Dimos V.Dimarogonas

Abstract: Multi-agent systems under temporal logic tasks have great potential due to their ability to deal with complex tasks. The control of these systems, however, poses many challenges and the majority of existing approaches result in large computational burdens. We instead propose computationally-efficient and robust

feedback control strategies for a class of systems that are, in a sense, feedback equivalent to single integrator systems, but where the dynamics are partially unknown for the control design. A bottom-up scenario is considered in which each agent is subject to a local task from a limited signal temporal logic fragment. Notably, the satisfaction of a local task may also depend on the behavior of other agents. We provide local continuous-time feedback control laws that, under some sufficient conditions, guarantee satisfaction of the local tasks. Otherwise, a local detection & repair scheme is proposed in combination with the previously derived feedback control laws to deal with infeasibilities, such as when local tasks are conflicting. The efficacy of the proposed method is demonstrated in simulations.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S0005109819302195

(2) Set reachability and observability of probabilistic Boolean networks

Authors: Rongpei Zhou ; Yuqian Guo ; Weihua Gui

Abstract: In this paper, the set reachability and observability of probabilistic Boolean networks (PBNs) are investigated. Using a parallel extension technique, we proved that the observability problem of a PBN can be recast as a set reachability problem of an interconnected PBN. For set reachability analysis, we designed a random logic dynamical system (RLDS) from the PBN under consideration by reconstructing the state transfer graph (STG). We proved that, for a PBN, a target subset is reachable from an initial subset if and only if all solutions to the corresponding RLDS starting from the initial subset converge to the zero state. Based on the STG reconstruction technique and using the largest invariant subset algorithm, the necessary and sufficient conditions for finite-time set reachability with probability one and asymptotical set reachability in distribution were obtained. All the results are expressed in terms of the transition probability matrix between non-zero states of the RLDS. Further, the results related to set reachability were applied to the observability problem of PBNs. The necessary and sufficient conditions for finite-time observability with probability one and asymptotical observability in distribution were obtained. Finally, examples were presented to illustrate the effectiveness of the proposed method.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S0005109819302286

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2.2. Selections of the IEEE Transactions on Automatic Control
VOLUME: 64, ISSUE: 8, August 2019

(1) Permissive Supervisor Synthesis for Markov Decision Processes Through Learning

Authors: Bo Wu ; Xiaobin Zhang ; Hai Lin

Abstract: This paper considers the permissive supervisor synthesis for probabilistic systems modeled as Markov Decision Processes (MDP). Such systems are prevalent in power grids, transportation networks, communication networks, and robotics. We propose a novel supervisor synthesis framework using automata learning and compositional model checking to generate the permissive local supervisors in a distributed manner. With the recent advances in assume-guarantee reasoning verification for MDPs, constructing the composed system can be avoided to alleviate the state space explosion. Our framework learns the supervisors iteratively using counterexamples from the verification and is guaranteed to terminate in finite steps and to be correct.

Full-text available at: https://ieeexplore.ieee.org/document/8521689

(2) Shrinking Horizon Model Predictive Control With Signal Temporal Logic Constraints Under Stochastic Disturbances

Authors: Samira S. Farahani ; Rupak Majumdar ; Vinayak S. Prabhu ; Sadegh Soudjani

Abstract: We present shrinking horizon model predictive control for discrete-time linear systems under stochastic disturbances with constraints encoded as signal temporal logic (STL) specification. The control objective is to satisfy a given STL specification with high probability against stochastic uncertainties while maximizing the robust satisfaction of an STL specification with minimum control effort. We formulate a general solution, which does not require precise knowledge of probability distributions of (possibly dependent) stochastic disturbances; only the bounded support of the density functions and moment intervals are used. For the specific case of disturbances that are normally distributed, we optimize the controllers by utilizing knowledge of the probability distribution of the disturbance. We show that in both cases, the control law can be obtained by solving optimization problems with linear constraints at each step. We experimentally demonstrate effectiveness of this approach by synthesizing a controller for a heating, ventilation, and air conditioning system.

Full-text available at: https://ieeexplore.ieee.org/document/8528869

(3) Dynamic Event-Triggered and Self-Triggered Control for Multi-agent Systems

Authors: Xinlei Yi ; Kun Liu ; Dimos V. Dimarogonas ; Karl H. Johansson

Abstract: We propose two novel dynamic event-triggered control laws to solve the average consensus problem for first-order continuous-

time multiagent systems over undirected graphs. Compared with the most existing triggering laws, the proposed laws involve internal dynamic variables, which play an essential role in guaranteeing that the triggering time sequence does not exhibit Zeno behavior. Moreover, some existing triggering laws are special cases of ours. For the proposed self-triggered algorithm, continuous agent listening is avoided as each agent predicts its next triggering time and broadcasts it to its neighbors at the current triggering time. Thus, each agent only needs to sense and broadcast at its triggering times, and to listen to and receive incoming information from its neighbors at their triggering times. It is proved that the proposed triggering laws make the state of each agent converge exponentially to the average of the agents°Ø initial states if and only if the underlying graph is connected. Numerical simulations are provided to illustrate the effectiveness of the theoretical results.

Full-text available at: https://ieeexplore.ieee.org/document/8485753
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2.3. Selections of the IEEE Transactions on Control Systems Technology
VOLUME: 27, ISSUE: 4, July 2019

(1) Safety of Manufacturing Systems Controllers by Logical Constraints With Safety Filter

Authors: Romain Pichard ; Alexandre Philippot ; Ramla Saddem ; Bernard Riera

Abstract: This brief presents an approach to safe controller synthesis for manufacturing systems controlled by programmable logic controllers (PLCs). In this brief, manufacturing systems are considered as discrete-event dynamic systems with logical inputs and outputs. The methodology is based on the use of safety constraints placed at the end of the PLC program. These constraints are checked offline by a formal approach and acted as a safety filter in order to be robust against control errors. The proposed approach separates the functional control part from the safety part and focuses on the latter. This brief presents the whole methodology and recent improvements on consistency checking of a set of Boolean expressions.

Full-text available at: https://ieeexplore.ieee.org/document/8351970
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2.4. Selections of the IEEE/CAA Journal of Automatica Sinica
VOLUME: 6, ISSUE: 4, July 2019

(1) A Simulation Engine for Stochastic Timed Petri Nets and Application to Emergency Healthcare Systems

Author: Jiani Zhou ; Jiacun Wang ; Jun Wang

Abstract: In many service delivery systems, the quantity of

available resources is often a decisive factor of service quality. Resources can be personnel, offices, devices, supplies, and so on, depending on the nature of the services a system provides. Although service computing has been an active research topic for decades, general approaches that assess the impact of resource provisioning on service quality matrices in a rigorous way remain to be seen. Petri nets have been a popular formalism for modeling systems exhibiting behaviors of competition and concurrency for almost a half century. Stochastic timed Petri nets (STPN), an extension to regular Petri nets, are a powerful tool for system performance evaluation. However, we did not find any single existing STPN software tool that supports all timed transition firing policies and server types, not to mention resource provisioning and requirement analysis. This paper presents a generic and resource oriented STPN simulation engine that provides all critical features necessary for the analysis of service delivery system quality vs. resource provisioning. The power of the simulation system is illustrated by an application to emergency health care systems.

Full-text available at: https://ieeexplore.ieee.org/document/8753754

(2) A Review on Swarm Intelligence and Evolutionary Algorithms for Solving Flexible Job Shop Scheduling Problems

Author: Kaizhou Gao ; Zhiguang Cao ; Le Zhang ; Zhenghua Chen ; Yuyan Han ; Quanke Pan

Abstract: Flexible job shop scheduling problems (FJSP) have received much attention from academia and industry for many years. Due to their exponential complexity, swarm intelligence (SI) and evolutionary algorithms (EA) are developed, employed and improved for solving them. More than 60% of the publications are related to SI and EA. This paper intents to give a comprehensive literature review of SI and EA for solving FJSP. First, the mathematical model of FJSP is presented and the constraints in applications are summarized. Then, the encoding and decoding strategies for connecting the problem and algorithms are reviewed. The strategies for initializing algorithms? population and local search operators for improving convergence performance are summarized. Next, one classical hybrid genetic algorithm (GA) and one newest imperialist competitive algorithm (ICA) with variables neighborhood search (VNS) for solving FJSP are presented. Finally, we summarize, discus and analyze the status of SI and EA for solving FJSP and give insight into future research directions.

Full-text available at: https://ieeexplore.ieee.org/document/8741295

3. Conferences

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

3.1 2019 Conference on Control Technology and Applications
Hong Kong, China, Aug 19 - Aug 21, 2019
http://ccta2019.ieeecss.org/

3.2 15th International Conference on Automation Science and Engineering
Vancouver, British Columbia, Canada, Aug 22 - Aug 26, 2019
http://case2019.hust.edu.cn/index.htm

3.3 57th Annual Allerton Conference on Communication, Control, and Computing
Allerton Park, United States, Sep 24 - Sep 27, 2019

3.4 2019 Conference on Decision and Control
Nice, France, December 11-13, 2019
https://cdc2019.ieeecss.org/

3.5 2020 Workshop on Discrete Event Systems
Rio de Janeiro, Brazil, May 13-15, 2020
https://wodes2020.eventos.ufrj.br

3.6. 2020 American Control Conference
Denver, Colorado, USA, July 1-3, 2020
http://acc2020.a2c2.org

3.7 2020 IFAC World Congress
Berlin, Germany, July 12-17, 2020
https://www.ifac2020.org

4. Call For Papers

4.1 Journal of Discrete Event Dynamic Systems: Theory and Applications---Topical Collection on Smart Cities

Smart cities have attracted more and more attention in recent years due to the close relationship to sustainable development and to the daily lives of citizens in developed as well as developing countries. The research focus in smart cities involves but is not limited to buildings, transportation, mobility, water system management, security, and pollution control. In order to make cities smarter, a technological infrastructure is required to connect networks of sensors and actuators embedded throughout the urban terrain, and to interact with wireless mobile devices. Smart city is also a great example for cyber-physical systems and the Internet of Things and is a rich domain for research and education.

In this special topical collection on smart cities, we focus on the application of theories and models of discrete event dynamic systems

in the general field of smart cities. Papers in the following directions are especially encouraged for submission: Smart Buildings, Intelligent Transportation Systems, Smart Grids, Water System Management, Cyber-security.

Important Dates
- Jan. 1, 2019, announcement of call-for-papers;
- Oct. 1, 2019, paper submission deadline;
- Feb. 1, 2020, expected completion of first round of review;
- Apr. 1, 2020, submission of revised papers;
- Jul. 1, 2020, completion of review process;
- Sept. 1, 2020, accepted papers start appearing Online First.

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Paper Submission
Submissions should be made through the journal website (https://www.editorialmanager.com/disc/default.aspx), under the TC: Smart Cities category. Contributors are strongly encouraged to read Instructions at
https://www.springer.com/mathematics/applications/journal/10626?detailsPage=pltci_2530565
while preparing their manuscript. Both short papers (less than 12 pages) and regular papers are welcome.

4.2. 2020 Workshop on Discrete Event Systems

The interdisciplinary field of Discrete Event Systems (DES) combines different formalisms, methodologies and tools from control, computer science and operations research. The research activity in this field is driven by the needs of many different applications domains: manufacturing, process control, supervisory systems, software engineering, transportation, etc.

The 15th Workshop on Discrete Event Systems aims at providing researchers from different fields (control theoreticians and control engineers, software engineers and computer scientists, operations research specialists) with an opportunity to exchange information

and new ideas, and to discuss new developments in the field of DES theory and applications.
The workshop will cover all topics in DES theory and applications, including (but not limited to) the following:
- Formalisms and modeling methodologies: Petri nets, automata, state charts, process algebras, max-plus algebra, queueing networks;
- Control of discrete-event systems with emphasis on supervisory control and on real time control;
- Performance evaluation, optimization and scheduling;
- Diagnosis, fault detection, test, identification;
- Discrete approaches for hybrid systems;
- Event-driven methods in systems and control;
- Applications including manufacturing systems, transportation systems, power production, distributed systems,
  software engineering, home automation, workflow, telecommunication systems, biological systems;
- Automation methods and software tools enabling efficient handling of industrial-sized systems.

WODES 2020 will be held at Military Institute of Engineering (IME), which, together with Polytechnic School of the Federal Universtiy of Rio de Janeiro, is the oldest engineering school of all Americas. It is located at the pleasant neighborhood of Urca, opposite to Praia Vermelha (Red Beach) and next to the Cable Station to Sugar Loaf. It stays a few minutes away from the famous beaches of Copacabana, Ipanema and Leblon.

Important Dates
- Special Session Proposals Due: October, 31st 2019
- Submission Site Opens: November, 10th 2019
- Initial Paper Submission Due: December, 16th 2019
- Decision Notification: February, 17th 2020
- Registration Site Opens: February, 24th 2020
- Final Submissions Due: March, 9th 2020

5. Positions

5.1 Assistant/Associate Professor in Systems Engineering at CFINS, Tsinghua University

The center for intelligent and networked systems (CFINS) at Tsinghua University (Beijing, China) (http://www.cfins.au.tsinghua.edu.cn/en/about/index.php) invites applications for one tenure-track position in systems engineering, starting from 2020. The applicant is expected to have a PhD degree in Control Science and Engineering, or Industrial Engineering, or Computer Science or related fields. Candidate will be considered at the assistant and associate professor level. The recruitment process starts now and continue until successful candidate has been identified. Interested applicants please contact Qing-Shan Jia at jiaqs@tsinghua.edu.cn for more details.

About CFINS:
The Center for Intelligent and Networked Systems (CFINS) is to provide a physical and intellectual environment for the intelligent analysis, design, operation and monitoring of complex and networked systems such as computer and communication networks, building systems, power systems, and supply chains by making innovative use of analytical and simulation methods and information technology. Please visit http://cfins.au.tsinghua.edu.cn/en/about/index.php for details.

5.2 PhD in Control and Optimization of Cyber Physical Systems at CFINS, Tsinghua University

The center for intelligent and networked systems (CFINS) at Tsinghua University (Beijing, China) (http://www.cfins.au.tsinghua.edu.cn) invites applications for PhD positions in the field of control and optimization of energy Internet and smart buildings. Potential applicants with knowledge on Markov decision process, power systems, robotic systems, and/or building systems are especially encouraged to apply. The potential applicant should be expected to receive a Bachelor/MS degree in EE/CS/IE or related areas, or already have a Bachelor/MS degree in these fields. Applications will be reviewed immediately. Interested applicants, please send an email to (Samuel) Qing-Shan Jia jiaqs@tsinghua.edu.cn.

5.3 Postdoc in Reinforcement Learning for Cyber Physical Systems at CFINS, Tsinghua University

The center for intelligent and networked systems (CFINS) at Tsinghua University (Beijing, China) (http://www.cfins.au.tsinghua.edu.cn) invites applications for 1 postdoc position in the field of reinforcement learning for cyber physical systems such as energy Internet and smart buildings. Potential applicants with knowledge on Markov decision process, power systems, robotic systems, and/or building systems are especially encouraged to apply. The potential applicant should be expected to receive a PhD degree in EE/CS/IE/SE or related areas by fall of 2020. This postdoc position is for two years and will be supervised by Professor (Samuel) Qing-Shan Jia. Applications will be reviewed immediately. Interested applicants, please send an email to (Samuel) Qing-Shan Jia jiaqs@tsinghua.edu.cn.

6. International Graduate School on Control

Introduction to Discrete Event Systems

Instructors: Stéphane Lafortune, Christos Cassandras

Marseille, France, June 8-12, 2020

Registration:
http://www.eeci-igsc.eu/

Course summary:
Discrete event systems are dynamic systems with discrete state spaces and event-driven dynamics. They arise when modeling the high-level behavior of cyber-physical systems or when modeling computing and software systems. Discrete event models can be purely logical, or they may include timing and stochastic information. This course will have two parts.
In the first half, we will study logical discrete event systems, focusing primarily on automata models. We will consider estimation, diagnosability, and opacity analysis for partially-observed systems, then supervisory control under full and partial observation. In the second half, we will study the performance analysis, control, and optimization of timed DES, using stochastic timed automata models. We will describe the use of discrete event simulation and review elementary queueing theory and Markov Decision Processes used to study stochastic timed DES. We with then present Perturbation Analysis (PA) theory as a method to control and optimize common performance metrics for DES. Finally, we will explain how to extend DES into Hybrid Systems, limiting ourselves to basic modeling and simple extensions of PA theory.
No prior knowledge of discrete event systems will be assumed. The course will rely on the textbook co- authored by the instructors.

Course outline:
0. Overview of DES and contrast to time-driven systems
1. Introduction to discrete event modeling formalisms
2. Analysis of logical discrete event systems
3. Supervisory control under full and partial observation
4. Timed Models of DES
5. DES (Monte Carlo) computer simulation
6. Review of queueing theory and Markov Decision Processes
7. Perturbation Analysis and Rapid Learning methods
8. From DES to Hybrid Systems