IEEE CONTROL SYSTEMS SOCIETY
TECHNICAL COMMITTEE ON DISCRETE EVENT SYSTEMS

Newsletter..... July 2019

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Contents:

1. Editorial

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

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.

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

2. Technical Committee Meeting at ACC 2019

Technical Committee on Discrete Event Systems will hold a meeting at American Control Conference 2019, Philadelphia, PA, USA.

Time: 12:00--13:30, July 12, Friday, 2019.
Location: Salon C

All TC members who are going to attend ACC'19 are welcome to come to this meeting. Lunch is supplied (first come first served, due to limited amount).

3. Selections of Journal Publications

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

3.1. Selections of Automatica
VOLUME: 105, July 2019

(1) A general approach for optimizing dynamic sensor activation for

discrete event systems

Authors: Xiang Yin ; Stephane Lafortune

Abstract: We study the problem of dynamic sensor activation for centralized partially-observed discrete event systems. The sensors can be turned on/off online dynamically according to a sensor activation policy in order to satisfy some observation property. We consider a general class of properties, called Information-State-based (or IS-based) properties, which include, but are not limited to, observability, -diagnosability, predictability, and opacity. We define a new Most Permissive Observer (MPO) that generalizes previous versions of this structure. Based on the generalized MPO, we first synthesize a logical minimal or maximal sensor activation policy based on a set inclusion criterion. Then we study the synthesis of optimal solutions for a given quantitative objective function that considers numerical activation costs and switching costs. Our results generalize previous works on dynamic sensor activation for enforcement of specific properties.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S000510981930161X

(2) State estimation of max-plus automata with unobservable events

Authors: Aiwen Lai ; Sebastien Lahaye ; Alessandro Giua

Abstract: The state estimation problem is a fundamental issue in discrete event systems. Partial observations arise when the occurrence of some events cannot be detected. The considered problem then consists in finding all the states in which the system may be when an observed sequence is given. To the best of our knowledge there are few works dealing with this problem in the framework of timed discrete event systems. In this paper we investigate state estimation for systems represented as max-plus automata. Max-plus automata represent a particular class of weighted automata and if a timed interpretation is given to weights, then max-plus automata are strongly related to timed automata. We first give the definition of consistent states with respect to an observed timed sequence and a given time instant. Then, based on the state vectors of a max-plus automaton, an algorithm is proposed to compute the set of all consistent states.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S0005109819301244

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3.2. Selections of the IEEE Transactions on Automatic Control
VOLUME: 64, ISSUE: 7, July 2019

(1) Datation of Faults for Markovian Stochastic DESs

Authors: Rabah Ammour ; Edouard Leclercq ; Eric Sanlaville ; Dimitri Lefebvre

Abstract: This technical note concerns the fault diagnosis of stochastic discrete event systems. Specifically, the goal is to characterize a detected fault by estimating its occurrence date. For that purpose, partially observed stochastic Petri nets are used to model the system, the failure processes, and the sensors. From the proposed modeling and collected dated measurements, the probabilities of consistent trajectories are computed and diagnosis in terms of faults probability is established as a consequence. For each detected fault, the probability density function of its occurrence date is approximated. This estimation improves the diagnosis by providing the most probable time interval of the fault occurrence. The interest of fault datation and the applicability of the proposed approach are showed through a case study that represents a distribution system.

Full-text available at: https://ieeexplore.ieee.org/document/8477116

(2) Enforcement of Diagnosability in Labeled Petri Nets via Optimal Sensor Selection

Authors: Ning Ran ; Alessandro Giua ; Carla Seatzu

Abstract: In this paper, we deal with the problem of enforcing diagnosability to labeled Petri nets (PNs) appropriately adding new sensors. We show that, solving an integer linear programming problem, it is possible to select a solution that is optimal with respect to a given objective function (e.g., the cost of sensors). The solution is based on two notions, already introduced by the authors in previous works, namely basis marking and unfolded verifier . This allows to solve the considered problem in a more efficient way with respect to other approaches in the literature. Finally, we propose an algorithm to compute the smallest value of K such that the PN system is K-diagnosable under the new labeling function, which implies that faults can be detected in at most K observations after their occurrence.

Full-text available at: https://ieeexplore.ieee.org/document/8481461

(3) Finite-State Approximations to Discounted and Average Cost Constrained Markov Decision Processes

Authors: Naci Saldi

Abstract: In this paper, we consider the finite-state approximation of a discrete-time constrained Markov decision process (MDP) under the discounted and average cost criteria. Using the linear programming formulation of the constrained discounted cost problem, we prove the asymptotic convergence of the optimal value of the finite-state model to the optimal value of the original model. With

further continuity condition on the transition probability, we also establish a method to compute approximately optimal policies. For the average cost, instead of using the finite-state linear programming approximation method, we use the original problem definition to establish the finite-state asymptotic approximation of the constrained problem and compute approximately optimal policies. Under Lipschitz-type regularity conditions on the components of the MDP, we also obtain explicit rate of convergence bounds quantifying how the approximation improves as the size of the approximating finite-state space increases.

Full-text available at: https://ieeexplore.ieee.org/document/8600330

(4) A Polynomial-Time Algorithm for Solving the Minimal Observability Problem in Conjunctive Boolean Networks

Authors: Eyal Weiss ; Michael Margaliot

Abstract: Many complex systems in biology, physics, and engineering include a large number of state variables (SVs), and measuring the full state of the system is often impossible. Typically, a set of sensors is used to measure a part of the SVs. A system is called observable if these measurements allow to reconstruct the entire state of the system. When the system is not observable, an important and practical problem is how to add a minimal number of sensors so that the system becomes observable. This minimal observability problem is practically useful and theoretically interesting, as it pinpoints the most informative nodes in the system. We consider the minimal observability problem for an important special class of Boolean networks (BNs), called conjunctive BNs (CBNs). Using a graph-theoretic approach, we provide a necessary and sufficient condition for observability of a CBN with n SVs and an efficient algorithm for solving the minimal observability problem. The algorithm time complexity is linear in the length of the description of the CBN and in particular it is $O(n2)$. We demonstrate the usefulness of these results by studying the properties of a class of randomly generated CBNs.

Full-text available at: https://ieeexplore.ieee.org/document/8540082

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3.3. Selections of Discrete Event Dynamic Systems: Theory and Applications
VOLUME: 29, ISSUE: 2, June 2019

(1) An improved approach for marking optimization of timed weighted marked graphs

Authors: Zhou He ; Miao Liu ; Ziyue Ma ; Zhiwu Li ; Alessandro Giua

Abstract: Timed weighted marked graphs are a mathematical formalism suitable to model automated manufacturing systems in which

synchronization and bulk services and arrivals appear, such as assembly lines and kanban systems. In this paper, we aim to develop practically efficient methods for the marking optimization of timed weighted marked graphs, a problem which consists in finding an initial resource assignment to minimize the cost of resources under a given requirement on the cycle time. Starting with a live initial marking, we first compute the critical places of a timed weighted marked graph by exploring an equivalent model called timed marked graph. Then, we develop an analytical method to identify the critical circuit of the system to which tokens will be iteratively added. Application to a real manufacturing system is finally provided, which shows that the developed approach is significantly more efficient than the existing ones.

Full-text available at: https://link.springer.com/article/10.1007/s10626-019-00278-w

(2) Coupling in the queue with impatience: case of several servers

Authors: Pascal Moyal

Abstract: We present the explicit construction of a stable queue with several servers and impatient customers, under stationary ergodic assumptions. Using a stochastic comparison of the (multivariate) workload sequence with two monotonic stochastic recursions, we propose a sufficient condition of existence of a unique stationary state of the system using Renovation theory. Whenever this condition is relaxed we use extension techniques to prove the existence of a stationary state in some cases.

Full-text available at: https://link.springer.com/article/10.1007/s10626-019-00280-2

(3) Sparsity in max-plus algebra and systems

Authors: Anastasios Tsiamis ; Petros Maragos

Abstract: We study sparsity in the max-plus algebraic setting. We seek both exact and approximate solutions of the max-plus linear equation with minimum cardinality of support. In the former case, the sparsest solution problem is shown to be equivalent to the minimum set cover problem and, thus, NP-complete. In the latter one, the approximation is quantified by the ?1 residual error norm, which is shown to have supermodular properties under some convex constraints, called lateness constraints. Thus, greedy approximation algorithms of polynomial complexity can be employed for both problems with guaranteed bounds of approximation. We also study the sparse recovery problem and present conditions, under which, the sparsest exact solution solves it. Through multi-machine interactive processes, we describe how the present framework could be applied to two practical discrete event systems problems: resource optimization and structure-seeking system identification. We also show how

sparsity is related to the pruning problem. Finally, we present a numerical example of the structure-seeking system identification problem and we study the performance of the greedy algorithm via simulations.

Full-text available at: https://link.springer.com/article/10.1007/s10626-019-00281-1

(4) Discrete event system identification with the aim of fault detection

Authors: Marcos V. Moreira ; Jean-Jacques Lesage

Abstract: In this paper, we present a method for discrete event system identification with the aim of fault detection. The method is based on a new model called Deterministic Automaton with Outputs and Conditional Transitions (DAOCT), which is computed from observed fault-free paths, and represents the fault-free system behavior. In practice, a trade-off between size and accuracy of the identified automaton has to be found. In order to obtain compact models, loops are introduced in the model, which implies that sequences that are not observed can be generated by the model leading to an exceeding language. This exceeding language is associated with possible non-detectable faults, and must be reduced in order to use the model for fault detection. We show, in this paper, that the exceeding language generated by the DAOCT is smaller than the exceeding language generated by another model proposed in the literature, reducing, therefore, the number of possible non-detectable faults. We also show that if the identified DAOCT does not have cyclic paths, then the exceeding language is empty, and the model represents all and only all observed fault-free sequences generated by the system. In order to illustrate the results of the paper, a physical system is simulated by using a 3D simulation software controlled by a Programmable Logic Controller (PLC). The main idea is to use a virtual digital system to simulate the fault-free behavior of a physical system, captured by the sequences of input and output signals of the PLC, and then use the method proposed in the paper to obtain the DAOCT model of the plant.

Full-text available at: https://link.springer.com/article/10.1007/s10626-019-00283-z

(5) Efficient generation of performance bounds for a class of traffic scheduling problems

Authors: Greyson Daugherty ; Spyros Reveliotis ; Greg Mohler

Abstract: This work seeks to develop (lower) performance bounds for a traffic scheduling problem that arises in many application contexts, ranging from industrial material handling and robotics to computer game animations and quantum computing. In a first approach, the sought bounds are obtained by applying the Lagrangian relaxation

method to a MIP formulation of the considered scheduling problem that is based on a natural notion of °∞state°± for the underlying traffic system and an analytical characterization of all the possible trajectories of this state over a predefined time horizon. But it is also shown that the corresponding °∞dual°± problem that provides these bounds, can be transformed to a linear program (LP) with numbers of variables and constraints polynomially related to the size of the underlying traffic system and the employed time horizon in the MIP formulation. Furthermore, the derived LP formulation constitutes the LP relaxation of a second MIP formulation for the considered scheduling problem that can be obtained through an existing connection between this problem and the °∞integral multi-commodity flow°± (IMCF) model of network optimization theory. Finally, the theoretical developments of the paper are complemented with a computational part that demonstrates the efficacy of the pursued methods in terms of the quality of the derived bounds, and their computational tractability.

Full-text available at: https://link.springer.com/article/10.1007/s10626-019-00284-y

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3.4. Selections of the IEEE Transactions on Systems, Man, and Cybernetics: Systems
VOLUME: 49, ISSUE: 7, July 2019

(1) Robust Deadlock Control for Automated Manufacturing Systems With Unreliable Resources Based on Petri Net Reachability Graphs

Authors: Gaiyun Liu ; Pei Li ; Zhiwu Li ; Naiqi Wu

Abstract: Resource failures may happen in automated manufacturing systems (AMSs) because of different reasons in the real world, making most existing deadlock control policies unapplicable. This paper develops methods for the robust deadlock control of AMSs with unreliable resources based on Petri nets. The considered AMSs are modeled with generalized systems of simple sequential processes with resources (GS3PR). First, a method based on reachability graph partition technique is provided to analyze the robust legal markings and the forbidden ones in an unreliable GS3PR (U-GS3PR), in which resource failures and recovery procedures are modeled with recovery subnets. Then, the control problem for such a system is converted into a problem for controlling the forbidden states in a U-GS3PR and control places can be designed by solving the maximal number of forbidden markings problems. Since the robust legal reachability spaces computed may be nonconvex and such a system cannot be optimally controlled by the conjunctions of linear constraints, we propose an interval-inhibitor-arc-based robust deadlock control policy for a system with nonconvex legal reachability spaces by solving the maximal number of tq-critical marking/transition separation instances problems (MNTMPs(tq)). Finally, examples are presented to demonstrate the proposed methods.

Full-text available at: https://ieeexplore.ieee.org/document/8345162

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3.5. Selections of the IEEE Transactions on Automation Science and Engineering
VOLUME: 16, ISSUE: 3, July 2019

(1) Designing Efficient Reconfigurable Control Systems Using IEC61499 and Symbolic Model Checking

Author: Safa Guellouz ; Adel Benzina ; Mohamed Khalgui ; Georg Frey ; Zhiwu Li ; Valeriy Vyatkin

Abstract: IEC 61499 provides a standardized approach for the development of distributed control systems. The standard introduces a component architecture, based on function blocks that are event-triggered components processing data and signals. However, it gives only limited support for the design of reconfigurable architectures. In particular, handling of several reconfiguration scenarios is quite heavy on this level since a scenario changes the execution model of the system due to requirements. To this end, a new IEC 61499-based model named reconfigurable function blocks (RFBs) is proposed. An RFB processes the reconfiguration events and switches directly to the suitable configuration using a hierarchical state machine model. The latter represents the reconfiguration model which reacts on changes in the environment in order to find an adequate reconfiguration scenario to be executed. Each scenario presents a particular sequence of algorithms, encapsulated in another execution control chart slave which represents the control model of an RFB. This hierarchy simplifies the design and separates the reconfiguration logic from control models. To verify its correctness and alleviate its state space explosion problem in model checking, this paper translates an RFB system automatically into a generalized model of reconfigurable timed net condition/event systems (GR-TNCES), a Petri net class that preserves the semantics of an RFB system. In this paper, along with verification of deterministic properties, we also propose to quantify and analyze some probabilistic properties. As a case study, we consider a smart-grid system, interpreting permanent faults in it as reconfiguration events, and we characterize them with the expected occurrence probability and the corresponding repair time. A tool chain ZiZo is developed to support the proposed approach. Note to Practitioners °™For reconfigurable distributed control systems, two models are indispensable: a control model that defines the hardware and software behaviors and a reconfiguration model that manages unpredictable changes in the related environment for configuring accordingly the system behavior. The proposed RFB approach is based on hierarchical state chart specification within function blocks, its automatic conversion to a reconfigurable Petri net GR-TNCES, which models all possible reconfiguration scenarios and a probabilistic model checking for qualitative and quantitative analysis. The system flexibility is ensured by a decision algorithm and a reconfiguration matrix which selects dynamically the right

scenario to execute. The approach is supported by ZiZo tool chain which creates and edits reconfigurable function blocks model and converts it automatically to GR-TNCES, and then to specific PRISM models. The detection of the worst cases before deployment is a major virtue of the approach that practitioners need to estimate and enhance the design process. Several properties are easily checked and estimated such as system feasibility before and after reconfiguration, deadlock detection, confluence, estimation of the reconfiguration failure, system availability, and best repair time. The developed software package can be applied in any domain requiring flexibility and failure estimation, such as new medical technologies, transportation systems, smart and microgirds, and manufacturing systems.

Full-text available at: https://ieeexplore.ieee.org/document/8533394

(2) Scheduling Dual-Armed Cluster Tools for Concurrent Processing of Multiple Wafer Types With Identical Job Flows

Author: Sung-Gil Ko ; Tae-Sun Yu ; Tae-Eog Lee

Abstract: As the order size for modern fabs tends to be smaller, fabs wish to process a class of similar wafer lots at a tool concurrently to reduce the work-in-progress lots as well as the total manufacturing lead time. We examine a scheduling problem for a dual-armed cluster tool that simultaneously produces multiple wafer types with identical wafer flow patterns but different process times. We prove that the conventional swap sequence, which is optimal and prevalently being used for single-wafer-type processing, is also optimal for such concurrent processing. We then propose a way of determining a release sequence of wafer types into the tool, called cycle plan , that maximizes the utilization of parallel chambers and hence increases the tool throughput rate. We present conditions for which the parallel chambers are shared by all wafer types and their workloads are evenly balanced so as to maximize the throughput rate. We also report the experimental results. Note to Practitioners °™This paper suggests how to operate cluster tools for concurrent processing of similar wafer types. The results ensure that the conventional swap sequence is still effective for concurrent processing. We also provide a simple strategy of mixing different wafer types and the optimal release sequence for the wafers. We confirm that the tool throughput can be significantly improved when the release sequence of wafers is properly determined.

Full-text available at: https://ieeexplore.ieee.org/document/8472192

(3) A Cyclic Scheduling Approach to Single-Arm Cluster Tools With Multiple Wafer Types and Residency Time Constraints

Author: Jipeng Wang ; Chunrong Pan ; Hesuan Hu ; Liang Li ; Yuan Zhou

Abstract: With the reduction of wafer batch size on account of the diversification and individuation of consumption demands, increasing importance has been attached to the schedulability and controllability of the cluster tools with multiple wafer types being concurrently processed, while the corresponding research is seldom and still open. This paper is devoted to addressing the steady-state scheduling of single-arm cluster tools with multiple wafer types and residency time constraints. Inspired by the definition of wafer flow pattern for the single wafer type, a novel description for the multiple wafer types is introduced. For the sake of efficiency and simplicity, the multiplex backward sequence is proposed. To balance the workload of process steps, a virtual module technology with a two-tiered architecture is implemented. Furthermore, several sufficient and necessary conditions are derived to verify the schedulability of the system. Finally, an efficient algorithm is presented to find the periodic steady-state schedule, and its practicability and availability are validated by the given illustrative examples. Note to Practitioners °™Cluster tools are a kind of highly automated, flexible, and integrated equipment applied widely in diversified semiconductor fabrication processes. Due to the strictness of processing constraints and unavailability of in-built buffers, it is challenging to effectively operate cluster tools. For a higher utilization of processing modules, fabs tend to concurrently process several kinds of wafers with dissimilar recipes in a cluster tool. However, the related scheduling and control problems remain open. With residency time constraints, this paper addresses the scheduling problems of single-arm cluster tools with multiple wafer types. By dissecting the mechanism of mixed-processing of multiple wafer types, several formal conditions are obtained to test the schedulability. Based on the multiplex backward sequence, a cyclic scheduling approach to single-arm cluster tools with multiple wafer types is presented. With the proposed method, schedulability conditions can be readily checked and a periodic schedule can be found easily. Thus, it can be applied to solve practical application problems.

Full-text available at: https://ieeexplore.ieee.org/document/8543218

(4) Inventory-Constrained Throughput Optimization for Stochastic Customer Orders

Author: Yaping Zhao ; Xiaoyun Xu ; Haidong Li

Abstract: Inventory®Cproduction coordination for customer orders is becoming increasingly important for companies to increase customer responsiveness and achieve economic purposes. In this paper, the joint optimization of inventory and production is considered for stochastic customer orders to maximize the throughput. Demands of customer orders dynamically arrive at the inventory department, and each incoming order consists of multiple product types with random workloads. To process the workloads, certain amounts of a common raw material are required and need to be drawn from the inventory department. A customer order will be lost if there do not exist

enough raw materials in the inventory department. With the necessary materials, workloads of accepted orders will be assigned to a set of unrelated parallel servers to be processed in the production department. This paper intends to maximize the effective throughput through proper coordination of the inventory and the production departments. For this problem, system bottlenecks are identified and analyzed, and mathematical programming models are developed to determine the optimal throughput and the corresponding inventory and production policies. Several special cases are also explored to provide intuitive insights into the relationship between the system parameters and optimal throughput. Relationships between key model parameters and effective throughput are identified through sensitivity analysis and further validated by the results of computational experiments. Note to Practitioners °™Coordination of production and inventory is crucial for system efficiency improvement. In order to better operate the system and respond to customer demands, this paper explores such coordination for stochastic customer orders to achieve the maximum effective throughput. Particularly, we consider the case where production is constrained by material inventory. System bottlenecks for various cases are identified, which can facilitate system diagnosis and performance evaluation. Based on the bottleneck analysis, an optimization problem is formulated to provide the optimal throughput and policy. Several important practical cases are also discussed, including single product type, identical/uniform servers, and speed-identical/uniform product types. Besides, sensitivity analysis is conducted to show how the changes of parameters such as expected workload and server speed will affect throughput performance. In the future research, more complex production environments and cost-related constraints will be further considered to help practitioners achieve desirable system outputs.

Full-text available at: https://ieeexplore.ieee.org/document/8595434

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3.6 Selections from the International Journal of Control
VOLUME: 92, ISSUE: 7, July 2019

(1) Relative coobservability for decentralised supervisory control of discrete-event systems

Author: Kai Cai ; Renyuan Zhang ; W.M. Wonham

Abstract: In this paper, we study the concept of relative coobservability in decentralised supervisory control of discrete-event systems under partial observation. This extends our previous work on relative observability from a centralised setup to a decentralised one. A fundamental concept in decentralised supervisory control is coobservability (and its several variations); this property is not, however, closed under set union, and hence there generally does not exist the supremal element. Our proposed relative coobservability, although stronger than coobservability, is algebraically well behaved, and the supremal relatively coobservable

sublanguage of a given language exists. We present a language-based algorithm to compute this supremal sublanguage; the algorithm allows straightforward implementation using off-the-shelf algorithms. Moreover, relative coobservability is weaker than conormality, which is also closed under set union; unlike conormality, relative coobservability imposes no constraint on disabling unobservable controllable events.

Full-text available at: https://www.tandfonline.com/doi/full/10.1080/00207179.2017.1397754

(2) Relative predictability of failure event occurrences and its opacity-based test algorithm

Author: Rui Zhao ; Fuchun Liu ; Jianxin Tan

Abstract: In this paper, the problem of relative predictability of failure event occurrences is investigated. The notion of relative predictability is proposed for logical automata and the concept of predictable rate is introduced to characterise the predictability property of a discrete-event system, which takes values in the interval [0, 1]. Intuitively, a discrete-event system being relatively predictable means that there exist some failure events which can be predicted from the observations of the system. The relationship between relative predictability and predictability introduced by Sahika Genc et al. analysed and the analysis shows that relative predictability is weaker than predictability for discrete-event systems. Furthermore, a necessary and sufficient condition for relative predictability is presented. In particular, an opacity-based algorithm is developed to test the relative predictability, which is polynomial in the number of states of the system. Also, some examples are provided to illustrate the presented results.

Full-text available at: https://www.tandfonline.com/doi/full/10.1080/00207179.2017.1403049

4. Conferences

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

4.1 2019 American Control Conference
Philadelphia, Pennsylvania, United States, Jul 10 - Jul 12, 2019
http://acc2019.a2c2.org/

4.2 38th Chinese Control Conference (CCC 2019)
Guangzhou, China, Jul 27 - Jul 30, 2019
http://www.ccc2019.cn/en/index.html

4.3 2019 Conference on Control Technology and Applications
Hong Kong, China, Aug 19 - Aug 21, 2019
http://ccta2019.ieeecss.org/

4.4 15th International Conference on Automation Science and Engineering
Vancouver, British Columbia, Canada, Aug 22 - Aug 26, 2019
http://case2019.hust.edu.cn/index.htm

4.5 57th Annual Allerton Conference on Communication, Control, and Computing
Allerton Park, United States, Sep 24 - Sep 27, 2019

4.6 2019 Conference on Decision and Control
Nice, France, December 11-13, 2019
https://cdc2019.ieeecss.org/

5. CFP: Journal Special Issues

5.1 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
- 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.

Guest Editors

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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.