IEEE CONTROL SYSTEMS SOCIETY TECHNICAL COMMITTEE

ON DISCRETE EVENT SYSTEMS

Newsletter..... February 2015

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Welcome to the newsletter of the IEEE Control Systems Technical Committee on Discrete Event Systems!

Personal note from the editor:

WELCOME TO THE FEBRUARY 2015 NEWSLETTER.

SAMUEL

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Journals

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SELECTIONS FROM THE IEEE TRANSACTIONS ON AUTOMATIC CONTROL
VOLUME: 60 ISSUE: 2
FEBRUARY 2015

1) Probabilistic Marking Estimation in Labeled Petri Nets

M.P. Cabasino, C.N. Hadjicostis ; C. Seatzu

Abstract

Given a labeled Petri net, possibly with silent (unobservable) transitions, we are interested

in performing marking estimation in a probabilistic setting. We assume a known initial marking

or a known finite set of initial markings, each with some a priori probability, and our goal is

to obtain the conditional probabilities of possible markings of the Petri net, conditioned on

an observed sequence of labels. Under the assumptions that (i) the set of possible markings,

starting from any reachable marking and following any arbitrarily long sequence of unobservable

transitions, is bounded, and (ii) a characterization of the a priori probabilities of

occurrence for each transition enabled at each reachable marking is available, explicitly or

implicitly, we develop a recursive algorithm that efficiently performs current marking

estimation.

http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6866174&searchWithin%3Dpetri

%26sortType%3Dasc_p_Sequence%26filter%3DAND%28p_IS_Number%3A7017603%29

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SELECTIONS FROM THE IEEE TRANSACTIONS ON CONTROL SYSTEMS TECHNOLOGY
VOLUME: 23 ISSUE: 2
FEBRUARY 2015

1) A Petri Net-Based Discrete-Event Control of Automated Manufacturing Systems with Assembly

Operations

H. Hu, M. Zhou

Abstract

In the context of automated manufacturing systems (AMSs), Petri nets are widely adopted to

solve the modeling, analysis, and control problems. So far, nearly all known approaches to

liveness-enforcing supervisory control study AMSs with flexible routes, whereas little work

investigates the ones with synchronization operations. Compared with flexibility,

synchronization allows the disassembly and assembly operations that correspond to splitting to

and merging from different subprocesses, respectively. Such structures bring difficulties to

establish a liveness condition of the Petri net model of AMSs. In this paper, we propose a

novel class of systems, which can well deal with these features so as to facilitate the

investigation of such complex systems. Using structural analysis, we show that their liveness

can be attributed to deadlock freeness, which is much easier to analyze, detect, and control by

synthesizing a proper supervisory controller. Furthermore, a set of mathematical formulations

is proposed to describe and extract the corresponding deadlocks. This facilitates the synthesis

of liveness enforcing supervisors as it avoids the consideration of deadlock-free but nonlive

scenarios. The effectiveness and efficiency of this new method is shown by AMS examples.

http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6880325&searchWithin%3Devent

%26sortType%3Dasc_p_Sequence%26filter%3DAND%28p_IS_Number%3A7042235%29

2)Symbolic Supervisory Control of Timed Discrete Event Systems

S. Miremadi, Z. Fei, ; K. Akesson; B. Lennartson

Abstract

We symbolically compute a nonblocking, controllable, and minimally restrictive supervisor for

timed discrete event systems (TDESs), in the supervisory control theory context. We model TDES

based on timed extended finite automata (TEFAs): an augmentation of extended finite automata

(EFAs) by incorporating discrete time into the model. EFAs are ordinary automata extended with

discrete variables, where conditional expressions and update functions can be attached to the

transitions. The controllability is defined based on the corresponding tick models of the

TEFAs. A tick can be considered as an event that is generated by a global digital clock. The

tick models suffer from a major problem: the state size is very sensitive to the clock

frequency. We show how a controllable supervisor, equivalent to the one computed based on the

tick models, can be obtained by eliminating the tick events. To tackle large problems, all

computations are conducted symbolically using binary decision diagrams (BDDs). We show that,

based on the proposed approach, a fixed point is reached earlier in the reachability analysis

and that the size of the intermediate BDDs usually becomes smaller. The framework has been

applied to a real industrial application and several benchmarks..

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%26sortType%3Dasc_p_Sequence%26filter%3DAND%28p_IS_Number%3A7042235%29

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SELECTIONS FROM THE AUTOMATICA
VOLUME: 54
APRIL 2015

1)Parameterized Markov decision process and its application to service rate control

Li Xia, Qing-Shan Jia

Abstract

In this paper, we discuss the optimization of Markov decision processes (MDPs) with

parameterized policy, where the state space is partitioned and a parameter is assigned to each

partition. The goal is to find the optimal parameters which maximize the long-run average

performance. The traditional policy iteration is usually inapplicable to parameterized policy

because the parameter tuning at different states are correlated. With some appropriate

assumptions and special conditions, we develop a modified policy iteration type algorithm to

find the optimal parameters. Compared with the traditional gradient-based approaches for MDP

with parameterized policy, this policy iteration type approach is much more efficient. Finally,

as an example, we apply this approach to a service rate control problem in closed Jackson

networks. As compared with the gradient-based approach which is trapped into local optimum, our

approach is demonstrated to efficiently find the optimal service rates in global scope.

http://www.sciencedirect.com/science/article/pii/S0005109815000072

2)Self-triggered sampling for second-moment stability of state-feedback controlled SDE systems

Ross P. Anderson, Dejan Milutinovi?, Dimos V. Dimarogonas

Abstract

Event-triggered and self-triggered control, whereby the times for controller updates are

computed from sampled data, have recently been shown to reduce the computational load or

increase task periods for real-time embedded control systems. In this work, we propose a self-

triggered scheme for nonlinear controlled stochastic differential equations with additive noise

terms. We find that the family of trajectories generated by these processes demands a departure

from the standard deterministic approach to event- and self-triggering, and, for that reason,

we use the statistics of the sampled-data system to derive a self-triggering update condition

that guarantees second-moment stability. We show that the length of the times between

controller updates as computed from the proposed scheme is strictly positive and provide

related examples.

http://www.sciencedirect.com/science/article/pii/S0005109815000308

3)A robust stability framework for LTI systems with time-varying sampling

Christophe Fiter, Laurentiu Hetel, Wilfrid Perruquetti, Jean-Pierre Richard

Abstract

This work aims at enlarging the sampling intervals in several state feedback control situations

by designing a sampling map in the state space. We consider the case of linear time invariant

(LTI) systems with state-bounded perturbations, and guarantee their exponential stability for a

chosen decay-rate. The approach is based on linear matrix inequalities (LMIs) obtained thanks

to Lyapunov－Razumikhin stability conditions and convexification arguments. First, it enables

to optimize the lower-bound of the sampling maps by computing the adequate Lyapunov－Razumikhin

function. This result can be interpreted as a robust stability analysis with respect to

arbitrary time-varying sampling intervals, which may be useful in the case of uncontrolled

sampling, or in the presence of phenomenon such as sampling jitter. Then, the obtained results

are extended to design the sampling map in three dynamic sampling control situations: event-

triggered control, self-triggered control, and state-dependent sampling. The results are

illustrated with a numerical example from the literature.

http://www.sciencedirect.com/science/article/pii/S000510981500045X

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SELECTIONS FROM THE IEEE TRANSACTIONS ON SOFTWARE ENGINEERING
VOLUME: 41 ISSUE: 2
APRIL 2015

1)Exploiting Model Morphology for Event-Based Testing

Abstract

Model-based testing employs models for testing. Model-based mutation testing (MBMT)

additionally involves fault models, called mutants, by applying mutation operators to the

original model. A problem encountered with MBMT is the elimination of equivalent mutants and

multiple mutants modeling the same faults. Another problem is the need to

compare a mutant to

the original model for test generation. This paper proposes an event-based approach to MBMT

that is not fixed on single events and a single model but rather operates on sequences of

events of length k >= 1 and invokes a sequence of models that are derived from the original one

by varying its morphology based on k. The approach employs formal grammars, related mutation

operators, and algorithms to generate test cases, enabling the following: (1) the exclusion of

equivalent mutants and multiple mutants; (2) the generation of a test case in linear time to

kill a selected mutant without comparing it to the original model; (3) the analysis of

morphologically different models enabling the systematic generation of mutants, thereby

extending the set of fault models studied in related literature. Three case studies validate

the approach and analyze its characteristics in comparison to random testing and another MBMT

approach.

http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6915728&searchWithin%3Devent

%26sortType%3Dasc_p_Sequence%26filter%3DAND%28p_IS_Number%3A7038242%29

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SELECTIONS FROM THE IEEE TRANSACTIONS ON AUTOMATION SCIENCE AND ENGINEERING
VOLUME: 12 ISSUE: 2
JANUARY 2015

1)A Polynomial Algorithm to Performance Analysis of Concurrent Systems Via Petri Nets and

Ordinary Differential Equations

Zuohua Ding, Yuan Zhou, MengChu Zhou

Abstract

In this paper, a new method is proposed to evaluate the performance of concurrent systems. A

concurrent system consisting of multiple processes that communicate via message passing

mechanisms is modeled by a Petri net, which is in turn represented by a set of ordinary

differential equations (ODEs) of a restricted type. The equations describe the system state

changes, and the solutions, also called state measures, can be used for the performance

analysis such as estimating response time, throughput and efficiency. This method can avoid a

state explosion problem encountered by the conventional methods based on Continuous-Time Markov

Chains. Its application to an IBM business system is given as an example.

http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6684591&searchWithin%3Devent

%26sortType%3Dasc_p_Sequence%26filter%3DAND%28p_IS_Number%3A7000614%29

2)Dynamic Low-Power Reconfiguration of Real-Time Systems with Periodic and Probabilistic Tasks

Xi Wang, I. Khemaissia , M. Khalgui; ZhiWu Li; O. Mosbahi; MengChu Zhou

Abstract

This paper deals with the dynamic low-power reconfiguration of a real-time system. It processes

periodic and probabilistic tasks that have hard/soft deadlines corresponding to

internal/external events. A runtime event-based reconfiguration scenario is a dynamic operation

allowing the addition/removal of the assumed periodic/probabilistic tasks. Thereafter, some

tasks may miss their hard deadlines and the power consumption may increase. In order to

reconfigure the system to be feasible, i.e., satisfying its real-time constraints with low-

power consumption, this research presents a software-agent-based architecture.

An intelligent

agent is developed, which provides four solutions to reconfigure the system at runtime. For

these solutions, in order to reconfigure the probabilistic tasks to be feasible, the agent

modifies their temporal parameters dynamically; moreover, in order to feasibly serve the

probabilistic tasks and reduce the system's power consumption, the agent provides three virtual

processors by dynamically extending the periods of the periodic tasks. A simulation study

verifies the effectiveness of the agent.

http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6784140&searchWithin%3Devent

%26sortType%3Dasc_p_Sequence%26filter%3DAND%28p_IS_Number%3A7000614%29

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SELECTIONS FROM THE IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS: SYSTEMS

VOLUME: 45 ISSUE: 3
MARCH 2015

1)Deadlock Prevention for Flexible Manufacturing Systems via Controllable Siphon Basis of Petri

Nets

H. Liu, K. Xing, W. Wu, M. Zhou, H. Zou

Abstract

Siphons are a kind of special structural objects in a Petri net, and play a key role in

synthesizing a live Petri net controller for flexible manufacturing systems. In order to obtain

a small size Petri net controller, this paper introduces the concept of a controllable siphon

basis. It then proves that a live Petri net controller can be established by adding a control

place and related arcs to each strict minimal siphon (SMS) in a controllable siphon basis. The

initial markings of control places are determined by an integer linear program. The number of

control places in the obtained controllers is the same as the number of SMSs in the

controllable siphon basis, while the latter is no more than that of the activity places in a

Petri net model. An algorithm for constructing a controllable siphon basis is proposed, and a

new deadlock prevention policy based on it is established. A few examples are provided to

demonstrate the proposed concepts and policy and used to compare them with the state-of-the-art

methods.

http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6895143&searchWithin%3Devent

%26sortType%3Dasc_p_Sequence%26filter%3DA1D%28p_IS_Number%3A7031988%29

2)Marking Estimation of P-Time Petri Nets with Unobservable Transitions

Abstract

This paper focuses on the problem of estimating the marking of an unlabeled P-time Petri net

with partial information modeled by unobservable transitions. The proposed approach is based on

a novel state observer synthesis method under partial observation. A procedure that, given a

sequence of observable transitions with their firing time instants, allows to determine the set

of markings consistent with the considered observation is given. The method relies on the

feasibility in time (called schedulability) of particular firing sequences, namely the

candidates firing sequences. Moreover, although time is taken into consideration, the proposed

technique is not hampered by the state space explosion problem as it relies on the underlying

untimed structure of the P-time model considered—the building of the state class graph is not

necessary.

http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6899701&searchWithin%3Devent

%26sortType%3Dasc_p_Sequence%26filter%3DAND%28p_IS_Number%3A7031988%29

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SELECTIONS FROM THE INTERNATIONAL JOURNAL OF CONTROL
VOLUME: 88 ISSUE: 3
MARCH 2015

1)Distributed event-triggered output regulation of multi-agent systems

Xiaoli Wang, Wei Ni, Zhibin Ma

Abstract

Motivated by the future use of embedded microprocessors with limited resources and limited

computational resources, the distributed output regulation with event-driven strategies problem

of linear multi-agent systems is considered in this paper. The main task is to design

distributed feedback by employing event-triggered technique for multi-agent systems such that

all agents can track an active leader, and/or distributed disturbance rejection. Both leader

and disturbance are generated by some external system (exosystem). Both distributed static and

dynamic feedback with event-triggered strategy are constructed here. Then, the input-to-state

stability of the closed-loop multi-agent system is analysed. Finally, a numerical example is

given to validate the proposed control.

http://www.tandfonline.com/doi/full/10.1080/00207179.2014.971432#abstract

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SELECTIONS FROM THE NONLINEAR ANALYSIS: HYBRID SYSTEMS
AVAILABLE ONLINE
DECEMBER 2014

1)Hybrid and Hybrid Adaptive Petri Nets: On the computation of a Reachability Graph

Estíbaliz Fraca, Jorge Júlvez, Manuel Silva

Abstract

Petri Nets (PNs) constitute a well known family of formalisms for the modelling and analysis of

Discrete Event Dynamic Systems (DEDS). As general formalisms for DEDS, PNs suffer from the

state explosion problem. A way to alleviate this difficulty is to relax the original discrete

model and deal with a fully or partially continuous model. In Hybrid Petri Nets (HPNs),

transitions can be either discrete or continuous, but not both. In Hybrid Adaptive Petri Nets

(HAPNs), each transition commutes between discrete and continuous behaviour depending on a

threshold: if its load is higher than its threshold, it behaves as continuous; otherwise, it

behaves as discrete. This way, transitions adapt their behaviour dynamically to their load.

This paper proposes a method to compute the Reachability Graph (RG) of HPNs and HAPNs.

http://www.sciencedirect.com/science/article/pii/S1751570X14000624

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