Special issue on “New approaches for DES modeling, analysis and synthesis”

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In 2014, we were invited by the Editor-in-Chief of J-DEDS at the time, Xiren Cao, to serve as Guest Editors for a special issue focused on “New approaches for DES modeling, analysis and synthesis”, that would capture recent trends in our research community. After consultation with colleagues, we invited five groups of authors to submit papers to this special issue. These papers were then reviewed according to the normal review process of J-DEDS. In the end, the four papers that were accepted cover a wide range of recent advances and propose new approaches for modeling, verification and control of discrete event systems (DES). A brief description of each paper in this special issue follows.

The first paper, “Supervisory Control Synthesis for Deterministic Context Free Specification Languages - Enforcing Controllability Least Restrictively”, by Anne-Kathrin Schmuck, Sven Schneider, Jörg Raisch, and Uwe Nestmann, deals with supervisory control of DES. Classical results on the subject consider the synthesis of least restrictive supervisors for DES, where plant and specifications are modeled by Regular Languages and their Deterministic Finite Automata (DFA) realizations. The paper extends those results by considering specifications written in the form of a Deterministic Context Free Language (DCFL) represented by Deterministic Push-Down Automata (DPDA). It provides an algorithm to compute least restrictive supervisors for this class of specifications. Since DCFL encompasses the class of regular languages, the contribution of the paper broadens the domain of application of the supervisory control theory.

The second paper, “A Framework for Compositional Nonblocking Verification of Extended Finite-State Machines”, by Sahar Mohajerani, Robi Malik and Martin Fabian, deals with the verification of nonblockingness in DES. This is a very important issue when dealing with DES modeled as the composition of several subsystems, and more specifically when using modular approaches for the synthesis of supervisors. In this class of DES, blocking may arise due to possible conflicts between subsystems. The paper presents a compositional nonblocking

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verification approach for DES modeled as a set of finite-state machines equipped with variables and guards, called Extended Finite-State Machines (EFSM). The basic idea is to perform a step by step synchronous composition on abstracted EFSM, which are simplified versions of the original EFSM, in a way that preserves the nonblocking property of the global system. Different methods of abstracting the EFSM are proposed and the approach is shown to perform successfully on several large scale DES.

In the paper by Marco Pocci, Isabel Demongodin, Norbert Giambiasi and Alessandro Giua, titled “Synchronizing Sequences on a Class of Unbounded Systems using Synchronized Petri Nets”, an approach is presented to determine the current state of an unbounded DES without knowing its initial state. Synchronized Petri nets, i.e., nets whose evolution is driven by external input events, are used. Despite the fact that no finite state space representation can exhaustively answer the reachability problem, it is shown that synchronizing sequences can be effectively computed for a particular class of unbounded synchronized Petri nets.

The last paper of this special issue, “VeriSiMPL 2: An Open-Source Software for the Verification of Max-Plus-Linear Systems” by Dieky Adzkiya, Yining Zhang and Alessandro Abate, deals with a technique to generate finite abstractions of autonomous Max-Plus-Linear (MPL) systems, a class of DES employed to characterize the dynamics of the timing related to the synchronization of successive events. The equivalence between the obtained finite abstractions - derived as finite-state transition systems - and the original MPL system is proven by simulation or bisimulation. Furthermore, the tool VeriSiMPL 2, an open-source software for the Verification of Max-Plus-Linear systems, is presented and tested through numerical benchmarks.

We are grateful to the authors for their creative and worthwhile contributions, and we thank the reviewers for their careful reading and constructive comments. We also wish to express our sincere thanks to the past and to the current Editors-in-Chief of J-DEDS, Xi-Ren Cao and Stéphane Lafortune, for inviting us to serve as Guest Editors for this special issue.

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