

Application and Theory of Petri Nets and Concurrency 2020: Special Issue of Selected Papers

Preface

This special issue presents selected papers from the 41st International Conference on Application and Theory of Petri Nets and Concurrency (Petri Nets 2020), which was organized by the LoVe (Logics and Verification) team of the computer science laboratory LIPN (Laboratoire d'Informatique de Paris Nord), University Sorbonne Paris Nord, and CNRS, jointly with the members of the Paris region MeFoSy-LoMa group (Méthodes Formelles pour les Systèmes Logiciels et Matériels) in June 2020. The conference took place online due to the covid pandemics. The Program Committee selected 23 out of 56 papers submitted to Petri Nets 2020 by authors from 21 different countries. Each paper was reviewed by three reviewers. After the conference, five papers were distinguished by the Program Committee members, whose authors were invited to revise and extend their conference papers for this special issue. The extended submissions have been reviewed in a separate reviewing process to meet the standards of *Fundamenta Informaticae*.

The paper *Piecewise Affine Dynamical Models of Timed Petri Nets - Application to Emergency Call Centers* by Xavier Allamigeon, Marin Boyet and Stéphane Gaubert Mail, contributes to the study of performance properties of timed Petri nets (TPNs) under priority routing policies, making strong use of the semi-Markov Decision processes (SMDPs). The paper presents a number of important and difficult results with highly relevant applications. The paper also shows an interesting paradox showing that an increase of resource may lead to a decrease of throughput under priority ruling.

In the paper *Inferring Unobserved Events in Systems With Shared Resources and Queues*, Dirk Fahland, Vadim Denisov and Wil van der Aalst consider systems where cases compete for shared resources, like baggage handling systems in airports. Often only partial logging is implemented in such systems, which complicates data-driven analysis of their performance. The authors reconstruct unobserved behavior and performance information of each case and each shared resource in the system that is consistent with both observed and reconstructed unobserved behavior and performance of all other cases and shared resources.

In the paper *On the expressive power of non-deterministic and unambiguous Petri nets over infinite words*, Olivier Finkel and Michał Skrzypczak present their results on the complexity of ω -languages

accepted by real time 4-blind-counter Büchi automata. The central result of the paper is equality of topological complexity of ω -languages of (non-deterministic) Petri nets and ω -languages of (non-deterministic) Turing machines. The authors also show that it is highly undecidable to determine the topological complexity of a Petri net ω -languages and infer that their equivalence and inclusion are Π_2^1 -complete, hence also highly undecidable.

In the paper *Automated Repair of Process Models with Non-Local Constraints Using State-Based Region Theory*, Anna Kalenkova, Josep Carmona, Artem Polyvyanyy and Marcello La Rosa aim to improve the quality of process models obtained by (possibly inaccurate) process discovery algorithms like Split Miner. They present a region-based approach to repair free-choice wf-models by adding additional non-free-choice conditions. The effectiveness of the approach is illustrated by experimental results.

The paper *Symbolic and Structural Model-Checking* by Yann Thierry-Mieg, introduces an approach to Petri nets model-checking combining under-approximation techniques by sampling of runs with SMT-based over-approximation techniques and a set of structural reduction rules. Crucially, the complexity stays proportional to the size of the net structure rather than to the state-space size. This approach won the 9th edition of the Model Checking Contest (MCC) in 2020 both for reachability queries and for deadlock detection.

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