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Fabrice Kordon · Daniel Moldt
Guest Editors

Transactions on Petri Nets and Other Models of Concurrency XVI

Maciej Koutny
Editor-in-Chief

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Daniel Moldt (Eds.)

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Preface by Editor-in-Chief

The 16th issue of LNCS Transactions on Petri Nets and Other Models of Concurrency (ToPNoC) contains revised and extended versions of a selection of the best papers from the workshops held at the 41st International Conference on Application and Theory of Petri Nets and Concurrency (Petri Nets 2020, Paris, France, June 23–25, 2020) and the 20th International Conference on Application of Concurrency to System Design (ACSD 2020, Paris, France, June 23–25, 2020).

I would like to thank the two guest editors of this special issue: Fabrice Kordon and Daniel Moldt. Moreover, I would like to thank all authors, reviewers, and organizers of the Petri Nets 2020 and ACSD 2020 satellite workshops, without whom this issue of ToPNoC would not have been possible.

February 2022 Maciej Koutny

LNCS Transactions on Petri Nets and Other Models of Concurrency: Aims and Scope

ToPNoC aims to publish papers from all areas of Petri nets and other models of concurrency ranging from theoretical work to tool support and industrial applications. The foundations of Petri nets were laid by the pioneering work of Carl Adam Petri and his colleagues in the early 1960s. Since then, a huge volume of material has been developed and published in journals and books as well as presented at workshops and conferences.

The annual International Conference on Application and Theory of Petri Nets and Concurrency started in 1980. For more information on the international Petri net community see http://www.informatik.uni-hamburg.de/TGI/PetriNets/.

All issues of ToPNoC are LNCS volumes. Hence, they appear in all main libraries and are also accessible on SpringerLink (electronically). It is possible to subscribe to ToPNoC without subscribing to the rest of LNCS.

ToPNoC contains the following:

- Revised versions of a selection of the best papers from workshops and tutorials concerned with Petri nets and concurrency
- Special issues related to particular subareas (similar to those published in the Advances in Petri Nets series)
- Other papers invited for publication in ToPNoC
- Papers submitted directly to ToPNoC by their authors

Like all other journals, ToPNoC has an Editorial Board, which is responsible for the quality of the journal. The members of the board assist in the reviewing of papers submitted or invited for publication in ToPNoC. Moreover, they may make recommendations concerning collections of papers for special issues. The Editorial Board consists of prominent researchers within the Petri net community and in related fields.

Topics

The topics covered include system design and verification using nets; analysis and synthesis; structure and behavior of nets; relationships between net theory and other approaches; causality/partial order theory of concurrency; net-based semantical, logical, and algebraic calculi; symbolic net representation (graphical or textual); computer tools for nets; experience with using nets, case studies; educational issues related to nets; higher-level net models; timed and stochastic nets; and standardization of nets.

Also included are applications of nets to biological systems; security systems; e-commerce and trading; embedded systems; environmental systems; flexible manufacturing systems; hardware structures; health and medical systems; office automation; operations research; performance evaluation; programming languages; protocols and

networks; railway networks; real-time systems; supervisory control; telecommunications; cyber physical systems; and workflow.

For more information about ToPNoC see http://www.springer.com/gp/computer-science/lncs/lncs-transactions/petri-nets-and-other-models-of-concurrency-topnoc-/731240

Submission of Manuscripts

Manuscripts should follow LNCS formatting guidelines, and should be submitted as PDF or zipped PostScript files to ToPNoC@ncl.ac.uk. All queries should be addressed to the same e-mail address.

LNCS Transactions on Petri Nets and Other Models of Concurrency: Editorial Board

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Preface by Guest Editors

This volume of ToPNoC contains revised versions of a selection of the best workshop papers presented at satellite events of the 41st International Conference on Application and Theory of Petri Nets and Concurrency (Petri Nets 2020) and the 20th International Conference on Application of Concurrency to System Design (ACSD 2020). These events took place in Paris, France, in June 2020.

As guest editors, we are indebted to the Program Committees of the workshops and in particular to the chairs. Without their enthusiastic efforts, this volume would not have been possible.

The workshop papers considered for this special issue were selected in close cooperation with the workshop chairs. Members of the Program Committees and other colleagues participated in reviewing the new versions of the papers eventually submitted. We received suggestions for papers for this special issue from

- ATAED 2020: Workshop on Algorithms & Theories for the Analysis of Event Data (chairs: Wil van der Aalst, Robin Bergenthum, and Josep Carmona), and
- PNSE 2020: International Workshop on Petri Nets and Software Engineering (chairs: Ekkart Kindler, Michael Köhler-Bußmeier, and Heiko Rölke).

The authors of the suggested papers were invited to improve and extend their results, where possible, on the basis of comments received before and during the workshops. Each resulting revised submission was reviewed by at least two referees. We followed the principle of asking for fresh reviews of the revised papers, also from referees not involved initially in the reviewing of the original workshop contributions. All papers underwent the standard two- or three-stage journal reviewing process, and eventually five papers were accepted after rigorous reviewing and revising.

Structural transformations, by preserving properties of formal models of concurrent systems, ease their verification. The paper ‘Property-Preserving Transformations of Elementary Net Systems Based on Morphisms’, by Luca Bernardinello, Irina Lomazova, Roman Nesterov, and Lucia Pomello, defines several such transformations focused on local abstractions and refinements. These transformations can be applied on elementary net systems. The original elementary net and the transformed one are related by an α-morphism preserving behavioral properties like deadlocks.

The paper focuses on a rigorous definition of these transformations, as well as an application of these transformation rules to Workflow Net Composition. In this application, ready-to-use solutions to organize correct interactions of components in complex parallel systems are deduced from the transformations.

It is very complex to model semi-structured processes in a meaningful way. Thus, people exploit logs for automatic discovery based on the notion of local process models. However, these techniques rarely find patterns larger than 4–5 events. Thus, too many models are discovered and the same events may be covered many times while others remain unexplained.

In their paper, 'Defining Meaningful Local Process Models', Mitchel Brunings, Dirk Fahland, and Boudewijn van Dongen show how sets of local process models are useful. In particular, a coverage metric is defined to evaluate (sets of) local process models. An application based on the BPIC12 benchmark (defined in 2012 by one of the authors) shows and illustrates how this approach works.

The paper 'Distributed Synthesis of Asynchronously Communicating Distributed Process Models', by Pieter Kwantes and Jetty Kleijn, addresses the challenge of synthesizing distributed process models. Given a language in the form of an event log, process models are created in the form of I-nets. Given processes in the form of E-nets and the common interfaces in the form of channels, a new I-net can be synthesized using an algorithm. The problem that interactions between processes are not included can be addressed by a context-dependent view. The conditions when local behavior that is not revealed from the event logs of the services acting together are specified.

As an application domain, local Enterprise nets are considered as asynchronously communicating local processes, which can be merged into global Industry nets. A formalization of the causal structure of the industrial network is obtained from the derivation of a partial order from the message exchange. It is shown how existing algorithms for the identification of isolated processes can be adapted to constitute higher-level Enterprise nets under certain boundary conditions.

Motivated by application domains that have a large number of tokens in corresponding Petri net models and thus often describe a very large state space, Torsten Liebke and Karsten Wolf pursue an approach that minimizes the initial marking needed for analysis as much as possible, which is described in their paper 'Using Approximation for the Verification of Token-Scaling Models'. By under-approximating the reachable states, model checking of a witness path that also applies to the original state space is enabled. Thus, existential temporal properties (ECTL*) become investigatable, which otherwise cannot be proved. The question of the minimum number of tokens that have to be used is approached by the authors via heuristics. A successful, concrete implementation takes place in the model checker LoLA 2.

Due to the large number of problems in the field of Petri net analysis, numerous verification techniques are used in the verification tools. Since the selection of the right analysis technique is hardly possible due to the respective net models and properties, the tools have to perform an appropriate management, e.g., by a portfolio manager.

Using the LoLA 2 tool as an example, Karsten Wolf shows the architecture of a portfolio manager in his paper 'Portfolio Management in Explicit Model Checking'. Central questions of the design of analysis tools are thus systematically discussed against the background of many years of experience of the practical use of LoLA 2. Resources are managed using a task tree. The internal structure of the task tree represents the logical structure of the portfolio and guides the application of the verification algorithms located in the leaves to optimize the use of resources.

In addition, the paper Practical Distributed Implementation of Very Large Scale Petri Net Simulations by Ashur Rafiev, Jordan Morris, Fei Xia, Alex Yakovlev, Matthew Naylor, Simon Moore, David Thomas, Graeme Bragg, Mark Vousden, and Andrew Brown, submitted directly to ToPNoC, presents a method for simulating large-scale concurrent Petri net models using parallel distributed hardware platforms.

As guest editors, we would like to thank all the authors and referees who have contributed to this issue. The quality of this volume is the result of the high scientific value of their work. Moreover, we would like to acknowledge the excellent cooperation throughout the whole process that has made our work a pleasant task, despite the extremely challenging conditions our communities had to face during the review phase with the COVID-19 pandemic. We are also grateful to the Springer/ToPNoC team for the final production of this issue.

February 2022

Fabrice Kordon
Daniel Moldt

Organization of This Issue

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