

Commenced Publication in 1973

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison

Lancaster University, UK

Takeo Kanade

Carnegie Mellon University, Pittsburgh, PA, USA

Josef Kittler

University of Surrey, Guildford, UK

Jon M. Kleinberg

Cornell University, Ithaca, NY, USA

Alfred Kobsa

University of California, Irvine, CA, USA

Friedemann Mattern

ETH Zurich, Switzerland

John C. Mitchell

Stanford University, CA, USA

Moni Naor

Weizmann Institute of Science, Rehovot, Israel

Oscar Nierstrasz

University of Bern, Switzerland

C. Pandu Rangan

Indian Institute of Technology, Madras, India

Bernhard Steffen

University of Dortmund, Germany

Madhu Sudan

Massachusetts Institute of Technology, MA, USA

Demetri Terzopoulos

University of California, Los Angeles, CA, USA

Doug Tygar

University of California, Berkeley, CA, USA

Gerhard Weikum

Max-Planck Institute of Computer Science, Saarbruecken, Germany

Kurt Jensen Wil M.P. van der Aalst
Jonathan Billington (Eds.)

Transactions on Petri Nets and Other Models of Concurrency I

Editor-in-Chief

Kurt Jensen
University of Aarhus
Faculty of Science
Department of Computer Science
IT-parken, Aabogade 34, 8200 Aarhus N, Denmark
E-mail: kjensen@cs.au.dk

Guest Editors

Wil M.P. van der Aalst
Technical University of Eindhoven
Department of Mathematics and Computer Science
Den Dolech 2, 5612 AZ Eindhoven, The Netherlands
E-mail: w.m.p.v.d.aalst@tue.nl

Jonathan Billington
University of South Australia
School of Electrical and Information Engineering
Mawson Lakes Campus, Mawson Lakes, South Australia 5095, Australia
E-mail: jonathan.billington@unisa.edu.au

Library of Congress Control Number: 2008942189

CR Subject Classification (1998): D.2.2, I.6, F.4, H.2.3

LNCS Sublibrary: SL 1 – Theoretical Computer Science and General Issues

ISSN	0302-9743 (Lecture Notes in Computer Science)
ISSN	1867-7193 (Transactions on Petri Nets and Other Models of Concurrency)
ISBN-10	3-540-89286-9 Springer Berlin Heidelberg New York
ISBN-13	978-3-540-89286-1 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

springer.com

© Springer-Verlag Berlin Heidelberg 2008
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India
Printed on acid-free paper SPIN: 12568871 06/3180 5 4 3 2 1 0

Preface by Editor-in-Chief

This is the first volume in a new Journal entitled “LNCS Transactions on Petri Nets and Other Models of Concurrency (ToPNoC)”. The volume contains revised and extended versions a selection of the best papers from the workshops at the “28th International Conference on Application and Theory of Petri Nets and Other Models of Concurrency”, which took place in Siedlce, Poland, June 25–29, 2007.

As Editor-in-Chief of ToPNoC, I would like to thank the two editors of this special issue: Wil van der Aalst and Jonathan Billington. Moreover, I would like to thank all authors, reviewers, and the organizers of the workshops that served as a basis for this first ToPNoC volume.

August 2008

Kurt Jensen
Editor-in-Chief

LNCS Transactions on Petri Nets and Other Models of Concurrency (ToPNoC)

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 foundation of Petri nets was laid by the pioneering work of Carl Adam Petri and his colleagues in the early 1960s. Since then, an enormous amount of material has been developed and published in journals and books and presented at workshops and conferences.

The annual International Conference on Application and Theory of Petri Nets and Other Models of Concurrency started in 1980. The International Petri Net Bibliography maintained by the Petri Net Newsletter contains close to 10,000 different entries, and the International Petri Net Mailing List has 1,500 subscribers. 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 large libraries and are also accessible in LNCS Online (electronically). Simultaneously the ToPNoC volumes form a Journal, and it is possible to subscribe to ToPNoC without subscribing to the rest of LNCS.

ToPNoC contains:

- Revised versions of a selection of the best papers from workshops and tutorials at the annual Petri net conferences
- Special sections/issues within 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 proposed for inclusion in ToPNoC as special sections/issues. The Editorial Board consists of prominent researchers within the Petri net community and in related fields.

Topics

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.

Applications of nets to different kinds of systems and application fields, e.g.: flexible manufacturing systems, real-time systems, embedded systems, defence systems, biological systems, health and medical systems, environmental systems, hardware structures, telecommunications, railway networks, office automation, workflows, supervisory control, protocols and networks, the Internet, e-commerce and trading, programming languages, performance evaluation, and operations research.

For more information about ToPNoC, please see: www.springer.com/lncs/topnoc

Submission of Manuscripts

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

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

Editor-in-Chief

Kurt Jensen, Denmark (<http://person.au.dk/en/kjensen@cs.au.dk>)

Honorary Editor

Carl Adam Petri, Germany

Associate Editors

Grzegorz Rozenberg, The Netherlands

Jonathan Billington, Australia

Susanna Donatelli, Italy

Wil van der Aalst, The Netherlands

Editorial Board

Didier Buchs, Switzerland

Gianfranco Ciardo, USA

José Manuel Colom, Spain

Jörg Desel, Germany

Michel Diaz, France

Hartmut Ehrig, Germany

Jorge C.A. de Figueiredo, Brazil

Luis Gomes, Portugal

Roberto Gorrieri, Italy

Serge Haddad, France

Xudong He, USA

Kees van Hee, The Netherlands

Kunihiko Hiraishi, Japan

Gabriel Juhas, Slovak Republic

Jetty Kleijn, The Netherlands

Maciej Koutny, UK

Lars M. Kristensen, Denmark

Charles Lakos, Australia

Johan Lilius, Finland

Chuang Lin, China

Satoru Miyano, Japan

Madhavan Mukund, India

Wojciech Penczek, Poland

Laure Petrucci, France

Lucia Pomello, Italy

Wolfgang Reisig, Germany

Manuel Silva, Spain

P.S. Thiagarajan, Singapore

Glynn Winskel, UK

Karsten Wolf, Germany

Alex Yakovlev, UK

Preface by Guest Editors

This inaugural issue of ToPNoC contains revised and extended versions of a selection of the best papers from the workshops held at the 28th International Conference on Application and Theory of Petri Nets and Other Models of Concurrency, which took place in Siedlce, Poland, June 25–29, 2007. The best papers were selected in close cooperation with the chairs of the workshops, and their authors were invited to submit improved and extended versions. After a rigorous review process we selected the 13 papers in this first issue.

We are indebted to the Program Committees of the workshops and in particular the workshop chairs. Without their competent and enthusiastic work this volume would not have been possible. Many members of the PCs participated in reviewing the revised and extended papers considered for this issue.

Papers from the following workshops were considered when selecting the best papers:

- The Workshop on Teaching Concurrency (TeaConc’2007) organized by Luis Gomes (Portugal) and Søren Christensen (Denmark).
- The International Workshop on Petri Nets and Software Engineering (PNSE’07) organized by Daniel Moldt (Germany), Fabrice Kordon (France), Kees van Hee (The Netherlands), José-Manuel Colom (Spain), and Rémi Bastide (France).
- The Workshop on Petri Net Standards 2007 organized by Ekkart Kindler (Denmark) and Laure Petrucci (Paris).
- The International Workshop on Formal Approaches to Business Processes and Web Services (FABPWS’07) organized by Kees van Hee, Wolfgang Reisig, and Karsten Wolf.
- The Workshop on Unfolding and Partial Order Techniques (UFO’07) organized by Eric Fabre (France) and Victor Khomenko (UK).

Thanks to the support of the workshops chairs and their PC members, we were able to select a set of high-quality papers. Moreover, we also invited a paper based on the tutorial “Elasticity and Petri nets” given in Siedlce.

All invited papers were reviewed by three or four referees. We followed the principle of also asking for “fresh” reviews of the revised papers, i.e., from referees who had not been involved initially in reviewing the papers. Some papers were accepted or rejected after the first round of reviewing while the authors of others were asked to make a major revision which was then accepted or rejected after a second round of reviewing. We thank the reviewers and authors for doing an outstanding job.

In the end 13 papers were accepted out of the 17 initially considered as best papers. (Note that the workshops accepted about 50 papers in total and that the number of submissions to these workshops was considerably higher.)

The first four papers of this issue originated from the Workshop on Teaching Concurrency. “Constructive Alignment for Teaching Model-Based Design for Concurrency” by Claus Brabrand, “Teaching Modelling and Validation of Concurrent Systems using Coloured Petri Nets” by Lars Kristensen and Kurt Jensen, and “Teaching Concurrency Concepts to Freshmen” by Holger Hermanns and Christian Eisentraut provide interesting views on teaching concurrency-related topics and show that more research into the way that we teach concurrency is justified. In “TAPAs: a Tool for the Analysis of Process Algebras”, Francesco Calzolari et al. present a tool for the analysis of concurrent systems and report their experiences with using this tool in teaching.

The next six papers were originally presented at the PNSE workshop. Kristian Lassen and Boudewijn van Dongen report on a new form of process discovery where explicit causalities in the form of Message Sequence Charts are taken into account in “Translating Message Sequence Charts to Other Process Languages Using Process Mining”. The paper “Net Components for the Integration of Process Mining into Agent-Oriented Software Engineering”, by Lawrence Cabac and Nicolas Denz, uses an original combination of two Petri-net-based tools, Renew and ProM, to link agents and mining.

Dahmani Djaouda et al. present a Petri-net variant incorporating time, give formal semantics, and propose an analysis technique in their paper “Time Recursive Petri Nets”.

In “Designing Case Handling Systems” Kees van Hee et al. combine Petri nets, XML, and the relational data model to describe and enact case handling processes. Isaac Corro Ramos and his co-authors focus on testing systems with a known process structure in “Model-Driven Testing Based on Test History”. They investigate both exhaustive testing and a statistical release procedure.

The paper “Assessing State Spaces Using Petri-Net Synthesis and Attribute-Based Visualization” by Eric Verbeek et al. focuses on the visualization of state spaces which are too large to show as a classical graph. Moreover, regions are used to extract the labeling structure needed for this visualization.

The next two papers were originally presented at the UFO workshop. Motivated by automated planning problems, Blai Bonet et al. present an analysis approach that combines Petri net unfolding with artificial intelligence heuristics to improve the performance of searching for a goal state in “Directed Unfolding of Petri Nets”. In their paper, “McMillan’s Complete Prefix for Contextual Nets”, Paolo Baldan et al. present a new algorithm that allows for unfolding a larger class of contextual nets (i.e., Petri nets with test arcs) where the unfolding is again a contextual net.

Finally, “Elasticity and Petri Nets” by Jordi Cortadella et al. describes methods for modelling, performance analysis, and optimization of elastic systems using (extended) marked graphs.

The above 13 papers cover a wide range of concurrency-related topics ranging from process mining and performance analysis to verification and model checking in application domains that include the design of hardware systems and business process management. Insight is also gained into how concurrency topics can be

taught at tertiary level. Therefore, this volume provides a useful blend of theory, practice and tools related to concurrency research.

August 2008

Wil van der Aalst
Jonathan Billington
Guest Editors, Inaugural Issue of ToPNoC

Organization of This Issue

Guest Editors

Wil van der Aalst, The Netherlands
Jonathan Billington, Australia

Co-chairs of the Workshops

Luis Gomes (Portugal)
Søren Christensen (Denmark)
Daniel Moldt (Germany)
Fabrice Kordon (France)
Kees van Hee (The Netherlands)
José-Manuel Colom (Spain)
Rémi Bastide (France)
Ekkart Kindler (Denmark)
Laure Petrucci (Paris)
Wolfgang Reisig (Germany)
Karsten Wolf (Germany)
Eric Fabre (France)
Victor Khomenko (UK)

Referees

Joao Paulo Barros	Kees van Hee	Rocco De Nicola
Remi Bastide	Keijo Heljanko	Laure Petrucci
Carmen Bratosin	Holger Hermanns	Laura Recalde
Didier Buchs	Vladimir Janousek	Heiko Rolke
Piotr Chrzastowski	Jens B. Jørgensen	Vladimir Rubin
-Wachtel	Astrid Kiehn	Sylvie Thiebaut
Gianfranco Ciardo	Victor Khomenko	Francesco Tiezzi
José-Manuel Colom	Gabriele Kotsis	Ruediger Valk
Philippe Darondeau	Maciej Koutny	Antti Valmari
Jörg Desel	Marta Koutny	Eric Verbeek
Boudewijn van Dongen	Lars Kristensen	Walter Vogler
Christian Eisentraut	Charles Lakos	Michael Westergaard
Javier Esparza	Kristian Bisgaard Lassen	Karsten Wolf
Dirk Fahland	Nimrod Lilith	Jianli Xu
Jorge César Abrantes de	Johan Lilius	Alex Yakovlev
Figueiredo	Robert Lorenz	Syed Abbas Kazim Zaidi
Guy Gallasch	Ricardo Machado	
Amar Gupta	Daniel Moldt	

Table of Contents

Constructive Alignment for Teaching Model-Based Design for Concurrency: A Case-Study on Implementing Alignment in Computer Science	1
<i>Claus Brabrand</i>	
Teaching Modelling and Validation of Concurrent Systems Using Coloured Petri Nets	19
<i>Lars Michael Kristensen and Kurt Jensen</i>	
Teaching Concurrency Concepts to Freshmen	35
<i>Christian Eisentraut and Holger Hermanns</i>	
TAPAs: A Tool for the Analysis of Process Algebras	54
<i>Francesco Calzolari, Rocco De Nicola, Michele Loreti, and Francesco Tiezzi</i>	
Translating Message Sequence Charts to other Process Languages Using Process Mining	71
<i>Kristian Bisgaard Lassen and Boudewijn F. van Dongen</i>	
Net Components for the Integration of Process Mining into Agent-Oriented Software Engineering	86
<i>Lawrence Cabac and Nicolas Denz</i>	
Time Recursive Petri Nets	104
<i>Djaouida Dahmani, Jean-Michel Ili��, and Malika Boukala</i>	
Designing Case Handling Systems	119
<i>Kees M. van Hee, Jeroen Keiren, Reinier Post, Natalia Sidorova, and Jan Martijn van der Werf</i>	
Model Driven Testing Based on Test History	134
<i>Isaac Corro Ramos, Alessandro Di Bucchianico, Lusine Hakobyan, and Kees van Hee</i>	
Assessing State Spaces Using Petri-Net Synthesis and Attribute-Based Visualization	152
<i>H.M.W. (Eric) Verbeek, A. Johannes Pretorius, Wil M.P. van der Aalst, and Jarke J. van Wijk</i>	
Directed Unfolding of Petri Nets	172
<i>Blai Bonet, Patrik Haslum, Sarah Hickmott, and Sylvie Thi��baux</i>	

McMillan's Complete Prefix for Contextual Nets	199
<i>Paolo Baldan, Andrea Corradini, Barbara König, and Stefan Schwoon</i>	
Elasticity and Petri Nets	221
<i>Jordi Cortadella, Michael Kishinevsky, Dmitry Bafistov, Josep Carmona, and Jorge Júlvez</i>	
Author Index	251