

# Lecture Notes in Bioinformatics

4230

Edited by S. Istrail, P. Pevzner, and M. Waterman

Editorial Board: A. Apostolico S. Brunak M. Gelfand  
T. Lengauer S. Miyano G. Myers M.-F. Sagot D. Sankoff  
R. Shamir T. Speed M. Vingron W. Wong

Subseries of Lecture Notes in Computer Science

Corrado Priami Anna Ingólfssdóttir  
Bud Mishra Hanne Riis Nielson (Eds.)

# Transactions on Computational Systems Biology VII

## Series Editors

Sorin Istrail, Brown University, Providence, RI, USA

Pavel Pevzner, University of California, San Diego, CA, USA

Michael Waterman, University of Southern California, Los Angeles, CA, USA

## Editor-in-Chief

Corrado Priami

The Microsoft Research - University of Trento

Centre for Computational and Systems Biology

Piazza Mancini, 17, 38050 Povo (TN), Italy

E-mail: priami@dit.unitn.it

## Volume Editors

Anna Ingólfssdóttir

Aalborg University

Department of Computer Science

Fr. Bagersvej 7E, Aalborg, Denmark

E-mail: annai@cs.auc.dk

Bud Mishra

Cold Spring Harbor Laboratory

One Bungtown Road

Cold Spring Harbor, NY 11724, USA

E-mail: mishra@nyu.edu

Hanne Riis Nielson

Technical University of Denmark

Informatics and Mathematical Modelling

Richard Petersens Plads, 2800 Lyngby, Denmark

E-mail: riis@imm.dtu.dk

Library of Congress Control Number: 2006935571

CR Subject Classification (1998): J.3, F.1, F.4, I.6

LNCS Sublibrary: SL 8 – Bioinformatics

ISSN 1861-2075

ISBN-10 3-540-48837-5 Springer Berlin Heidelberg New York

ISBN-13 978-3-540-48837-8 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 is a part of Springer Science+Business Media

springer.com

© Springer-Verlag Berlin Heidelberg 2006

Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India

Printed on acid-free paper SPIN: 11905455 06/3142 5 4 3 2 1 0

# Preface

This issue of the journal reports some selected contributions from the workshops *BioConcur 2004* chaired by Anna Ingolfssdottir and Hanne Riis Nielson and *BioConcur 2005* chaired by Bud Mishra and Corrado Priami.

There are three contributions from BioConcur 2004. The first one is by Calder, Gilmore and Hillston on the modelling of signalling pathways using the stochastic process algebra PEPA. The second contribution is by Kuttler and Niehren on gene regulation in  $\pi$ -calculus. The last contribution is by Remy, Ruet, Mendoza, Thieffry and Chsouiya on the relationships between logical regulator graphs and Petri nets.

There are five contributions from BioConcur 2005. The first contribution is by Eccher and Lecca on the automatic translation of SBML models to stochastic  $\pi$ -calculus. The second paper is by Blinov, Yang, Faeder and Hlavacek on the use of graph theory to model biological networks. The third contribution, by Jha and Shyamasundar, introduces biochemical Kripke structures for distributed model checking. The fourth paper is by Phillips, Cardelli and Castagna on a graphical notation for stochastic  $\pi$ -calculus. The last paper is by Remy and Ruet on differentiation and homeostatic behaviour of boolean dynamic systems.

The volume ends with a regular contribution by Margoninsky, Saffrey, Hetherington, Finkelstein and Warner that describes a specification language and a framework for the execution of composite models.

July 2006

Corrado Priami

# Table of Contents

Modelling the Influence of RKIP on the ERK Signalling Pathway Using the Stochastic Process Algebra PEPA . . . . .	1
<i>Muffy Calder, Stephen Gilmore, Jane Hillston</i>	
Gene Regulation in the Pi Calculus: Simulating Cooperativity at the Lambda Switch . . . . .	24
<i>C��line Kuttler, Joachim Niehren</i>	
From Logical Regulatory Graphs to Standard Petri Nets: Dynamical Roles and Functionality of Feedback Circuits . . . . .	56
<i>Elisabeth Remy, Paul Ruet, Luis Mendoza, Denis Thieffry, Claudine Chaouiya</i>	
Translating SBML Models into the Stochastic $\pi$ -Calculus for Stochastic Simulation . . . . .	73
<i>Claudio Eccher, Paola Lecca</i>	
Graph Theory for Rule-Based Modeling of Biochemical Networks . . . . .	89
<i>Michael L. Blinov, Jin Yang, James R. Faeder, William S. Hlavacek</i>	
Adapting Biochemical Kripke Structures for Distributed Model Checking . . . . .	107
<i>Susmit Jha, R.K. Shyamasundar</i>	
A Graphical Representation for Biological Processes in the Stochastic $\pi$ -Calculus . . . . .	123
<i>Andrew Phillips, Luca Cardelli, Giuseppe Castagna</i>	
On Differentiation and Homeostatic Behaviours of Boolean Dynamical Systems . . . . .	153
<i>��lisabeth Remy, Paul Ruet</i>	
A Specification Language and a Framework for the Execution of Composite Models in Systems Biology . . . . .	163
<i>Ofer Margoninski, Peter Saffrey, James Hetherington, Anthony Finkelstein, Anne Warner</i>	
<b>Author Index</b> . . . . .	185

# **LNCS Transactions on Computational Systems Biology – Editorial Board**

Corrado Priami, Editor-in-chief	University of Trento, Italy
Charles Auffray	Genexpress, CNRS and Pierre & Marie Curie University, France
Matthew Bellgard	Murdoch University, Australia
Soren Brunak	Technical University of Denmark, Denmark
Luca Cardelli	Microsoft Research Cambridge, UK
Zhu Chen	Shanghai Institute of Hematology, China
Vincent Danos	CNRS, University of Paris VII, France
Eytan Domany	Center for Systems Biology, Weizmann Institute, Israel
Walter Fontana	Santa Fe Institute, USA
Takashi Gojobori	National Institute of Genetics, Japan
Martijn A. Huynen	Center for Molecular and Biomolecular Informatics, The Netherlands
Marta Kwiatkowska	University of Birmingham, UK
Doron Lancet	Crown Human Genome Center, Israel
Pedro Mendes	Virginia Bioinformatics Institute, USA
Bud Mishra	Courant Institute and Cold Spring Harbor Lab, USA
Satoru Miayano	University of Tokyo, Japan
Denis Noble	University of Oxford, UK
Yi Pan	Georgia State University, USA
Alberto Policriti	University of Udine, Italy
Magali Roux-Rouquie	CNRS, Pasteur Institute, France
Vincent Schachter	Genoscope, France
Adeline Uhrmacher	University of Rostock, Germany
Alfonso Valencia	Centro Nacional de Biotecnologia, Spain