

## Distributed, Parallel and Biologically Inspired Systems

Mike Hinchey, Bernd Kleinjohann, Lisa Kleinjohann, Peter Lindsay, Franz J. Rammig, Jon Timmis, Marilyn Wolf

► **To cite this version:**

Mike Hinchey, Bernd Kleinjohann, Lisa Kleinjohann, Peter Lindsay, Franz J. Rammig, et al.. Distributed, Parallel and Biologically Inspired Systems: 7th IFIPTC 10Working Conference, DIPES 2010 and 3rd IFIP TC 10 International Conference, BICC 2010 Held as Part of WCC 2010 Brisbane, Australia, September 20-23, 2010, Proceedings. Springer, AICT-329, 2010, IFIP Advances in Information and Communication Technology, 978-3-642-15233-7. <hal-01556922>

**HAL Id: hal-01556922**

**<https://hal.inria.fr/hal-01556922>**

Submitted on 5 Jul 2017

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Editor-in-Chief

*A. Joe Turner, Seneca, SC, USA*

Editorial Board

Foundations of Computer Science

*Mike Hinchey, Lero, Limerick, Ireland*

Software: Theory and Practice

*Bertrand Meyer, ETH Zurich, Switzerland*

Education

*Bernard Cornu, CNED-EIFAD, Poitiers, France*

Information Technology Applications

*Ronald Waxman, EDA Standards Consulting, Beachwood, OH, USA*

Communication Systems

*Guy Leduc, Université de Liège, Belgium*

System Modeling and Optimization

*Jacques Henry, Université de Bordeaux, France*

Information Systems

*Barbara Pernici, Politecnico di Milano, Italy*

Relationship between Computers and Society

*Chrisanthi Avgerou, London School of Economics, UK*

Computer Systems Technology

*Paolo Prinetto, Politecnico di Torino, Italy*

Security and Privacy Protection in Information Processing Systems

*Kai Rannenber, Goethe University Frankfurt, Germany*

Artificial Intelligence

*Max A. Bramer, University of Portsmouth, UK*

Human-Computer Interaction

*Annelise Mark Pejtersen, Center of Cognitive Systems Engineering, Denmark*

Entertainment Computing

*Ryohei Nakatsu, National University of Singapore*

## **IFIP – The International Federation for Information Processing**

IFIP was founded in 1960 under the auspices of UNESCO, following the First World Computer Congress held in Paris the previous year. An umbrella organization for societies working in information processing, IFIP's aim is two-fold: to support information processing within its member countries and to encourage technology transfer to developing nations. As its mission statement clearly states,

*IFIP's mission is to be the leading, truly international, apolitical organization which encourages and assists in the development, exploitation and application of information technology for the benefit of all people.*

IFIP is a non-profitmaking organization, run almost solely by 2500 volunteers. It operates through a number of technical committees, which organize events and publications. IFIP's events range from an international congress to local seminars, but the most important are:

- The IFIP World Computer Congress, held every second year;
- Open conferences;
- Working conferences.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is small and by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is less rigorous and papers are subjected to extensive group discussion.

Publications arising from IFIP events vary. The papers presented at the IFIP World Computer Congress and at open conferences are published as conference proceedings, while the results of the working conferences are often published as collections of selected and edited papers.

Any national society whose primary activity is in information may apply to become a full member of IFIP, although full membership is restricted to one society per country. Full members are entitled to vote at the annual General Assembly. National societies preferring a less committed involvement may apply for associate or corresponding membership. Associate members enjoy the same benefits as full members, but without voting rights. Corresponding members are not represented in IFIP bodies. Affiliated membership is open to non-national societies, and individual and honorary membership schemes are also offered.

Mike Hinchey Bernd Kleinjohann  
Lisa Kleinjohann Peter A. Lindsay  
Franz J. Rammig Jon Timmis  
Marilyn Wolf (Eds.)

# Distributed, Parallel and Biologically Inspired Systems

7th IFIP TC 10 Working Conference, DIPES 2010 and  
3rd IFIP TC 10 International Conference, BICC 2010  
Held as Part of WCC 2010  
Brisbane, Australia, September 20-23, 2010  
Proceedings

## Volume Editors

Mike Hinchey  
Lero, University of Limerick, Limerick, Ireland  
E-mail: mike.hinchey@lero.ie

Bernd Kleinjohann  
University of Paderborn / C-Lab, Germany  
E-mail: bernd@c-lab.de

Lisa Kleinjohann  
University of Paderborn / C-Lab, Germany  
E-mail: lisa@c-lab.de

Peter A. Lindsay  
University of Queensland, St. Lucia, Australia  
E-mail: p.lindsay@uq.edu.au

Franz J. Rammig  
University of Paderborn, Heinz Nixdorf Institute, Germany  
E-mail: franz@upb.de

Jon Timmis  
University of York, Heslington, UK  
E-mail: jtimmis@cs.york.ac.uk

Marilyn Wolf  
Georgia Institute of Technology, Atlanta, USA  
E-mail: marilyn.wolf@ece.gatech.edu

Library of Congress Control Number: 2010932430

CR Subject Classification (1998): D.2, C.2, I.2, F.3, H.4, C.3

ISSN 1868-4238  
ISBN-10 3-642-15233-3 Springer Berlin Heidelberg New York  
ISBN-13 978-3-642-15233-7 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

© IFIP International Federation for Information Processing 2010  
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India  
Printed on acid-free paper 06/3180

# **IFIP World Computer Congress 2010 (WCC 2010)**

## **Message from the Chairs**

Every two years, the International Federation for Information Processing (IFIP) hosts a major event which showcases the scientific endeavors of its over one hundred technical committees and working groups. On the occasion of IFIP's 50th anniversary, 2010 saw the 21st IFIP World Computer Congress (WCC 2010) take place in Australia for the third time, at the Brisbane Convention and Exhibition Centre, Brisbane, Queensland, September 20–23, 2010.

The congress was hosted by the Australian Computer Society, ACS. It was run as a federation of co-located conferences offered by the different IFIP technical committees, working groups and special interest groups, under the coordination of the International Program Committee.

The event was larger than ever before, consisting of 17 parallel conferences, focusing on topics ranging from artificial intelligence to entertainment computing, human choice and computers, security, networks of the future and theoretical computer science. The conference History of Computing was a valuable contribution to IFIP's 50th anniversary, as it specifically addressed IT developments during those years. The conference e-Health was organized jointly with the International Medical Informatics Association (IMIA), which evolved from IFIP Technical Committee TC-4 "Medical Informatics".

Some of these were established conferences that run at regular intervals, e.g., annually, and some represented new, groundbreaking areas of computing. Each conference had a call for papers, an International Program Committee of experts and a thorough peer reviewing process of full papers. The congress received 642 papers for the 17 conferences, and selected 319 from those, representing an acceptance rate of 49.69% (averaged over all conferences). To support interoperation between events, conferences were grouped into 8 areas: Deliver IT, Govern IT, Learn IT, Play IT, Sustain IT, Treat IT, Trust IT, and Value IT.

This volume is one of 13 volumes associated with the 17 scientific conferences. Each volume covers a specific topic and separately or together they form a valuable record of the state of computing research in the world in 2010. Each volume was prepared for publication in the Springer IFIP Advances in Information and Communication Technology series by the conference's volume editors. The overall Publications Chair for all volumes published for this congress is Mike Hinchey.

For full details of the World Computer Congress, please refer to the webpage at <http://www.ifip.org>.

June 2010            Augusto Casaca, Portugal, Chair, International Program Committee  
Phillip Nyssen, Australia, Co-chair, International Program Committee  
Nick Tate, Australia, Chair, Organizing Committee  
Mike Hinchey, Ireland, Publications Chair  
Klaus Brunnstein, Germany, General Congress Chair

# Preface

This volume contains the proceedings of two conferences held as part of the 21<sup>st</sup> IFIP World Computer Congress in Brisbane, Australia, 20–23 September 2010.

The first part of the book presents the proceedings of DIPES 2010, the 7<sup>th</sup> IFIP Conference on Distributed and Parallel Embedded Systems. The conference, introduced in a separate preface by the Chairs, covers a range of topics from specification and design of embedded systems through to dependability and fault tolerance.

The second part of the book contains the proceedings of BICC 2010, the 3<sup>rd</sup> IFIP Conference on Biologically-Inspired Collaborative Computing. The conference is concerned with emerging techniques from research areas such as organic computing, autonomic computing and self-adaptive systems, where inspiration for techniques derives from exhibited behaviour in nature and biology. Such techniques require the use of research developed by the DIPES community in supporting collaboration over multiple systems.

We hope that the combination of the two proceedings will add value for the reader and advance our related work.

July 2010

Mike Hinchey  
Bernd Kleinjohann  
Lisa Kleinjohann  
Peter Lindsay  
Franz J. Rammig  
Jon Timmis  
Marilyn Wolf

# Organization

## 7th IFIP TC 10 Working Conference on Distributed and Parallel Embedded Systems (DIPES 2010)

### General Chair

Marilyn Wolf Georgia Institute of Technology, USA

### Program Chair

Bernd Kleinjohann University of Paderborn/C-LAB, Germany

### Organizing Chair

Lisa Kleinjohann University of Paderborn/C-LAB, Germany

### Program Committee

Jean Arlat	LAAS-CNRS Toulouse, France
Christophe Bobda	University of Kaiserslautern, Germany
Arndt Bode	Technical University of Munich, Germany
Joao M. P. Cardoso	University of Porto, FEUP, Portugal
Luigi Carro	UFRGS, Brazil
Matjac Colnaric	University of Maribor, Slovenia
Tom Conte	Georgia Institute of Technology, USA
Alfons Crespo Lorente	TU Valencia, Spain
Nikil Dutt	UC Irvine, USA
Petru Eles	Linköping University, Sweden
Rolf Ernst	TU Braunschweig, Germany
Bernhard Eschermann	ABB Switzerland Ltd., Switzerland
Joao Fernandes	University of Minho, Portugal
Uwe Glässer	Simon Fraser University, Canada
Luis Gomes	University of Nova Lisboa, Portugal
Wolfgang Halang	Fernuniversität Hagen, Germany
Uwe Honekamp	Vector Informatik GmbH, Germany
Pao-Ann Hsiung	National Chung Chen University, Taiwan
Kane Kim	UC Irvine, USA
Raimund Kirner	TU Vienna, Austria
Bernd Kleinjohann	University of Paderborn/C-LAB, Germany
Lisa Kleinjohann	University of Paderborn/C-LAB, Germany



Hermann Kopetz	TU Wien, Austria
Johan Lilius	TUCS, Finland
Ricardo J. Machado	University of Minho, Portugal
Erik Maehle	University of Luebeck, Germany
Baerbel Mertsching	University of Paderborn, Germany
Vincent Mooney	Georgia Institute of Technology, USA
Carlos E. Pereira	UFRGS, Brazil
Luis Pinho	ISEP-IPP, Porto, Portugal
Peter Puschner	TU Vienna, Austria
Franz J. Rammig	University of Paderborn, Germany
Achim Rettberg	University of Oldenburg, Germany
Bernhard Rinner	Klagenfurt University, Austria
Luis-Miguel Santana Ormeno	ST Microelectronics, France
Henrique Santos	University of Minho, Portugal
Klaus Schneider	University of Kaiserslautern, Germany
Joaquin Sitte	Queensland University of Technology, Brisbane, Australia
Edwin Sha	University of Texas at Dallas, USA
Zili Shao	The Hong Kong Polytechnic University, Hong Kong
Joachim Stroop	dSPACE, Germany
Francois Terrier	CEA/Saclay, France
Lothar Thiele	TH Zurich, Switzerland
Flavio R. Wagner	UFRGS, Brazil
Klaus Waldschmidt	University of Frankfurt, Germany
Marilyn Wolf	Georgia Institute of Technology, USA
Dieter Wuttke	TU Ilmenau, Germany
Alex Yakovlev	University of Newcastle, UK
Laurence T. Yang	St. Francis Xavier University, Canada

## Organizing Committee

Lisa Kleinjohann	University of Paderborn/C-LAB, Germany
Claudius Stern	University of Paderborn/C-LAB, Germany

## Co-Organizing Institutions

IFIP TC10, WG 10.2, WG 10.5

# 3rd IFIP TC 10 International Conference on Biologically-Inspired Collaborative Computing (BICC 2010)

## Program Committee

Hussein Abbas	University of New South Wales, Australia
Sven Brueckner	New Vectors LLC, USA
Yuan-Shun Dai	University of Tennessee at Knoxville, USA
Marco Dorigo	IRIDIA, Université Libre de Bruxelles, Belgium
Luca Maria Gambardella	IDSIA, Switzerland
Jadwiga Indulska	University of Queensland, Australia
Thomas Jansen	University College Cork, Ireland
Tiziana Margaria	University of Potsdam, Germany
Eliane Martins	UNICAMP, Brazil
Roy A. Maxion	Carnegie Mellon University, USA
Christian Müller-Schloer	Universität Hannover, Germany
Takashi Nanya, RCAST	University of Tokyo, Japan
Bernhard Nebel	Albert-Ludwigs-Universität Freiburg, Germany
Giuseppe Nicosia	University of Catania, Italy
Anastasia Pagnoni	Università degli Studi di Milano, Italy
Jochen Pfalzgraf	Universität Salzburg, Austria
Daniel Polani	University of Hertfordshire, UK
Ricardo Reis	Univ. Federal do Rio Grande do Sul, Brazil
Richard D. Schlichting	AT&T Labs, USA
Hartmut Schmeck	KIT, Germany
Bernhard Sendhoff	Honda Research Institute, Germany
Giovanna Di Marzo Serugendo	Birkbeck University of London, UK
Joaquin Sitte	Queensland University of Technology, Australia
Roy Sterritt	University of Ulster, Northern Ireland
Janet Wiles	University of Queensland, Australia

# Table of Contents

<b>Distributed and Parallel Embedded Systems (DIPES 2010)</b> .....	1
Preface .....	3
<i>Marilyn Wolf, Bernd Kleinjohann, and Lisa Kleinjohann</i>	
<b>Opening and Keynote</b>	
Safety, Efficiency and Autonomy - Mastering Conflicting Trends in Embedded Systems Design .....	5
<i>Rolf Ernst</i>	
<b>Specification and Modeling</b>	
Rialto 2.0: A Language for Heterogeneous Computations .....	7
<i>Johan Lilius, Andreas Dahlin, and Lionel Morel</i>	
Scenario-Based Modeling in Industrial Information Systems .....	19
<i>Ricardo J. Machado, João M. Fernandes, João P. Barros, and Luís Gomes</i>	
An Entirely Model-Based Framework for Hardware Design and Simulation .....	31
<i>Safouan Taha, Ansgar Radermacher, and Sébastien Gérard</i>	
Extending the Standard Execution Model of UML for Real-Time Systems .....	43
<i>Abderraouf Benyahia, Arnaud Cuccuru, Safouan Taha, François Terrier, Frédéric Boulanger, and Sébastien Gérard</i>	
<b>Fault Tolerance</b>	
Task Migration for Fault-Tolerant FlexRay Networks .....	55
<i>Kay Klobedanz, Gilles B. Defo, Henning Zabel, Wolfgang Mueller, and Yuan Zhi</i>	
Flexible and Dynamic Replication Control for Interdependent Distributed Real-Time Embedded Systems .....	66
<i>Luís Nogueira, Luís Miguel Pinho, and Jorge Coelho</i>	

## Verification and Validation

Generation of Executable Testbenches from Natural Language Requirement Specifications for Embedded Real-Time Systems . . . . .	78
<i>Wolfgang Mueller, Alexander Bol, Alexander Krupp, and Ola Lundkvist</i>	
Model Checking of Concurrent Algorithms: From Java to C . . . . .	90
<i>Cyrille Artho, Masami Hagiya, Watcharin Leungwattanakit, Yoshinori Tanabe, and Mitsuharu Yamamoto</i>	
Integrate Online Model Checking into Distributed Reconfigurable System on Chip with Adaptable OS Services . . . . .	102
<i>Sufyan Samara, Yuhong Zhao, and Franz J. Rammig</i>	
Efficient Mutation-Analysis Coverage for Constrained Random Verification . . . . .	114
<i>Tao Xie, Wolfgang Mueller, and Florian Letombe</i>	

## Code-Generation, Simulation and Timing Analysis

Generating VHDL Source Code from UML Models of Embedded Systems . . . . .	125
<i>Tomás G. Moreira, Marco A. Wehrmeister, Carlos E. Pereira, Jean-François Pétin, and Eric Levrat</i>	
RACE: A Rapid, Architectural Simulation and Synthesis Framework for Embedded Processors . . . . .	137
<i>Roshan Ragel, Angelo Ambrose, Jorgen Peddersen, and Sri Parameswaran</i>	
A Mixed Level Simulation Environment for Stepwise RTOS Software Refinement . . . . .	145
<i>Markus Becker, Henning Zabel, and Wolfgang Mueller</i>	
Global Best-Case Response Time for Improving the Worst-Case Response Times in Distributed Real-Time Systems . . . . .	157
<i>Steffen Kollmann, Victor Pollex, and Frank Slomka</i>	

## Distributed Architectures and Design Support

Dependency-Driven Distribution of Synchronous Programs . . . . .	169
<i>Daniel Baudisch, Jens Brandt, and Klaus Schneider</i>	
Distributed Resource-Aware Scheduling for Multi-core Architectures with SystemC . . . . .	181
<i>Philipp A. Hartmann, Kim Grüttner, Achim Rettberg, and Ina Podolski</i>	

Robust Partitioned Scheduling for Real-Time Multiprocessor Systems . . . . .	193
<i>Frédéric Fauberteau, Serge Midonnet, and Laurent George</i>	
An Infrastructure for Flexible Runtime Reconfigurable Multi-microcontroller Systems . . . . .	205
<i>Claudius Stern, Philipp Adelt, Matthias Schmitz, Lisa Kleinjohann, and Bernd Kleinjohann</i>	
<b>Biologically-Inspired Collaborative Computing (BICC 2010)</b> . . . . .	217
Preface . . . . .	219
<i>Peter Lindsay, Franz J. Rammig, Mike Hinchey, and Jon Timmis</i>	
<b>Ants and Adaptive Systems</b>	
Model Checking the Ant Colony Optimisation . . . . .	221
<i>Lucio Mauro Duarte, Luciana Foss, Flávio Rech Wagner, and Tales Heimfarth</i>	
Feature Selection for Classification Using an Ant System Approach . . . . .	233
<i>Nadia Abd-Alsabour</i>	
Novelty-Aware Attack Recognition – Intrusion Detection with Organic Computing Techniques . . . . .	242
<i>Dominik Fisch, Ferdinand Kastl, and Bernhard Sick</i>	
Evolutionary-Computation Based Risk Assessment of Aircraft Landing Sequencing Algorithms . . . . .	254
<i>Wenjing Zhao, Jiangjun Tang, Sameer Alam, Axel Bender, and Hussein A. Abbass</i>	
<b>Learning Classifier Systems and Collaborative Systems</b>	
A Collaborative Decision Support Model for Marine Safety and Security Operations . . . . .	266
<i>Uwe Glässer, Piper Jackson, Ali Khalili Araghi, Hans Wehn, and Hamed Yaghoubi Shahir</i>	
Combining Software and Hardware LCS for Lightweight On-Chip Learning . . . . .	278
<i>Andreas Bernauer, Johannes Zeppenfeld, Oliver Bringmann, Andreas Herkersdorf, and Wolfgang Rosenstiel</i>	
Collaborating and Learning Predators on a Pursuit Scenario . . . . .	290
<i>Nugroho Fredivianus, Urban Richter, and Hartmut Schmeck</i>	

SelSta - A Biologically Inspired Approach for Self-Stabilizing Humanoid Robot Walking . . . . .	302
<i>Bojan Jakimovski, Michael Kotke, Martin Hörenz, and Erik Maehle</i>	
<b>Author Index . . . . .</b>	<b>315</b>

# **Distributed and Parallel Embedded Systems (DIPES 2010)**

Edited by

Bernd Kleinjohann  
Universität Paderborn / C-LAB  
Germany

Lisa Kleinjohann  
Universität Paderborn / C-LAB  
Germany

Marilyn Wolf  
Georgia Institute of Technology  
USA

# Preface

IFIP Working Group 10.2 was pleased to sponsor DIPES 2010, the IFIP Conference on Distributed and Parallel Embedded Systems. The conference was held in Brisbane, Australia during September 20-22, 2010 as part of the IFIP World Computer Conference.

Already when establishing this conference series in 1998, the idea of distribution, where the control task is carried out by a number of controllers distributed over the entire system and connected by some interconnect network, was emphasized in its title. This idea naturally leads to the recent research field of cyber physical systems where embedded systems are no longer seen as “closed boxes” that do not expose the computing capability to the outside. Instead networked embedded systems interact with physical processes in a feedback loop leading to ever more “intelligent” applications with increased adaptability, autonomy, efficiency, functionality, reliability, safety, and usability. Examples like collision avoidance, nano-tolerance manufacturing, autonomous systems for search and rescue, zero-net energy buildings, assistive technologies and ubiquitous health-care cover a wide range of domains influencing nearly all parts of our lives.

Hence, the design of distributed embedded systems interacting with physical processes is becoming ever more challenging and more than ever needs the interdisciplinary research of designers and researchers from industry and academia. DIPES provides an excellent forum for discussing recent research activities and results.

DIPES 2010 received 37 submissions: 30 from Europe, 4 from South America, 2 from Asia/Australia, and 1 from Africa. From these submissions, the Program Committee accepted 18 papers for presentation at the conference. The contributions present advanced design methods for distributed embedded systems, starting from specification and modelling over verification and validation to scheduling, partitioning and code generation, also targeting specific architectures such as upcoming multi-core systems or reconfigurable systems.

We would like to thank all authors for their submitted papers and the Program Committee for their careful reviews. Our thanks also go to Rolf Ernst for his inspiring keynote speech on mastering the conflicting trends safety, efficiency and autonomy in embedded systems design. We gratefully acknowledge the superb organization of this event by the WCC Committee. Furthermore, we also thank our colleague Claudius Stern for his valuable support in preparing the camera-ready material for this book.

Marilyn Wolf  
Bernd Kleinjohann  
Lisa Kleinjohann