IFIP Advances in Information and Communication Technology 499

Editor-in-Chief

Kai Rannenberg, Goethe University Frankfurt, Germany

Editorial Board

TC 1 – Foundations of Computer Science
Jacques Sakarovitch, Télécom ParisTech, France

TC 2 – Software: Theory and Practice
Michael Goedicke, University of Duisburg-Essen, Germany

TC 3 – Education
Arthur Tatnall, Victoria University, Melbourne, Australia

TC 5 – Information Technology Applications
Erich J. Neuhold, University of Vienna, Austria

TC 6 – Communication Systems
Aiko Pras, University of Twente, Enschede, The Netherlands

TC 7 – System Modeling and Optimization
Fredi Tröltzsch, TU Berlin, Germany

TC 8 – Information Systems
Jan Pries-Heje, Roskilde University, Denmark

TC 9 – ICT and Society
Diane Whitehouse, The Castlegate Consultancy, Malton, UK

TC 10 – Computer Systems Technology
Ricardo Reis, Federal University of Rio Grande do Sul, Porto Alegre, Brazil

TC 11 – Security and Privacy Protection in Information Processing Systems
Steven Furnell, Plymouth University, UK

TC 12 – Artificial Intelligence
Ulrich Furbach, University of Koblenz-Landau, Germany

TC 13 – Human-Computer Interaction
Marco Winckler, University Paul Sabatier, Toulouse, France

TC 14 – Entertainment Computing
Matthias Rauterberg, Eindhoven University of Technology, The Netherlands

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. A federation for societies working in information processing, IFIP's aim is two-fold: to support information processing in the countries of its members and to encourage technology transfer to developing nations. As its mission statement clearly states:

> *IFIP is the global non-profit federation of societies of ICT professionals that aims at achieving a worldwide professional and socially responsible development and application of information and communication technologies.*

IFIP is a non-profit-making organization, run almost solely by 2500 volunteers. It operates through a number of technical committees and working groups, which organize events and publications. IFIP's events range from large international open conferences to working conferences and local seminars.

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 generally smaller and occasionally by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is also 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.

IFIP distinguishes three types of institutional membership: Country Representative Members, Members at Large, and Associate Members. The type of organization that can apply for membership is a wide variety and includes national or international societies of individual computer scientists/ICT professionals, associations or federations of such societies, government institutions/government related organizations, national or international research institutes or consortia, universities, academies of sciences, companies, national or international associations or federations of companies.

More information about this series at http://www.springer.com/series/6102

Luis M. Camarinha-Matos · Mafalda Parreira-Rocha
Javaneh Ramezani (Eds.)

Technological Innovation for Smart Systems

8th IFIP WG 5.5/SOCOLNET
Advanced Doctoral Conference on Computing, Electrical and Industrial Systems, DoCEIS 2017
Costa de Caparica, Portugal, May 3–5, 2017
Proceedings

Springer

Editors
Luis M. Camarinha-Matos
FCT- Department of Electrical Engineering
Universidade Nova de Lisboa
Monte da Caparica
Portugal

Javaneh Ramezani
FCT- Department of Electrical Engineering
Universidade Nova de Lisboa
Monte da Caparica
Portugal

Mafalda Parreira-Rocha
FCT- Department of Electrical Engineering
Universidade Nova de Lisboa
Monte da Caparica
Portugal

ISSN 1868-4238 ISSN 1868-422X (electronic)
IFIP Advances in Information and Communication Technology
ISBN 978-3-319-56076-2 ISBN 978-3-319-56077-9 (eBook)
DOI 10.1007/978-3-319-56077-9

Library of Congress Control Number: 2017935961

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

This volume of the proceedings of the **Advanced Doctoral Conference on Computing, Electrical and Industrial Systems** (DoCEIS) 2017 presents a series of selected articles produced in the context of engineering doctoral programs. The theme was "Technological Innovation for Smart Systems" and contributions reflect the growing interests in research, development, and application of smart systems. The rapid evolution in smart sensors, actuators, and embedded intelligence technology and its seamless integration into multiple system architecture and platforms have revolutionized the technological world, and even the way we live, since the last decade. The pervasive nature of this technology has enabled rapid permeation into all facets and levels of engineering disciplines and has earned immense attention and focus not only within academic circles and research communities worldwide, but also in the practical applications development.

Potential benefits can be found in all engineering fields and at all levels, e.g., supporting systems-of-systems, facilitating the industrial Internet and networked enterprises, enabling effective smart energy grids, creating the basis for smart environments, etc. A "smart systems" approach can change the way engineering systems are designed and operated while leading to exciting challenges for researchers and industrial practitioners. Smart systems are undeniably the technology of the future, with unparalleled possibilities, hence the need to further explore and exploit its prospects.

DoCEIS is aimed as an international forum providing a platform for the presentation of research results generated in PhD works, and a space for discussion of post-graduate studies, PhD thesis plans, and practical aspects of a PhD work and results from doctoral research in these inter-related areas of engineering, while promoting a strong multi-disciplinary dialog. As such, participants were challenged to look beyond their specific research question and relate their work to the selected theme of the conference, namely, to identify in which ways their research topics can benefit from, or contribute to, smart systems-based solutions.

A basis for innovation nowadays is to embrace the application of multi-disciplinary and interdisciplinary approaches in the context of research. In fact, more and more funding agencies are including this element as a key requirement in their funded programs. As such, the challenge put forward by the DoCEIS series of conferences to its authors can be seen as a contribution to the process of acquiring such skills, which are mandatory in the profession of a PhD.

This eighth edition of DoCEIS, which was sponsored by SOCOLNET, IFIP WG5.5, and IEEE IES, attracted a considerable number of paper submissions from a large number of PhD students and their supervisors from 23 countries. This book comprises the works selected by the international Program Committee for inclusion in the main program and covers a wide spectrum of application domains. As such, research results and on-going work are presented, illustrated, and discussed in areas such as:

- Collaborative networks
- Computational intelligence
- Systems analysis
- Smart manufacturing systems
- Smart sensorial systems
- Embedded and real-time systems
- Energy management
- Energy optimization
- Distributed infrastructure
- Solar energy
- Electrical machines
- Power electronics
- Electronics

As anticipated, and confirmed by the submissions, it is shown that virtually any research topic in this broad engineering area can either benefit from a smart systems perspective, or be a direct contributor with models, approaches, and technologies for further development of such systems.

We expect that this book will provide readers with an inspiring set of promising ideas and new challenges, presented in a multi-disciplinary context, and that by their diversity these results can trigger and motivate richer research and development directions.

We would like to thank all the authors for their contributions. We also appreciate the efforts and dedication of the DoCEIS international Program Committee members, who both helped with the selection of articles and contributed with valuable comments to improve their quality.

February 2017

Luis M. Camarinha-Matos
Mafalda Parreira-Rocha
Javaneh Ramezani

Organization

The 8th IFIP/SOCOLNET Advanced Doctoral Conference on Computing, Electrical, and Industrial Systems was held in Costa de Caparica, Portugal, during May 3–5, 2017.

Conference and Program Chair

Luis M. Camarinha-Matos, Portugal

Organizing Committee Co-chairs

Luis Gomes, Portugal
João Goes, Portugal
Pedro Pereira, Portugal

International Program Committee

Adriana Giret, Spain
Ahmed F. Zobaa, UK
Alok Choudhary, UK
Amir Assadi, USA
Andrea Bottino, Italy
Andrew Adamatzky, UK
Angel Ortiz, Spain
Antoni Grau, Spain
Antonios Tsourdos, UK
Armando Pires, Portugal
Asal Kiazadeh, Portugal
Barbora Buhnova, Czech Republic
Bernadetta Kwintiana, Germany
Constantin Filote, Romania
Diego Gachet, Spain
Dirk Lehmhus, Germany
Duc Pham, UK
Eduard Shevtshenko, Estonia
Enrique Romero-Cadaval, Spain
Erik Bruun, Denmark
Eugénio Oliveira, Portugal
Ezio Bartocci, Austria
Fausto Pedro Garcia Marquez, Spain
Florin G. Filip, Romania
Ghazanfar Safdar, UK
Giuseppe Buja, Italy
Gordana Ostojic, Serbia
Hans-Jörg Kreowski, Germany
Horacio Neto, Portugal
Igor Kuzle, Croatia
Ip-Shing Fan, UK
João Goes, Portugal
João Martins, Portugal
João Paulo Pimentão, Portugal
Jose M. De La Rosa, Spain
José Igreja, Portugal
José M. Fonseca, Portugal
Juan Jose Rodriguez Andina, Spain
Klaus-Dieter Thoben, Germany
Kleanthis Thramboulidis, Greece

Laura Carnevali, Italy
Luigi Piegari, Italy
Luis Bernardo, Portugal
Luis Gomes, Portugal
Luis M. Correia, Portugal
Luis M. Camarinha-Matos, Portugal (Chair)
Luis Oliveira, Portugal
Manuela Vieira, Portugal
Marcin Paprzycki, Poland
Maria Helena Fino, Portugal
Marin Lujak, Spain
Marko Beko, Portugal
Michael Huebner, Germany
Niels Lohse, UK
Nik Bessis, UK
Noelia Correia, Portugal
Nuno Paulino, Portugal
Olga Battaia, France
Paul Grefen, The Netherlands
Paulo Miyagi, Brazil
Paulo Pinto, Portugal
Pedro Pereira, Portugal
Peter Marwedel, Germany
Peter Palensky, Austria
Pierluigi Siano, Italy
Ricardo Gonçalves, Portugal
Ricardo Rabelo, Brazil
Rita Ribeiro, Portugal
Roberto Canonico, Italy
Rolf Drechsler, Germany
Ruggero Donida Labati, Italy
Rui Melicio, Portugal
Simon Pietro Romano, Italy
Stefano Di Carlo, Italy
Sven-Volker Rehm, Germany
Thilo Sauter, Austria
Thomas Strasser, Austria
Vladimir Katic, Serbia
Wojciech Cellary, Poland
Youcef Soufi, Algeria
Zbigniew Leonowicz, Poland

Organizing Committee (PhD Students)

Adriano Ferreira, Portugal
Fernando Monteiro, Portugal
Javaneh Ramezani, Iran
José Gonçalves, Portugal
Kankam Adu, Ghana
Luis Irio, Portugal
Mafalda Rocha, Portugal
Miguel Teixeira, Portugal
Pedro Monteiro, Portugal
Ricardo Peres, Portugal
Shabnam Pasandideh, Iran
Majid Zamiri, Iran

Technical Sponsors

Society of Collaborative Networks

IFIP WG 5.5 COVE
Co-Operation infrastructure for Virtual Enterprises
and electronic business

IEEE−Industrial Electronics Society

Organizational Sponsors

Organized by: PhD Program on Electrical and Computer Engineering FCT-UNL.

Contents