

Advances in Intelligent Systems and Computing

Volume 1160

Series Editor

Janusz Kacprzyk, Systems Research Institute, Polish Academy of Sciences,
Warsaw, Poland

Advisory Editors

Nikhil R. Pal, Indian Statistical Institute, Kolkata, India

Rafael Bello Perez, Faculty of Mathematics, Physics and Computing,
Universidad Central de Las Villas, Santa Clara, Cuba

Emilio S. Corchado, University of Salamanca, Salamanca, Spain

Hani Hagras, School of Computer Science and Electronic Engineering,
University of Essex, Colchester, UK

László T. Kóczy, Department of Automation, Széchenyi István University,
Gyor, Hungary

Vladik Kreinovich, Department of Computer Science, University of Texas
at El Paso, El Paso, TX, USA

Chin-Teng Lin, Department of Electrical Engineering, National Chiao
Tung University, Hsinchu, Taiwan

Jie Lu, Faculty of Engineering and Information Technology,
University of Technology Sydney, Sydney, NSW, Australia

Patricia Melin, Graduate Program of Computer Science, Tijuana Institute
of Technology, Tijuana, Mexico

Nadia Nedjah, Department of Electronics Engineering, University of Rio de Janeiro,
Rio de Janeiro, Brazil

Ngoc Thanh Nguyen, Faculty of Computer Science and Management,
Wrocław University of Technology, Wrocław, Poland

Jun Wang, Department of Mechanical and Automation Engineering,
The Chinese University of Hong Kong, Shatin, Hong Kong

The series “Advances in Intelligent Systems and Computing” contains publications on theory, applications, and design methods of Intelligent Systems and Intelligent Computing. Virtually all disciplines such as engineering, natural sciences, computer and information science, ICT, economics, business, e-commerce, environment, healthcare, life science are covered. The list of topics spans all the areas of modern intelligent systems and computing such as: computational intelligence, soft computing including neural networks, fuzzy systems, evolutionary computing and the fusion of these paradigms, social intelligence, ambient intelligence, computational neuroscience, artificial life, virtual worlds and society, cognitive science and systems, Perception and Vision, DNA and immune based systems, self-organizing and adaptive systems, e-Learning and teaching, human-centered and human-centric computing, recommender systems, intelligent control, robotics and mechatronics including human-machine teaming, knowledge-based paradigms, learning paradigms, machine ethics, intelligent data analysis, knowledge management, intelligent agents, intelligent decision making and support, intelligent network security, trust management, interactive entertainment, Web intelligence and multimedia.

The publications within “Advances in Intelligent Systems and Computing” are primarily proceedings of important conferences, symposia and congresses. They cover significant recent developments in the field, both of a foundational and applicable character. An important characteristic feature of the series is the short publication time and world-wide distribution. This permits a rapid and broad dissemination of research results.

**** Indexing: The books of this series are submitted to ISI Proceedings, EI-Compendex, DBLP, SCOPUS, Google Scholar and Springerlink ****

More information about this series at <http://www.springer.com/series/11156>

Álvaro Rocha · Hojjat Adeli ·
Luís Paulo Reis · Sandra Costanzo ·
Irena Orovic · Fernando Moreira
Editors

Trends and Innovations in Information Systems and Technologies

Volume 2



Springer

Editors

Álvaro Rocha
Departamento de Engenharia Informática
Universidade de Coimbra
Coimbra, Portugal

Hojjat Adeli
College of Engineering
The Ohio State University
Columbus, OH, USA

Luís Paulo Reis 
FEUP
Universidade do Porto
Porto, Portugal

Sandra Costanzo
DIMES
Università della Calabria
Arcavacata di Rende, Italy

Irena Orovic
Faculty of Electrical Engineering
University of Montenegro
Podgorica, Montenegro

Fernando Moreira
Universidade Portucalense
Porto, Portugal

ISSN 2194-5357

ISSN 2194-5365 (electronic)

Advances in Intelligent Systems and Computing

ISBN 978-3-030-45690-0

ISBN 978-3-030-45691-7 (eBook)

<https://doi.org/10.1007/978-3-030-45691-7>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2020

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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

Preface

This book contains a selection of papers accepted for presentation and discussion at the 2020 World Conference on Information Systems and Technologies (WorldCIST'20). This conference had the support of the IEEE Systems, Man, and Cybernetics Society (IEEE SMC), Iberian Association for Information Systems and Technologies/Associação Ibérica de Sistemas e Tecnologias de Informação (AISTI), Global Institute for IT Management (GIIM), University of Montenegro, Mediterranean University and Faculty for Business in Tourism of Budva. It took place at Budva, Montenegro, during 7–10 April 2020.

The World Conference on Information Systems and Technologies (WorldCIST) is a global forum for researchers and practitioners to present and discuss recent results and innovations, current trends, professional experiences and challenges of modern information systems and technologies research, technological development and applications. One of its main aims is to strengthen the drive towards a holistic symbiosis between academy, society and industry. WorldCIST'20 built on the successes of WorldCIST'13 held at Olhão, Algarve, Portugal; WorldCIST'14 held at Funchal, Madeira, Portugal; WorldCIST'15 held at São Miguel, Azores, Portugal; WorldCIST'16 held at Recife, Pernambuco, Brazil; WorldCIST'17 held at Porto Santo, Madeira, Portugal; WorldCIST'18 held at Naples, Italy and WorldCIST'19 which took place at La Toja, Spain.

The program committee of WorldCIST'20 was composed of a multidisciplinary group of almost 300 experts and those who are intimately concerned with information systems and technologies. They have had the responsibility for evaluating, in a ‘blind review’ process, the papers received for each of the main themes proposed for the conference: (A) Information and Knowledge Management; (B) Organizational Models and Information Systems; (C) Software and Systems Modelling; (D) Software Systems, Architectures, Applications and Tools; (E) Multimedia Systems and Applications; (F) Computer Networks, Mobility and Pervasive Systems; (G) Intelligent and Decision Support Systems; (H) Big Data Analytics and Applications; (I) Human–Computer Interaction; (J) Ethics, Computers and Security; (K) Health Informatics; (L) Information Technologies in

Education; (M) Information Technologies in Radiocommunications; (N) Technologies for Biomedical Applications.

The conference also included workshop sessions taking place in parallel with the conference ones. Workshop sessions covered themes such as (i) Innovative Technologies Applied to Rural; (ii) Network Modelling, Learning and Analysis; (iii) Intelligent Systems and Machines; (iv) Healthcare Information Systems Interoperability, Security and Efficiency; (v) Applied Statistics and Data Analysis using Computer Science; (vi) Cybersecurity for Smart Cities Development; (vii) Education through ICT; (viii) Unlocking the Artificial Intelligence Interplay with Business Innovation (ix) and Pervasive Information Systems.

WorldCIST'20 received about 400 contributions from 57 countries around the world. The papers accepted for presentation and discussion at the conference are published by Springer (this book) in three volumes and will be submitted for indexing by ISI, EI-Compendex, SCOPUS, DBLP and/or Google Scholar, among others. Extended versions of selected best papers will be published in special or regular issues of relevant journals, mainly SCI/SSCI and Scopus/EI-Compendex indexed journals.

We acknowledge all of those that contributed to the staging of WorldCIST'20 (authors, committees, workshop organizers and sponsors). We deeply appreciate their involvement and support that were crucial for the success of WorldCIST'20.

April 2020

Álvaro Rocha
Hojjat Adeli
Luís Paulo Reis
Sandra Costanzo
Irena Orovic
Fernando Moreira

Organization

Conference

General Chair

Álvaro Rocha

University of Coimbra, Portugal

Co-chairs

Hojjat Adeli
Luis Paulo Reis
Sandra Costanzo

The Ohio State University, USA
University of Porto, Portugal
University of Calabria, Italy

Local Organizing Committee

Irena Orovic (Chair)	University of Montenegro, Montenegro
Milos Dakovic	University of Montenegro, Montenegro
Andjela Draganic	University of Montenegro, Montenegro
Milos Brajovic	University of Montenegro, Montenegro
Snezana Scepanovic	Mediterranean University, Montenegro
Rade Ratkovic	Faculty of Business and Tourism, Montenegro

Advisory Committee

Ana Maria Correia (Chair)	University of Sheffield, UK
Benjamin Lev	Drexel University, USA
Chatura Ranaweera	Wilfrid Laurier University, Canada
Chris Kimble	KEDGE Business School and MRM, UM2, Montpellier, France
Erik Bohlin	Chalmers University of Technology, Sweden
Eva Onaindia	Polytechnical University of Valencia, Spain
Gintautas Dzemyda	Vilnius University, Lithuania

Janusz Kacprzyk	Polish Academy of Sciences, Poland
Jason Whalley	Northumbria University, UK
João Tavares	University of Porto, Portugal
Jon Hall	The Open University, UK
Justin Zhang	University of North Florida, USA
Karl Stroetmann	Empirica Communication and Technology Research, Germany
Kathleen Carley	Carnegie Mellon University, USA
Keng Siau	Missouri University of Science and Technology, USA
Manlio Del Giudice	University of Rome Link Campus, Italy
Michael Koenig	Long Island University, USA
Miguel-Angel Sicilia	University of Alcalá, Spain
Reza Langari	Texas A&M University, USA
Vedat Verter	McGill University, Canada
Vishanth Weerakkody	Bradford University, UK
Wim Van Grembergen	University of Antwerp, Belgium

Program Committee

Abdul Rauf	RISE SICS, Sweden
Adnan Mahmood	Waterford Institute of Technology, Ireland
Adriana Peña Pérez Negrón	Universidad de Guadalajara, Mexico
Adriani Besimi	South East European University, Macedonia
Agostinho Sousa Pinto	Polytechnic of Porto, Portugal
Ahmed El Ouakadi	Abdelmalek Essaadi University, Morocco
Ahmed Rafea	American University in Cairo, Egypt
Alberto Freitas	FMUP, University of Porto, Portugal
Aleksandra Labus	University of Belgrade, Serbia
Alexandru Vulpe	University Politehnica of Bucharest, Romania
Ali Idri	ENSIAS, University Mohammed V, Morocco
Amélia Badica	Universiti of Craiova, Romania
Amélia Cristina Ferreira Silva	Polytechnic of Porto, Portugal
Almir Souza Silva Neto	IFMA, Brazil
Amit Shelef	Sapir Academic College, Israel
Ana Isabel Martins	University of Aveiro, Portugal
Ana Luis	University of Coimbra, Portugal
Anabela Tereso	University of Minho, Portugal
Anacleto Correia	CINAV, Portugal
Anca Alexandra Purcarea	University Politehnica of Bucharest, Romania
Andjela Draganic	University of Montenegro, Montenegro
Aneta Polewko-Klim	University of Białystok, Institute of Informatics, Poland
Aneta Poniszewska-Maranda	Lodz University of Technology, Poland
Angela Quezada	Instituto Tecnológico de Tijuana, Mexico

Anis Tissaoui	University of Jendouba, Tunisia
Ankur Singh Bist	KIET, India
Ann Svensson	University West, Sweden
Antoni Oliver	University of the Balearic Islands, Spain
Antonio Jiménez-Martín	Universidad Politécnica de Madrid, Spain
Antonio Pereira	Polytechnic of Leiria, Portugal
Armando Toda	University of São Paulo, Brazil
Arslan Enikeev	Kazan Federal University, Russia
Benedita Malheiro	Polytechnic of Porto, ISEP, Portugal
Boris Shishkov	ULSIT/IMI-BAS/IICREST, Bulgaria
Borja Bordel	Universidad Politécnica de Madrid, Spain
Branko Perisic	Faculty of Technical Sciences, Serbia
Bruno Veloso	INESC TEC, Portugal
Carla Pinto	Polytechnic of Porto, ISEP, Portugal
Carla Santos Pereira	Universidade Portucalense, Portugal
Catarina Reis	Polytechnic of Leiria, Portugal
Cengiz Acarturk	Middle East Technical University, Turkey
Cesar Collazos	Universidad del Cauca, Colombia
Christophe Feltus	LIST, Luxembourg
Christophe Soares	University Fernando Pessoa, Portugal
Christos Bouras	University of Patras, Greece
Christos Chrysoulas	London South Bank University, UK
Christos Troussas	University of Piraeus, Greece
Ciro Martins	University of Aveiro, Portugal
Claudio Sapateiro	Polytechnic of Setúbal, Portugal
Costin Badica	University of Craiova, Romania
Cristian García Bauza	PLADEMA-UNICEN-CONICET, Argentina
Cristian Mateos	ISISTAN-CONICET, UNICEN, Argentina
Daria Bylieva	Peter the Great St.Petersburg Polytechnic University, Russia
Dante Carrizo	Universidad de Atacama, Chile
Dayana Spagnuelo	Vrije Universiteit Amsterdam, Netherlands
Dušan Barać	University of Belgrade, Serbia
Edita Butrime	Lithuanian University of Health Sciences, Lithuania
Edna Dias Canedo	University of Brasilia, Brazil
Eduardo Santos	Pontifical Catholic University of Paraná, Brazil
Egils Ginters	Riga Technical University, Latvia
Ekaterina Isaeva	Perm State University, Russia
Elena Mikhailova	ITMO University, Russia
Eliana Leite	University of Minho, Portugal
Erik Fernando Mendez	Autonomous Regional University of the Andes, Ecuador
Garcea	Stockholm University, Sweden
Eriks Sneiders	ESPE, Ecuador
Esteban Castellanos	

Faisal Musa Abbas	Abubakar Tafawa Balewa University Bauchi, Nigeria
Fatima Azzahra Amazal	Ibn Zohr University, Morocco
Fernando Almeida	INESC TEC and University of Porto, Portugal
Fernando Bobillo	University of Zaragoza, Spain
Fernando Molina-Granja	National University of Chimborazo, Ecuador
Fernando Moreira	Portucalense University, Portugal
Fernando Ribeiro	Polytechnic Castelo Branco, Portugal
Filipe Caldeira	Polytechnic of Viseu, Portugal
Filipe Portela	University of Minho, Portugal
Filipe Sá	Polytechnic of Viseu, Portugal
Filippo Neri	University of Naples, Italy
Firat Bestepe	Republic of Turkey Ministry of Development, Turkey
Francesco Bianconi	Università degli Studi di Perugia, Italy
Francisco García-Peñalvo	University of Salamanca, Spain
Francisco Valverde	Universidad Central del Ecuador, Ecuador
Galim Vakhitov	Kazan Federal University, Russia
Gayo Diallo	University of Bordeaux, France
George Suciu	BEIA Consult International, Romania
Gheorghe Sebestyen	Technical University of Cluj-Napoca, Romania
Ghani Albaali	Princess Sumaya University for Technology, Jordan
Gian Piero Zarri	University Paris-Sorbonne, France
Giuseppe Di Massa	University of Calabria, Italy
Gonçalo Paiva Dias	University of Aveiro, Portugal
Goreti Marreiros	ISEP/GECAD, Portugal
Graciela Lara López	University of Guadalajara, Mexico
Habiba Drias	University of Science and Technology Houari Boumediene, Algeria
Hafed Zarzour	University of Souk Ahras, Algeria
Hamid Alasadi	Basra University, Iraq
Hatem Ben Sta	University of Tunis at El Manar, Tunisia
Hector Fernando Gomez	Universidad Tecnica de Ambato, Ecuador
Alvarado	
Hélder Gomes	University of Aveiro, Portugal
Helia Guerra	University of the Azores, Portugal
Henrique da Mota Silveira	University of Campinas (UNICAMP), Brazil
Henrique S. Mamede	University Aberta, Portugal
Hing Kai Chan	University of Nottingham Ningbo China, China
Hugo Paredes	INESC TEC and University of Trás-os-Montes e Alto Douro, Portugal
Ibtissam Abnane	Mohamed V University in Rabat, Morocco
Igor Aguilar Alonso	Universidad Nacional Tecnológica de Lima Sur, Peru

Imen Ben Said	Université de Sfax, Tunisia
Inês Domingues	University of Coimbra, Portugal
Isabel Lopes	Polytechnic of Bragança, Portugal
Isabel Pedrosa	Coimbra Business School ISCAC, Portugal
Isaias Martins	University of Leon, Spain
Issam Moghrabi	Gulf University for Science and Technology, Kuwait
Ivan Dundžer	University of Zabreb, Croatia
Ivan Lukovic	University of Novi Sad, Serbia
Jaime Diaz	University of La Frontera, Chile
Jan Kubicek	Technical University of Ostrava, Czech Republic
Jean Robert Kala Kamdjoug	Catholic University of Central Africa, Cameroon
Jesús Gallardo Casero	University of Zaragoza, Spain
Jezreel Mejia	CIMAT, Unidad Zacatecas, Mexico
Jikai Li	The College of New Jersey, USA
Jinzhi Lu	KTH Royal Institute of Technology, Sweden
Joao Carlos Silva	IPCA, Portugal
João Manuel R. S. Tavares	University of Porto, FEUP, Portugal
João Paulo Pereira	Polytechnic of Bragança, Portugal
João Reis	University of Aveiro, Portugal
João Reis	University of Lisbon, Portugal
João Rodrigues	University of the Algarve, Portugal
João Vidal Carvalho	Polytechnic of Coimbra, Portugal
Joaquin Nicolas Ros	University of Murcia, Spain
Jorge Barbosa	Polytechnic of Coimbra, Portugal
Jorge Buele	Technical University of Ambato, Ecuador
Jorge Espartero Garcia	Polytechnic Institute of Viana do Castelo, Portugal
Jorge Gomes	University of Lisbon, Portugal
Jorge Oliveira e Sá	University of Minho, Portugal
José Álvarez-García	University of Extremadura, Spain
José Braga de Vasconcelos	Universidade New Atlântica, Portugal
Jose Luis Herrero Agustin	University of Extremadura, Spain
José Luís Reis	ISMAI, Portugal
Jose Luis Sierra	Complutense University of Madrid, Spain
Jose M. Parente de Oliveira	Aeronautics Institute of Technology, Brazil
José Machado	University of Minho, Portugal
José Paulo Lousado	Polytechnic of Viseu, Portugal
Jose Torres	Universidty Fernando Pessoa, Portugal
José-Luís Pereira	Universidade do Minho, Portugal
Juan M. Santos	University of Vigo, Spain
Juan Manuel Carrillo de Gea	University of Murcia, Spain
Juan Pablo Damato	UNCIBA-CONICET, Argentina
Juncal Gutiérrez-Artacho	University of Granada, Spain
Kalinka Kaloyanova	Sofia University, Bulgaria

Kamel Rouibah	Kuwait University, Kuwait
Khalid Benali	LORIA University of Lorraine, France
Korhan Gunel	Adnan Menderes University, Turkey
Krzysztof Wolk	Polish-Japanese Academy of Information Technology, Poland
Kuan Yew Wong	Universiti Teknologi Malaysia (UTM), Malaysia
Laila Cheikhi	University Mohammed V, Rabat, Morocco
Laura Varela-Candamio	Universidade da Coruña, Spain
Laurentiu Boicescu	E.T.T.I. U.P.B., Romania
Leonardo Botega	University Centre Eurípides of Marília (UNIVEM), Brazil
Leonid Leonidovich Khoroshko	Moscow Aviation Institute (National Research University), Russia
Lia-Anca Hangan	Technical University of Cluj-Napoca, Romania
Lila Rao-Graham	University of the West Indies, Jamaica
Łukasz Tomczyk	Pedagogical University of Cracow, Poland
Luis Alvarez Sabucedo	University of Vigo, Spain
Luis Cavique	University Aberta, Portugal
Luis Gouveia	University Fernando Pessoa, Portugal
Luis Mendes Gomes	University of the Azores, Portugal
Luis Silva Rodrigues	Polythencic of Porto, Portugal
Luiz Rafael Andrade	Tiradentes University, Brazil
Luz Sussy Bayona Oré	Universidad Nacional Mayor de San Marcos, Peru
Makslim Goman	JKU, Austria
Manal el Bajta	ENSIAS, Morocco
Manuel Antonio Fernández-Villacañas Marín	Technical University of Madrid, Spain
Manuel Silva	Polytechnic of Porto and INESC TEC, Portugal
Manuel Tupia	Pontifical Catholic University of Peru, Peru
Manuel Au-Yong-Oliveira	University of Aveiro, Portugal
Marciele Bernardes	University of Minho, Brazil
Marco Bernardo	Polytechnic of Viseu, Portugal
Marco Ronchetti	Universita' di Trento, Italy
Mareca María Piilar	Universidad Politécnica de Madrid, Spain
Marek Kvet	Zilinska Univerzita v Ziline, Slovakia
María de la Cruz del Río-Rama	University of Vigo, Spain
Maria João Ferreira	Universidade Portucalense, Portugal
Maria João Varanda Pereira	Polytechnic of Bragança, Portugal
Maria José Angélico	Polytechnic of Porto, Portugal
Maria José Sousa	University of Coimbra, Portugal
María Teresa García-Álvarez	University of A Coruna, Spain
Mariam Bachiri	ENSIAS, Morocco

Marijana Despotovic-Zrakic	Faculty Organizational Science, Serbia
Mário Antunes	Polytechnic of Leiria and CRACS INESC TEC, Portugal
Marisa Maximiano	Polytechnic Institute of Leiria, Portugal
Marisol Garcia-Valls	Polytechnic University of Valencia, Spain
Maristela Holanda	University of Brasilia, Brazil
Marius Vochin	E.T.T.I. U.P.B., Romania
Marlene Goncalves da Silva	Universidad Simón Bolívar, Venezuela
Maroi Agrebi	University of Polytechnique Hauts-de-France, France
Martin Henkel	Stockholm University, Sweden
Martín López Nores	University of Vigo, Spain
Martin Zelm	INTEROP-VLab, Belgium
Mawloud Mosbah	University 20 Août 1955 of Skikda, Algeria
Michal Adamczak	Poznan School of Logistics, Poland
Michal Kvet	University of Zilina, Slovakia
Miguel António Sovierzoski	Federal University of Technology - Paraná, Brazil
Mihai Lungu	University of Craiova, Romania
Mircea Georgescu	Al. I. Cuza University of Iasi, Romania
Mirna Muñoz	Centro de Investigación en Matemáticas A.C., Mexico
Mohamed Hosni	ENSIAS, Morocco
Monica Leba	University of Petrosani, Romania
Mu-Song Chen	Da-Yeh University, China
Natalia Grafeeva	Saint Petersburg University, Russia
Natalia Miloslavskaya	National Research Nuclear University MEPhI, Russia
Naveed Ahmed	University of Sharjah, United Arab Emirates
Neeraj Gupta	KIET Group of Institutions Ghaziabad, India
Nelson Rocha	University of Aveiro, Portugal
Nikolai Prokopyev	Kazan Federal University, Russia
Niranjan S. K.	JSS Science and Technology University, India
Noemi Emanuela Cazzaniga	Politecnico di Milano, Italy
Noureddine Kerzazi	Polytechnique Montréal, Canada
Nuno Melão	Polytechnic of Viseu, Portugal
Nuno Octávio Fernandes	Polytechnic of Castelo Branco, Portugal
Olimpiu Stoicuta	University of Petrosani, Romania
Patricia Zachman	Universidad Nacional del Chaco Austral, Argentina
Patrick C-H. Soh	Multimedia University, Malaysia
Paula Alexandra Rego	Polytechnic of Viana do Castelo and LIACC, Portugal
Paulo Maio	Polytechnic of Porto, ISEP, Portugal
Paulo Novais	University of Minho, Portugal

Paulvanna Nayaki Marimuthu	Kuwait University, Kuwait
Paweł Karczmarek	The John Paul II Catholic University of Lublin, Poland
Pedro Rangel Henriques	University of Minho, Portugal
Pedro Sobral	University Fernando Pessoa, Portugal
Pedro Sousa	University of Minho, Portugal
Philipp Brune	Neu-Ulm University of Applied Sciences, Germany
Piotr Kulczycki	Systems Research Institute, Polish Academy of Sciences, Poland
Prabhat Mahanti	University of New Brunswick, Canada
Rabia Azzi	Bordeaux University, France
Radu-Emil Precup	Politehnica University of Timisoara, Romania
Rafael Caldeirinha	Polytechnic of Leiria, Portugal
Rafael M. Luque Baena	University of Malaga, Spain
Rahim Rahmani	University Stockholm, Sweden
Raiani Ali	Hamad Bin Khalifa University, Qatar
Ramayah T.	Universiti Sains Malaysia, Malaysia
Ramiro Gonçalves	University of Trás-os-Montes e Alto Douro & INESC TEC, Portugal
Ramon Alcarria	Universidad Politécnica de Madrid, Spain
Ramon Fabregat Gesa	University of Girona, Spain
Renata Maria Maracho	Federal University of Minas Gerais, Brazil
Reyes Juárez Ramírez	Universidad Autónoma de Baja California, Mexico
Rui Jose	University of Minho, Portugal
Rui Pitarma	Polytechnic Institute of Guarda, Portugal
Rui S. Moreira	UFP & INESC TEC & LIACC, Portugal
Rustam Burnashev	Kazan Federal University, Russia
Saeed Salah	Al-Quds University, Palestine
Said Achhab	Mohammed V University in Rabat, Morocco
Sajid Anwar	Institute of Management Sciences Peshawar, Pakistan
Sami Habib	Kuwait University, Kuwait
Samuel Sepulveda	University of La Frontera, Chile
Sanaz Kavianpour	University of Technology, Malaysia
Sandra Patricia Cano	University of San Buenaventura Cali, Colombia
Mazuera	
Savo Tomovic	University of Montenegro, Montenegro
Sassi Sassi	FSJEGJ, Tunisia
Seppo Sirkemaa	University of Turku, Finland
Sergio Albiol-Pérez	University of Zaragoza, Spain
Shahed Mohammadi	Ayandegan University, Iran
Shahnawaz Talpur	Mehran University of Engineering & Technology Jamshoro, Pakistan

Silviu Vert	Politehnica University of Timisoara, Romania
Simona Mirela Riurean	University of Petrosani, Romania
Slawomir Zolkiewski	Silesian University of Technology, Poland
Solange N. Alves-Souza	University of São Paulo, Brazil
Solange Rito Lima	University of Minho, Portugal
Sonia Sobral	Portucalense University, Portugal
Sorin Zoican	Polytechnic University of Bucharest, Romania
Souraya Hamida	Batna 2 University, Algeria
Sümeyya Ilkin	Kocaeli University, Turkey
Syed Nasirin	Universiti Malaysia Sabah, Malaysia
Taoufik Rachad	University Mohamed V, Morocco
Tatiana Antipova	Institute of Certified Specialists, Russia
Teresa Guarda	University Estatal Peninsula de Santa Elena, Ecuador
Tero Kokkonen	JAMK University of Applied Sciences, Finland
The Thanh Van	HCMC University of Food Industry, Vietnam
Thomas Weber	EPFL, Switzerland
Timothy Asiedu	TIM Technology Services Ltd., Ghana
Tom Sander	New College of Humanities, Germany
Tomaž Klobučar	Jozef Stefan Institute, Slovenia
Toshihiko Kato	University of Electro-Communications, Japan
Tzung-Pei Hong	National University of Kaohsiung, Taiwan
Valentina Colla	Scuola Superiore Sant'Anna, Italy
Veronica Segarra Faggioni	Private Technical University of Loja, Ecuador
Victor Alves	University of Minho, Portugal
Victor Georgiev	Kazan Federal University, Russia
Victor Kaptelinin	Umeå University, Sweden
Vincenza Carchiolo	University of Catania, Italy
Vitalyi Igorevich Talanin	Zaporozhye Institute of Economics and Information Technologies, Ukraine
Wafa Mefteh	Tunisia
Wolf Zimmermann	Martin Luther University Halle-Wittenberg, Germany
Yadira Quiñonez	Autonomous University of Sinaloa, Mexico
Yair Wiseman	Bar-Ilan University, Israel
Yuhua Li	Cardiff University, UK
Yuwei Lin	University of Roehampton, UK
Yves Rybarczyk	Dalarna University, Sweden
Zorica Bogdanovic	University of Belgrade, Serbia

Contents

Software Systems, Architectures, Applications and Tools

Single Producer – Multiple Consumers Ring Buffer Data Distribution System with Memory Management	3
Mariusz Orlikowski	
Exploring the Innovative Aspects of CV Distributed Ledgers Based on Blockchain	14
F. O. Silva, Rui Humberto Pereira, Maria José Angélico Gonçalves, Amélia Ferreira da Silva, and Manuel Silva	
Characterizing the Cost of Introducing Secure Programming Patterns and Practices in Ethereum	25
Aboua Ange Kevin N'Da, Santiago Matalonga, and Keshav Dahal	
A Survey of AI Accelerators for Edge Environment	35
Wenbin Li and Matthieu Liewig	
Building a Virtualized Environment for Programming Courses	45
Tuisku Polvinen, Timo Ylikännö, Ari Mäkeläinen, Sampsa Rauti, Jari-Matti Mäkelä, and Jani Tammi	
Data Extraction System for Hot Bike-Sharing Spots in an Intermediate City	56
Walter Remache, Andrés Heredia, and Gabriel Barros-Gavilanes	
Software Tools for Airport Pavement Design	66
Tiago Tamagusko and Adelino Ferreira	
Design of a Gravity Compensation for Robot Control Based on Low-Cost Automation	77
Dalia Alvarez-Montenegro, Juan Escobar-Naranjo, Geovanni D. Brito, Carlos A. Garcia, and Marcelo V. Garcia	

Electronic Payment Fraud Detection Using Supervised and Unsupervised Learning	88
Lilian Pires Pracidelli and Fabio Silva Lopes	
Fog Computing in Real Time Resource Limited IoT Environments	102
Pedro Costa, Bruno Gomes, Nilsa Melo, Rafael Rodrigues, Célio Carvalho, Karim Karmali, Salim Karmali, Christophe Soares, José M. Torres, Pedro Sobral, and Rui S. Moreira	
A Power Efficient IoT Edge Computing Solution for Cooking Oil Recycling	113
Bruno Gomes, Nilsa Melo, Rafael Rodrigues, Pedro Costa, Célio Carvalho, Karim Karmali, Salim Karmali, Christophe Soares, José M. Torres, Pedro Sobral, and Rui S. Moreira	
Supervising Industrial Distributed Processes Through Soft Models, Deformation Metrics and Temporal Logic Rules	125
Borja Bordel, Ramón Alcarria, and Tomás Robles	
Frameworks to Develop Secure Mobile Applications: A Systematic Literature Review	137
Jezreel Mejía, Perla Maciel, Mirna Muñoz, and Yadira Quiñonez	
Social Media: People's Salvation or Their Perdition?	147
Yúmina Zêdo, João Costa, Viviana Andrade, and Manuel Au-Yong-Oliveira	
Artificial Intelligence Applied to Digital Marketing	158
Tiago Ribeiro and José Luís Reis	
Fact-Check Spreading Behavior in Twitter: A Qualitative Profile for False-Claim News	170
Francisco S. Marcondes, José João Almeida, Dalila Durães, and Paulo Novais	
Artefact of Augmented Reality to Support the Treatment of Specific Phobias	181
Raul Vilas Boas, Lázaro Lima, Greice Zanini, and Pedro Rangel Henriques	
Social Care Services for Older Adults: Paper Registration Versus a Web-Based Platform Registration	188
Ana Isabel Martins, Hilma Caravau, Ana Filipa Rosa, Ana Filipa Almeida, and Nelson Pacheco Rocha	
Enabling Green Building's Comfort Using Information and Communication Technologies: A Systematic Review of the Literature	197
Ana Isabel Martins, Ana Carolina Oliveira Lima, Paulo Bartolomeu, Lucilene Ferreira Mouzinho, Joaquim Ferreira, and Nelson Pacheco Rocha	

eFish – An Innovative Fresh Fish Evaluation System	209
Renato Sousa Pinto, Manuel Au-Yong-Oliveira, Rui Ferreira, Osvaldo Rocha Pacheco, and Rui Miranda Rocha	
A Virtual Reality Approach to Automatic Blood Sample Generation	221
Jaime Díaz, Jeferson Arango-López, Samuel Sepúlveda, Danay Ahumada, Fernando Moreira, and Joaquin Gebauer	
Building Information Modeling Academic Assessment	231
Miguel Ángel Pérez Sandoval, Isidro Navarro Delgado, and Georgina Sandoval	
Radar System for the Reconstruction of 3D Objects: A Preliminary Study	238
Jeneffer Barberán, Ginna Obregón, Darwin Moreta, Manuel Ayala, Javier Obregón, Rodrigo Domínguez, and Jorge Luis Buele	
Multimedia Systems and Applications	
Achieving Stronger Compaction for DCT-Based Steganography: A Region-Growing Approach	251
Mohammed Baziad, Tamer Rabie, and Ibrahim Kamel	
Teaching Computer Programming as Well-Defined Domain for Beginners with Protoboard	262
Carlos Hurtado, Guillermo Licea, Mario García-Valdez, Angeles Quezada, and Manuel Castañón-Puga	
Computer Networks, Mobility and Pervasive Systems	
Machine Learning and Data Networks: Perspectives, Feasibility, and Opportunities	275
Raúl Lozada-Yáñez, Fernando Molina-Granja, Pablo Lozada-Yáñez, and Jonny Guaiña-Yungan	
Underground Channel Model for Visible Light Wireless Communication Based on Neural Networks	293
Simona Riurean, Olimpiu Stoicuta, Monica Leba, Andreea Ionica, and Álvaro Rocha	
mpCUBIC: A CUBIC-like Congestion Control Algorithm for Multipath TCP	306
Toshihiko Kato, Shiho Haruyama, Ryo Yamamoto, and Satoshi Ohzahata	
Context-Aware Mobile Applications in Fog Infrastructure: A Literature Review	318
Celestino Barros, Vitor Rocio, André Sousa, and Hugo Paredes	

Analyzing IoT-Based Botnet Malware Activity with Distributed Low Interaction Honeypots	329
Sergio Vidal-González, Isaías García-Rodríguez, Héctor Aláiz-Moretón, Carmen Benavides-Cuéllar, José Alberto Benítez-Andrades, María Teresa García-Ordás, and Paulo Novais	
Evolution of HTTPS Usage by Portuguese Municipalities	339
Hélder Gomes, André Zúquete, Gonçalo Paiva Dias, Fábio Marques, and Catarina Silva	
Augmented Reality to Enhance Visitors' Experience at Archaeological Sites	349
Samuli Laato and Antti Laato	
Design and Performance Analysis for Intelligent F-PMIPv6 Mobility Support for Smart Manufacturing	359
Byung Jun Park and Jongpil Jeong	
Development of Trustworthy Self-adaptive Framework for Wireless Sensor Networks	368
Sami J. Habib and Paulvanna N. Marimuthu	
Intelligent and Decision Support Systems	
Traffic Flow Prediction Using Public Transport and Weather Data: A Medium Sized City Case Study	381
Carlos Silva and Fernando Martins	
Filtering Users Accounts for Enhancing the Results of Social Media Mining Tasks	391
May Shalaby and Ahmed Rafea	
From Reinforcement Learning Towards Artificial General Intelligence	401
Filipe Marinho Rocha, Vítor Santos Costa, and Luís Paulo Reis	
Overcoming Reinforcement Learning Limits with Inductive Logic Programming	414
Filipe Marinho Rocha, Vítor Santos Costa, and Luís Paulo Reis	
A Comparison of LSTM and XGBoost for Predicting Firemen Interventions	424
Selene Cerna, Christophe Guyeux, Héber H. Arcolezi, Raphaël Couturier, and Guillaume Royer	
Exact Algorithms for Scheduling Programs with Shared Tasks	435
Imed Kacem, Giorgio Lucarelli, and Théo Nazé	

Automating Complaints Processing in the Food and Economic Sector: A Classification Approach	445
Gustavo Magalhães, Brígida Mónica Faria, Luís Paulo Reis, Henrique Lopes Cardoso, Cristina Caldeira, and Ana Oliveira	
IoT Services Applied at the Smart Cities Level	457
George Suciu, Ijaz Hussain, Andreea Badicu, Lucian Necula, and Teodora Uşurelu	
Statistical Evaluation of Artificial Intelligence -Based Intrusion Detection System	464
Samir Puuska, Tero Kokkonen, Petri Mutka, Janne Alatalo, Eppu Heilimo, and Antti Mäkelä	
Analyzing Peer-to-Peer Lending Secondary Market: What Determines the Successful Trade of a Loan Note?	471
Ajay Byanjankar, József Mezei, and Xiaolu Wang	
Experience Analysis Through an Event Based Model Using Mereotopological Relations: From Video to Hypergraph	482
Giles Beaudon, Eddie Soulier, and Anne Gayet	
Level Identification in Coupled Tanks Using Extreme Learning Machine	493
Alanio Ferreira de Lima, Gabriel F. Machado, Darielson A. Souza, Francisco H. V. da Silva, Josias G. Batista, José N. N. Júnior, and Deivid M. de Freitas	
Decision Intelligence in Street Lighting Management	501
Diogo Nunes, Daniel Teixeira, Davide Carneiro, Cristóvão Sousa, and Paulo Novais	
Cardiac Arrhythmia Detection Using Computational Intelligence Techniques Based on ECG Signals	511
Jean C. C. Lima, Alanio Ferreira de Lima, Darielson A. Souza, Márcia T. Tonieto, Josias G. Batista, and Manoel E. N. de Oliveira	
Personalising Explainable Recommendations: Literature and Conceptualisation	518
Mohammad Naiseh, Nan Jiang, Jianbing Ma, and Raian Ali	
Colorectal Image Classification with Transfer Learning and Auto-Adaptive Artificial Intelligence Platform	534
Zoltan Czako, Gheorghe Sebestyen, and Anca Hangan	
Toolbox for Azure Kinect COTS Device to be Used in Automatic Screening of Idiopathic Scoliosis	544
Dejan Dimitrijević, Vladimir Todorović, Nemanja Nedić, Igor Zečević, and Sergiu Nedevschi	

Big Data Analytics and Applications

- Detecting Public Transport Passenger Movement Patterns** 555
Natalia Grafeeva and Elena Mikhailova

- A Parallel CPU/GPU Bees Swarm Optimization Algorithm for the Satisfiability Problem** 564
Celia Hireche and Habiba Drias

- Comparison of Major LiDAR Data-Driven Feature Extraction Methods for Autonomous Vehicles** 574
Duarte Fernandes, Rafael Névoa, António Silva, Cláudia Simões, João Monteiro, Paulo Novais, and Pedro Melo

- Where Is the Health Informatics Market Going?** 584
André Caravela Machado, Márcia Martins, Bárbara Cordeiro, and Manuel Au-Yong-Oliveira

- Data Integration Strategy for Robust Classification of Biomedical Data** 596
Aneta Polewko-Klim and Witold R. Rudnicki

- Identification of Clinical Variables Relevant for Survival Prediction in Patients with Metastatic Castration-Resistant Prostate Cancer** 607
Wojciech Lesiński, Aneta Polewko-Klim, and Witold R. Rudnicki

Human-Computer Interaction

- Digital Technologies Acceptance/Acquisition Modeling Respecting Age Factor** 621
Egils Ginters

- Location-Based Games as Interfaces for Collecting User Data** 631
Sampsaa Rauti and Samuli Laato

- Application of the ISO 9241-171 Standard and Usability Inspection Methods for the Evaluation of Assistive Technologies for Individuals with Visual Impairments** 643
Ana Carolina Oliveira Lima, Maria de Fátima Vieira, Ana Isabel Martins, Lucilene Ferreira Mouzinho, and Nelson Pacheco Rocha

- Augmented Reality Technologies Selection Using the Task-Technology Fit Model – A Study with ICETS** 654
Nageswaran Vaidyanathan

- Towards Situated User-Driven Interaction Design of Ambient Smart Objects in Domestic Settings** 664
Victor Kaptelinin and Mikael Hansson

The Impact of Homophily and Herd Size on Decision Confidence in the Social Commerce Context	672
Mariam Munawar, Khaled Hassanein, and Milena Head	
Multimodal Intelligent Wheelchair Interface	679
Filipe Coelho, Luís Paulo Reis, Brígida Mónica Faria, Alexandra Oliveira, and Victor Carvalho	
Innovation and Robots in Retail - How Far Away Is the Future?	690
Manuel Au-Yong-Oliveira, Jacinta Garcia, and Cristina Correia	
Usability Evaluation of Personalized Digital Memory Book for Alzheimer's Patient (my-MOBAL)	702
Anis Hasliza Abu Hashim-de Vries, Marina Ismail, Azlinah Mohamed, and Ponnusamy Subramaniam	
Web Cookies: Is There a Trade-off Between Website Efficiency and User Privacy?	713
Pedro Pinto, Romeu Lages, and Manuel Au-Yong-Oliveira	
On the Need for Cultural Sensitivity in Digital Wellbeing Tools and Messages: A UK-China Comparison	723
John McAlaney, Manal Aldhayan, Mohamed Basel Almourad, Sainabou Cham, and Raian Ali	
Measurement of Drag Distance of Objects Using Mobile Devices: Case Study Children with Autism	734
Angeles Quezada, Reyes Juárez-Ramírez, Margarita Ramirez, Ricardo Rosales, and Carlos Hurtado	
Right Arm Exoskeleton for Mobility Impaired	744
Marius-Nicolae Risteiu and Monica Leba	
Semi-automatic Eye Movement-Controlled Wheelchair Using Low-Cost Embedded System	755
Gustavo Caiza, Cristina Reinoso, Henry Vallejo, Mauro Albarracín, and Edison P. Salazar	
Design and Control of a Biologically Inspired Shoulder Joint	765
Marius Leonard Olar, Monica Leba, and Sebastian Rosca	
Modelling and Simulation of 3D Human Arm Prosthesis	775
Sebastian Daniel Rosca, Monica Leba, and Arun Fabian Panaite	
Ethics, Computers and Security	
On the Assessment of Compliance with the Requirements of Regulatory Documents to Ensure Information Security	789
Natalia Miloslavskaya and Svetlana Tolstaya	

Iconified Representations of Privacy Policies: A GDPR Perspective	796
Sander de Jong and Dayana Spagnuelo	
Data Protection in Public Sector: Normative Analysis of Portuguese and Brazilian Legal Orders	807
Marciele Berger Bernardes, Francisco Pacheco de Andrade, and Paulo Novais	
Common Passwords and Common Words in Passwords	818
Jikai Li, Ethan Zeigler, Thomas Holland, Dimitris Papamichail, David Greco, Joshua Grabentein, and Daan Liang	
Using Fuzzy Cognitive Map Approach for Assessing Cybersecurity for Telehealth Scenario	828
Thiago Poleto, Rodrigo Cleiton Paiva de Oliveira, Ayara Letícia Bentes da Silva, and Victor Diogho Heuer de Carvalho	
Author Index	839