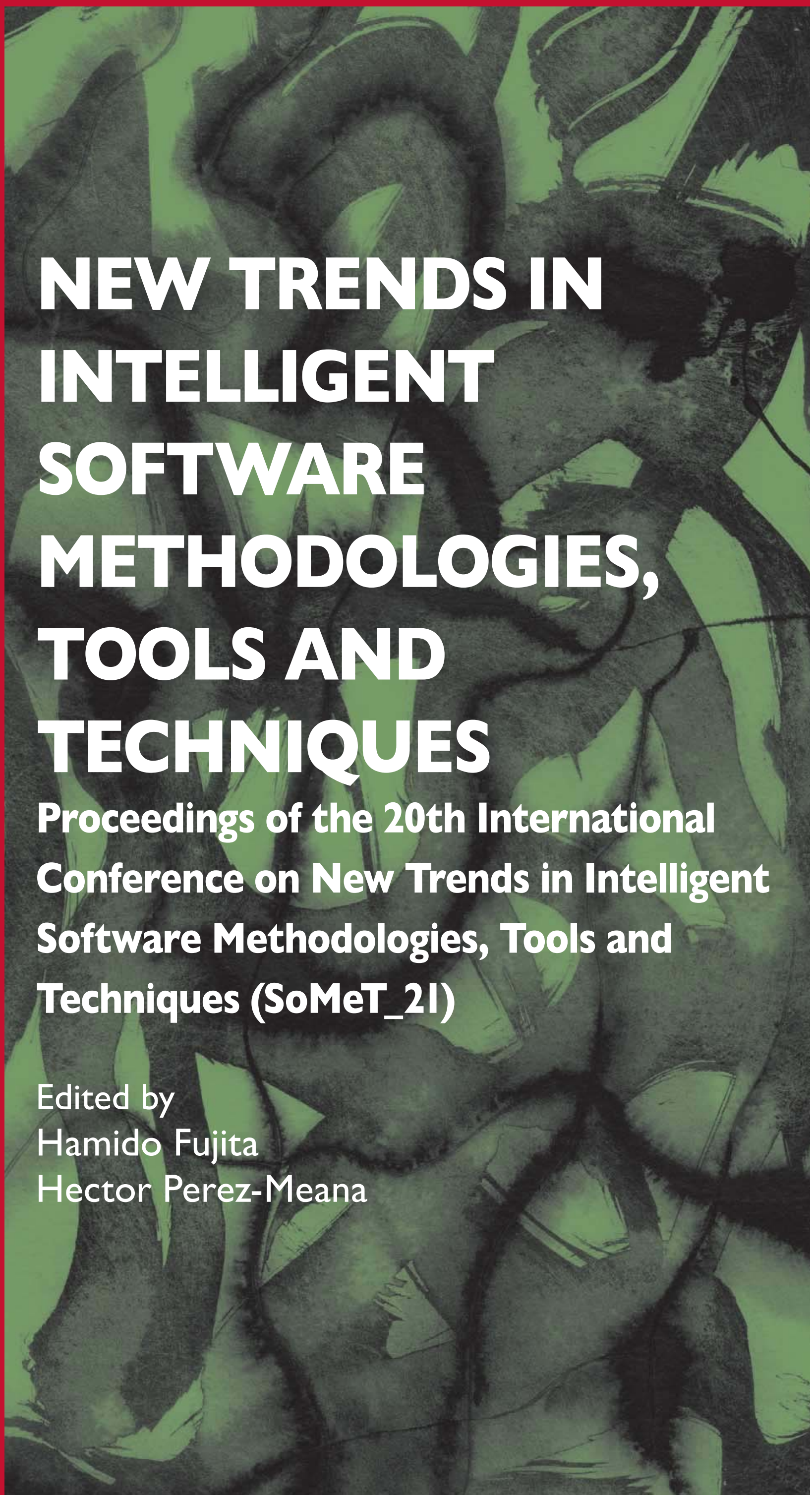
Frontiers in Artificial Intelligence and Applications



NEW TRENDS IN INTELLIGENT SOFTWARE METHODOLOGIES, TOOLS AND TECHNIQUES

Proceedings of the 20th International Conference on New Trends in Intelligent Software Methodologies, Tools and Techniques (SoMeT_21)

Edited by
Hamido Fujita
Hector Perez-Meana

IOS Press

NEW TRENDS IN INTELLIGENT SOFTWARE METHODOLOGIES, TOOLS AND TECHNIQUES

The integration of AI with software is an essential enabler for science and the new economy, creating new markets and opportunities for a more reliable, flexible and robust society. Current software methodologies, tools and techniques often fall short of expectations, however, and much software remains insufficiently robust and reliable for a constantly changing and evolving market.

This book presents 54 papers delivered at the 20th edition of the International Conference on New Trends in Intelligent Software Methodology Tools, and Techniques (SoMeT_21), held in Cancun, Mexico, from 21–23 September 2021. The aim of the conference was to capture the essence of a new state-of-the-art in software science and its supporting technology and to identify the challenges that such a technology will need to master, and this book explores the new trends and theories illuminating the direction of development in this field as it heads towards a transformation in the role of software and science integration in tomorrow's global information society.

The 54 revised papers were selected for publication by means of a rigorous review process involving 3 or 4 reviewers for each paper, followed by selection by the SoMeT_21 international reviewing committee. The book is divided into 9 chapters, classified by paper topic and relevance to the chapter theme.

Covering topics ranging from research practices, techniques and methodologies to proposing and reporting on the solutions required by global business, the book offers an opportunity for the software science community to consider where they are today and where they are headed in the future.

9 781643 681948

ISBN 978-1-64368-194-8 (print)
ISBN 978-1-64368-195-5 (online)
ISSN 0922-6389 (print)
ISSN 1879-8314 (online)

NEW TRENDS IN INTELLIGENT SOFTWARE METHODOLOGIES, TOOLS AND TECHNIQUES

Frontiers in Artificial Intelligence and Applications

The book series Frontiers in Artificial Intelligence and Applications (FAIA) covers all aspects of theoretical and applied Artificial Intelligence research in the form of monographs, selected doctoral dissertations, handbooks and proceedings volumes. The FAIA series contains several sub-series, including 'Information Modelling and Knowledge Bases' and 'Knowledge-Based Intelligent Engineering Systems'. It also includes the biennial European Conference on Artificial Intelligence (ECAI) proceedings volumes, and other EurAI (European Association for Artificial Intelligence, formerly ECCAI) sponsored publications. The series has become a highly visible platform for the publication and dissemination of original research in this field. Volumes are selected for inclusion by an international editorial board of well-known scholars in the field of AI. All contributions to the volumes in the series have been peer reviewed.

The FAIA series is indexed in ACM Digital Library; DBLP; EI Compendex; Google Scholar; Scopus; Web of Science: Conference Proceedings Citation Index – Science (CPCI-S) and Book Citation Index – Science (BKCI-S); Zentralblatt MATH.

Volume 337

Recently published in this series

ISSN 0922-6389 (print)
ISSN 1879-8314 (online)

New Trends in Intelligent Software Methodologies, Tools and Techniques

Proceedings of the 20th International Conference on New Trends in Intelligent Software Methodologies, Tools and Techniques (SoMeT_21)

Edited by

Hamido Fujita

i-SOMET Incorporated Association, Morioka, Japan

and

Hector Perez-Meana

National Polytechnic Institute, Mexico City, Mexico

IOS Press

Amsterdam • Berlin • Washington, DC

ISBN 978-1-64368-194-8 (print)
ISBN 978-1-64368-195-5 (online)
doi: 10.3233/FAIA337

Publisher
IOS Press BV
Nieuwe Hemweg 6B
1013 BG Amsterdam
Netherlands
fax: +31 20 687 0019
e-mail: order@iospress.nl

For book sales in the USA and Canada:
IOS Press, Inc.
6751 Tepper Drive
Clifton, VA 20124
USA
Tel.: +1 703 830 6300
Fax: +1 703 830 2300
sales@iospress.com

PRINTED IN THE NETHERLANDS

https://i-somet.org/

Preface

The integration of Applied Intelligence with Software is an essential enabler for science and the new economy. It creates new markets and opens up new directions for a more reliable, flexible and robust society. It empowers the exploration of our world in ever more depth. However, the software involved often falls short of our expectations. Current software methodologies, tools, and techniques remain insufficiently robust and reliable for a constantly changing and evolving market, and many promising approaches have proved to be no more than case-oriented methods that are not fully automated.

This book explores the new trends and theories which illuminate the direction of developments in this field and which we believe will lead to a transformation in the role of software and science integration in tomorrow's global information society.

Discussing issues ranging from research practices, techniques and methodologies, to proposing and reporting on the solutions required by global business, the book offers an opportunity for the software science community to think about where we are today and where we are headed in the future.

The book aims to capture the essence of a new state of the art in software science and its supporting technology, as well as to identify the challenges that such a technology will need to master. It contains the extensively reviewed papers presented at the 20th round of the International Conference on New Trends in Intelligent Software Methodology Tools, and Techniques, (SoMeT_21) held in Cancun Mexico, with the collaboration of National Polytechnic Institute, (IPN) Mexico City, Mexico, from 21–23 September 2021. (https://atenea.esimecu.ipn.mx/SOMET2021.html). This 2021 edition of SoMeT1 also celebrates the 20th anniversary of the conference series, which is ranked B+ among other high-ranking Computer Science conferences worldwide. The 2021 event is supported by the i-SOMET Incorporated Association, (www.i-somet.org) established by Prof. Hamido Fujita.

As ever, the 2021 conference brought together researchers and practitioners to share their original research results and practical development experience in software science and related new technologies.

This volume participates in the conference and the SoMeT series of which it forms

[1] Previous related events that contributed to this publication are: SoMeT_02 (the Sorbonne, Paris, 2002); SoMeT_03 (Stockholm, Sweden, 2003); SoMeT_04 (Leipzig, Germany, 2004); SoMeT_05 (Tokyo, Japan, 2005); SoMeT_06 (Quebec, Canada, 2006); SoMeT_07 (Rome, Italy, 2007); SoMeT_08 (Sharjah, UAE, 2008); SoMeT_09 (Prague, Czech Republic, 2009); SoMeT_10 (Yokohama, Japan, 2010), and SoMeT_11 (Saint Petersburg, Russia), SoMeT_12 (Genoa, Italy), SoMeT_13 (Budapest, Hungary), SoMeT_14 (Langkawi, Malaysia), SoMeT_15 (Naples, Italy), SoMeT_16 (Larnaca, Cyprus), SoMeT_17 (Kitakyushu, Japan), SoMeT_18 (Granada, Spain), SoMeT_19 (Sarawak, Malaysia), SoMeT_20 (Kitakyushu, Japan).

a part by providing an opportunity for the exchange of ideas and experiences in the field of software technology; opening up new avenues for software development, methodologies, tools, and techniques, especially with regard to intelligent software, by applying artificial intelligence techniques in Software Development and tackling human interaction in the development process for better high level interface. The emphasis has been placed on human-centric software methodologies, end-user development techniques, and emotional reasoning, for an optimally harmonized performance between the design tool and the user.

The word “intelligent” in the full SOMET title emphasizes the need to apply artificial intelligence to issues of software design for systems application, for example, in disaster recovery and other systems supporting civil protection and in other areas where human intelligence is a requirement in system engineering.

A major goal of this volume was to assemble the work of scholars from the international research community as part of the process of discussing and sharing the research experiences of new software methodologies and techniques. One of the important areas addressed is the handling of cognitive issues in software development to adapt it to the user’s mental state. Tools and techniques related to this aspect form part of the contributions to this book. Another subject raised at the conference was intelligent software design in software ontology and conceptual software design in the practice of human-centric information system application.

The book also investigates other comparable theories and practices in software science, including emerging technologies, from their computational foundations in terms of models, methodologies, and tools. This is essential for a comprehensive overview of information systems and research projects, and to assess their practical impact on real-world software problems. This represents another milestone in mastering the new challenges of software and its promising technology addressed by the SoMeT conferences, and provides the reader with new insights and inspiration, as well as concrete material to further the study of this new technology.

The book contains a collection of carefully selected papers, refereed by the reviewing committee, and covering (but not limited to):

1) Software engineering aspects of software security programs, diagnosis and maintenance
2) Static and dynamic analysis of software performance models
3) Software security aspects and networking
4) Agile software and lean methods
5) Practical artifacts of software security, software validation and diagnosis
6) Software optimization and formal methods
7) Intelligent Decision Support Systems
8) Software methodologies and related techniques
9) Automatic software generation, re-coding and legacy systems
10) Software quality and process assessment
11) Intelligent software systems design and evolution
12) Artificial Intelligence techniques for Software Engineering and Requirement Engineering
13) End-user requirement engineering and programming environments for Web applications
14) Ontology, cognitive models and philosophical aspects on software design
15) Business oriented software application models

16) Emergency Management Informatics, software methods and application for supporting Civil Protection, First Response and Disaster Recovery
17) Model Driven Development (DVD), code centric to model centric software engineering
18) Cognitive Software and human behavioral analysis in software design.

From the 112 high-quality submissions received, we have selected 54 of the best revised articles for publication in this book. The referees in the program committee have reviewed all these submissions carefully, and on the basis of technical soundness, relevance, originality, significance, and clarity, these 54 papers were selected. They were then revised on the basis of the review reports before being selected by the SoMeT_21 international reviewing committee. It is worth stating that there were three or four reviewers for each paper published in this book. The book is divided into 9 Chapters, classified based on paper topic and its relevance to each chapter-related theme, and as follows:

CHAPTER 1	Software System with Intelligent Design
CHAPTER 2	Software System Security and techniques
CHAPTER 3	Formal Techniques for System Software and Quality assessment
CHAPTER 4	Applied Intelligence in Software
CHAPTER 5	Intelligent Decision Support Systems
CHAPTER 6	Document Analytics- based Systems
CHAPTER 7	Knowledge Science and Intelligent Computing
CHAPTER 8	Ontology in Data and Software
CHAPTER 9	Machine Learning in Systems Software

This book is the result of a collective effort from many industrial partners and colleagues from around the world. We would particularly like to express our gratitude for the support provided by the National Polytechnic Institute, (IPN) Mexico, and for the work of all those authors who have contributed their invaluable support to this work. Most especially, we thank the program committee, reviewing committee and all those who participated in the rigorous reviewing process and the lively discussion and evaluation meetings which led to the selected papers which appear in this book. Last but not least, we would also like to thank the Microsoft Conference Management Tool team for their expert guidance on the use of the Microsoft CMT System as a conference-support tool throughout all the phases of SoMeT_21.

Editors

This page intentionally left blank

Conference Organization

General Chairs

Hamido Fujita — i-SOMET Incorporated Association, Morioka, Japan
e-mail: hfujita@i-somet.org

Hector Perez-Meana — National Polytechnic Institute, Mexico City, Mexico
e-mail: hmperezm@ipn.mx

Program Chairs

Jun Sasaki — Iwate Prefectural University, Iwate, Japan
e-mail: jsasaki@iwate-pu.ac.jp

Gabriel Sanchez-Perez — National Polytechnic Institute, Mexico City, Mexico
e-mail: caaann@gmail.com

Organizing Chairs

Mariko Nakano — National Polytechnic Institute, Mexico City, Mexico
e-mail: mnakano@ipn.mx

Andres Hernandez-Matamoros — The University of Tokyo, Chiba, Japan
e-mail: phd.matamoros@gmail.com

Publicity Chairs

Jesus Olivares-Mercado — National Polytechnic Institute, Mexico City, Mexico
e-mail: jolivares@ipn.mx

Lidia Prudente-Tixteco — National Polytechnic Institute, Mexico City, Mexico
e-mail: lidtix@gmail.com

Program committee of SoMeT_21
https://atenea.esimecu.ipn.mx/organization.html

Alexander Vazhenin	University of Aizu, Fukushima, Japan
Andreas Speck	Kiel University, Germany
Antonio Tallon	University of Seville, Spain
Azlan In Mohd Zain	Universiti Teknologi Malaysia, Malaysia
Azurah A Samah	Universiti Teknologi Malaysia, Malaysia
Anna-Maria Di Sciullo	University de Quebec de Montreal, Canada
Balsam A. Mustafa	Universiti Malaysia Pahang, Malaysia
Beata Czarnacka-Chrobot	Warsaw School of Economics, Poland
Bipin Indurkhya	Jagiellonian University, in Krakow, Poland
Cheah WaiShiang	Universiti Malaysia Sarawak, Malaysia
Chi-Yo Huang	National Taiwan Normal University, Taiwan
Clemens Schaefer	It Factum Gmbh, Germany
Colette Rolland	Pantheon-Sorbonne University, Paris, France
Domenico Pisanelli	ISTC-CNR, Rome, Italy
Dmitry Mouromtsev	ITMO University Saint Petersburg, Russia
Elke Pulvermueller	Osnabrück University, Germany
Enrique Herrera-Viedma	University of Granada, Spain
Guido Guizzi	University of Naples Federico II, Italy
Hector Perez-Morago	National University of Distance Education, Spain
Hector Perez-Meana	SEPI ESIME Culhuacan - Instituto Politécnico Nacional, Mexico
Horvath Laszlo	Obuda University, Budapest, Hungary
Igor Kotenko	Saint Petersburg Institute for Informatics, Russia
Imran Babar	Army Public College of Management & Sciences, Pakistan
Jonathan Bowen	King's College London, United Kingdom
Jun Hakura	Iwate Prefectural University, Japan
Juan Manuel Corchado	University of Salamanca, Spain
Juan Miguel Tapia García	University of Granada. Spain
Love Ekenberg	Stockholm University, Sweden
Mahadi Bahari	Universiti Teknologi Malaysia, Malaysia
María José del Moral Ávila	University of Granada, Spain
Maroua Gasmi	INSAT, Tunisia
Masaki Kurematsu	Iwate Prefectural University, Japan
Peter Brída	University of Zilina, Slovakia
Peter T. Breuer	Charles III University of Madrid, Spain
Ramón Alberto Carrasco Gonzalez	Complutense University of Madrid, Spain
Roberto Revetria	University of Genova, Italy
Roliana Ibrahim	Universiti Teknologi Malaysia, Malaysia
Sebastia Massanet Massanet	Universitat de les Illes Balears
Sergei Gorlatch	University of Muenster, Germany
Shahida Sulaiman	Universiti Teknologi Malaysia, Malaysia
Volker Gruhn	University of Duisburg-Essen, Germany
Yury Zagorulko	Novosibirsk University, Russia
Yutaka Watanobe	University of Aizu, Japan

List of Reviewers for SoMeT_21

Maria Grazia Marchesano	Università degli Studi di Napoli Federico II
Alexander Vazhenin	University of Aizu
Amira Dhouib	MIRACL
Anna Maria Di Sciullo	Université du Québec à Montréal
Azreen Azman	Universiti Putra Malaysia
Dmitry Mouromtsev	ITMO University
Duc Nguyen	Vietnam Maritime University
Fatai Sadiq	Ambrose Alli University, Ekpoma, Edo State-Nigeria
Giovanni Paragliola	ICAR-CNR
Henrik Tünnermann	The University of Electro-Communications
Hidekazu Yanagimoto	Osaka Prefecture University
Ignacio Turias	Universidad de Cadiz
Igor Saenko	St. Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences (SPIIRAS)
Mohamed Nazih Omri	MARS LABO SOUSSE
Mohamed Tahar Bhiri	FSS Sfax
Oya Kalıpsız	Yıldız Teknik Üniversitesi
Sana benzarti	ISITCOM
Sian Lun Lau	Sunway University
Volker Gruhn	Adesso, Germany
Mario Gonzalez-Lee	Universidad Autonoma Metropolitana
Hien Nguyen	University of Information Technology
Jesus Olivares-Mercado	Instituto Politecnico NacionaL
Jose Garcia-Hernandez	Centro de Investigación y Estudios Avanzados Del IPN
Luis Rojas-Cardenas	Universidad Autonoma Metropolitana
Kelsey Ramirez-Gutierrez	Instituto Nacional de Optica Astrofísica y Electrónica, Mexico
Daniel Robles-Camarillo	Universidad Politécnica de Pachuca
Karina Perez-Daniel	Universidad Panamericana
Elizabeth Garcia-Rios	Instituto Tecnologico Superior del Occidente del Estado de Hidalgo
Victor Sanchez	University of Warwick
Dalton Valadares	Univeridade Federal de Campina Grande
Antonio Hernandez-Zavala	Instituto Politécnico Nacional
Maria Julia Blas	Instituto de Diseño y Desarrollo INGAR
Andres Garcia	Universidad Mexiquence del Bicentenario, Mexico
Lazaro Bustio	INAOE
Arturo Olvera	Atonomous University of Puebla
Samuel Morrillas	Univerisdad Politecnica de Valencia
Ali Mili	New Jersey Institute of Technology, Newark NJ USA
Ali Selamat	Universiti Teknologi Malaysia
Andreas Speck	Kiel University

Andres Hernandez-Matamoros	University of Tokyo, Japan
Anis Yazidi	Oslo Metropolitan University
Anusuyah Subbarao	Universiti Teknologi Malaysia
Azouzi Sameh	ISITCOM
Badran Raddaoui	Telecom Sudparis, 9 Rue Charles Fourier, 91000 Evry
Beata Czarnacka-Chrobot	Warsaw School of Economics
Bruno Golosio	University of Cagliari
Cheah WaiShiang	Universiti Malaysia Sarawak
Chi-Yo Huang	Taiwan Normal University
Clemens Schaefer	it factum GmbH
Daniel Urda	Universidad de Cadiz
Domenico Pisanelli	CNR
Duc-Man Nguyen	Duy Tan University
Ehsan ul Haq	Universiti Teknologi Malaysia
Elke Pulvermueller	Osnabrück University
Emil Pricop	Automatic Control, Computers and Electronics Department. Petroleum-Gas University of Ploiesti, Romania
Enrique Herrera-Viedma	University of Granada
Farid Nouioua	France
Fernando Barbosa	Polytechnic Institute of Castelo Branco
Filippo Cavallo	University of Florence
Francisco Javier Cabrerizo	University of Granada
Gang Kou	Southwestern University of Finance and Economics
Giovanni Paragliola	CNR
Hamido Fujita	i-SOMET Incorporated Association, Morioka
Hayaru Shouno	Graduate School of Informatics and Engineering, The University of Electro-Communications
Hector Perez-Meana	Instituto Politecnico Nacional
Hisashi Koga	Univeristy of Electro-Communications
Horvath Laszlo	Obuda University
Ignacio Javier Pérez	University of Cádiz
Igor Kotenko	St. Petersburg Federal Research Center of the Russian Academy of Sciences (SPC RAS)
Imen Marsit	Mars Labo Sousse
Inmaculada Ayala	Universidad de Málaga
Jan Kubicek	VSB - Technical University of Ostrava
Jaouhar Fattahi	Université Laval
Jesus Olivares-Mercado	Instituto Politecnico Nacional
Jesus Serrano-Guerrero	University of Castilla La Mancha
Jian Wu	Zhejiang Normal University
Jose-Miguel Horcas	Universidad de Málaga
Juan Antonio Morente-Molinera	Universidad Internacional de la Rioja
Juan Miguel Tapia	University of Granada
Jun Sasaki	IPU
Kaiyu Dai	Fudan University

Keizo Yamada	Graduate School of Software and Information Science, Iwate Prefectural University
Khalid Nafil	University Mohammed V in Rabat
Khalid Sultan	University of Hail, KSA
Kovacs Levente	Obuda University
Laura Fiorini	Scuola Superiore Sant'Anna
Love Ekenberg	Stockholm University and IIASA
Manuel Cedillo-Hernandez	Instituto Politecnico Nacional
Manuel Cobo	University of Cadiz
Marco Pota	CNR
MARIKO Nakano-Miyatake	Instituto Politecnico Nacional
Marshima Mohd Rosli	Universiti Teknologi MARA
Masaki Kurematsu	Iwate Prefectural University
Massimo Esposito	ICAR
Miroslav Hudec	University of Belgrade
Mohamed Mejri	Laval University, Canada
Mohamed Rawidean Mohd Kassim	MIMOS
Mohd Helmy Abd Wahab	University Tun Hussein Onn Malaysia
Mourad Kmimech	UR-OASIS, ENIT, University of Tunis El Manar, Tunisia
Muhammad Ayaz	Umm Al-Qura University
Muhammad Imran Babar	Army Public College of Management & Sciences Rawalpindi, Pakistan
Muhammad Sufyian Mohd Azmi	Universiti Tenaga Nasional
Mustafa Balsam	Universiti Malaysia Pahang, Malaysia
Nam Vo	Chung-Ang University
Natalya Garanina	A.P. Ershov Institute of Informatics Systems, Russia
Nhon Do	University of Information Technology
Noor Azurati Ahmad	Universiti Teknologi Malaysia & Sapura Secured Technologies Sdn Bhd
Norhaslinda Kamaruddin	Universiti Teknologi MARA
Nurulhuda Zainuddin	Universiti Teknologi Malaysia
Peter Breuer	Hecusys LLC
Rania Azad	Sulaimani Polytechnic University
Razali Yaakob	Universiti Putra Malaysia (UPM)
Rebaz Nabi	Sulaimani Polytechnic University, Kurdistan Technical Institute
Rebwar Nabi	Sulaimani Polytechnic University
Roberto Revetria	University of Genoa
Ruben González Crespo	Universidad Internacional de La Rioja (UNIR)
Saadah Hassan	Universiti Putra Malaysia
Sanir Suleiman	Universiti Teknologi Malaysia
Sardasht M. Mahmood	University of Sulaimani
Sergei Gorlatch	Muenster University
Shahliza Abd Halim	Universiti Teknologi Malaysia
Shinpei Matsumoto	Hiroshima Institute of Technology

Shuang Li	Graduate School of Software and Information Science, Iwate Prefectural University
Teresa Tomás	Instituto Politécnico de Lisboa
Thang Huynh Quyet	SOICT, HUST
Thanh Binh Nguyen	University of Science
Vu Dinh	University of Delaware
Tun-Wen Pai	National Taiwan Ocean University
Tzung-Pei Hong	National University of Kaohsiung
Volker Gruhn	University of Duisburg-Essen
Xing Wu	Shanghai University
Yasser Mohammed	Assiut University
Yunus Yusoff	Universiti Tenaga Nasional
Yury Zagorulko	Institute of Informatics Systems, SB RAS

Contents