

Founding Editors

Gerhard Goos

Karlsruhe Institute of Technology, Karlsruhe, Germany

Juris Hartmanis

Cornell University, Ithaca, NY, USA

Editorial Board Members

Elisa Bertino

Purdue University, West Lafayette, IN, USA

Wen Gao

Peking University, Beijing, China

Bernhard Steffen 

TU Dortmund University, Dortmund, Germany

Gerhard Woeginger 

RWTH Aachen, Aachen, Germany

Moti Yung

Columbia University, New York, NY, USA

More information about this subseries at <http://www.springer.com/series/7407>

Maciej Paszynski · Dieter Kranzlmüller ·
Valeria V. Krzhizhanovskaya ·
Jack J. Dongarra · Peter M. A. Sloot (Eds.)

Computational Science – ICCS 2021

21st International Conference
Krakow, Poland, June 16–18, 2021
Proceedings, Part IV

Editors

Maciej Paszynski 
AGH University of Science and Technology
Krakow, Poland

Valeria V. Krzhizhanovskaya 
University of Amsterdam
Amsterdam, The Netherlands

Peter M. A. Sloot 
University of Amsterdam
Amsterdam, The Netherlands

ITMO University
St. Petersburg, Russia

Nanyang Technological University
Singapore, Singapore

Dieter Kranzlmüller 
Ludwig-Maximilians-Universität München
Munich, Germany

Leibniz Supercomputing Center (LRZ)
Garching bei München, Germany

Jack J. Dongarra 
University of Tennessee at Knoxville
Knoxville, TN, USA

ISSN 0302-9743

ISSN 1611-3349 (electronic)

Lecture Notes in Computer Science

ISBN 978-3-030-77969-6

ISBN 978-3-030-77970-2 (eBook)

<https://doi.org/10.1007/978-3-030-77970-2>

LNCS Sublibrary: SL1 – Theoretical Computer Science and General Issues

© Springer Nature Switzerland AG 2021, corrected publication 2021

Chapters 18 and 27 are licensed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>). For further details see license information in the chapters.

This work is subject to copyright. All rights are reserved 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, expressed 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

Welcome to the proceedings of the 21st annual International Conference on Computational Science (ICCS 2021 - <https://www.iccs-meeting.org/iccs2021/>).

In preparing this edition, we had high hopes that the ongoing COVID-19 pandemic would fade away and allow us to meet this June in the beautiful city of Kraków, Poland. Unfortunately, this is not yet the case, as the world struggles to adapt to the many profound changes brought about by this crisis. ICCS 2021 has had to adapt too and is thus being held entirely online, for the first time in its history.

These challenges notwithstanding, we have tried our best to keep the ICCS community as dynamic and productive as always. We are proud to present the proceedings you are reading as a result of that.

ICCS 2021 was jointly organized by the AGH University of Science and Technology, the University of Amsterdam, NTU Singapore, and the University of Tennessee.

The International Conference on Computational Science is an annual conference that brings together researchers and scientists from mathematics and computer science as basic computing disciplines, as well as researchers from various application areas who are pioneering computational methods in sciences such as physics, chemistry, life sciences, engineering, arts, and humanitarian fields, to discuss problems and solutions in the area, identify new issues, and shape future directions for research.

Since its inception in 2001, ICCS has attracted an increasing number of attendees and higher quality papers, and this year is not an exception, with over 350 registered participants. The proceedings have become a primary intellectual resource for computational science researchers, defining and advancing the state of the art in this field.

The theme for 2021, “**Computational Science for a Better Future**,” highlights the role of computational science in tackling the current challenges of our fast-changing world. This conference was a unique event focusing on recent developments in scalable scientific algorithms, advanced software tools, computational grids, advanced numerical methods, and novel application areas. These innovative models, algorithms, and tools drive new science through efficient application in physical systems, computational and systems biology, environmental systems, finance, and other areas.

ICCS is well known for its excellent lineup of keynote speakers. The keynotes for 2021 were given by

- **Maciej Besta**, ETH Zürich, Switzerland
- **Marian Bubak**, AGH University of Science and Technology, Poland | Sano Centre for Computational Medicine, Poland
- **Anne Gelb**, Dartmouth College, USA
- **Georgiy Stenchikov**, King Abdullah University of Science and Technology, Saudi Arabia
- **Marco Viceconti**, University of Bologna, Italy

- **Krzysztof Walczak**, Poznan University of Economics and Business, Poland
- **Jessica Zhang**, Carnegie Mellon University, USA

This year we had 635 submissions (156 submissions to the main track and 479 to the thematic tracks). In the main track, 48 full papers were accepted (31%); in the thematic tracks, 212 full papers were accepted (44%). A high acceptance rate in the thematic tracks is explained by the nature of these tracks, where organisers personally invite many experts in a particular field to participate in their sessions.

ICCS relies strongly on our thematic track organizers' vital contributions to attract high-quality papers in many subject areas. We would like to thank all committee members from the main and thematic tracks for their contribution to ensure a high standard for the accepted papers. We would also like to thank *Springer*, *Elsevier*, and *Intelligibilis* for their support. Finally, we appreciate all the local organizing committee members for their hard work to prepare for this conference.

We are proud to note that ICCS is an A-rank conference in the CORE classification.

We wish you good health in these troubled times and look forward to meeting you at the conference.

June 2021

Maciej Paszynski
Dieter Kranzlmüller
Valeria V. Krzhizhanovskaya
Jack J. Dongarra
Peter M. A. Sloot

Organization

Local Organizing Committee at AGH University of Science and Technology

Chairs

Maciej Paszynski
Aleksander Byrski

Members

Marcin Łos
Maciej Woźniak
Leszek Siwik
Magdalena Suchoń

Thematic Tracks and Organizers

Advances in High-Performance Computational Earth Sciences: Applications and Frameworks – IHPCES

Takashi Shimokawabe
Kohei Fujita
Dominik Bartuschat

Applications of Computational Methods in Artificial Intelligence and Machine Learning – ACMAIML

Kourosh Modarresi
Paul Hofmann
Raja Velu
Peter Woehrmann

Artificial Intelligence and High-Performance Computing for Advanced Simulations – AIHPC4AS

Maciej Paszynski
Robert Schaefer
David Pardo
Victor Calo

Biomedical and Bioinformatics Challenges for Computer Science – BBC

Mario Cannataro
Giuseppe Agapito

Mauro Castelli
Riccardo Dondi
Italo Zoppis

Classifier Learning from Difficult Data – CLD²

Michał Woźniak
Bartosz Krawczyk

Computational Analysis of Complex Social Systems – CSOC

Debraj Roy

Computational Collective Intelligence – CCI

Marcin Maleszka
Ngoc Thanh Nguyen
Marcin Hernes
Sinh Van Nguyen

Computational Health – CompHealth

Sergey Kovalchuk
Georgiy Bobashev
Stefan Thurner

Computational Methods for Emerging Problems in (dis-)Information Analysis – DisA

Michał Choras
Robert Burduk
Konstantinos Demestichas

Computational Methods in Smart Agriculture – CMSA

Andrew Lewis

Computational Optimization, Modelling, and Simulation – COMS

Xin-She Yang
Leifur Leifsson
Sławomir Koziel

Computational Science in IoT and Smart Systems – IoTSS

Vaidy Sunderam
Dariusz Mrozek

Computer Graphics, Image Processing and Artificial Intelligence – CGIPAI

Andres Iglesias
Lihua You
Alexander Malyshev
Hassan Ugail

Data-Driven Computational Sciences – DDCS

Craig Douglas

Machine Learning and Data Assimilation for Dynamical Systems – MLDADS

Rossella Arcucci

MeshFree Methods and Radial Basis Functions in Computational Sciences – MESHFREE

Vaclav Skala
Marco-Evangelos Biancolini
Samsul Ariffin Abdul Karim
Rongjiang Pan
Fernando-César Meira-Menandro

Multiscale Modelling and Simulation – MMS

Derek Groen
Diana Suleimenova
Stefano Casarin
Bartosz Bosak
Wouter Edeling

Quantum Computing Workshop – QCW

Katarzyna Rycerz
Marian Bubak

Simulations of Flow and Transport: Modeling, Algorithms and Computation – SOFTMAC

Shuyu Sun
Jingfa Li
James Liu

Smart Systems: Bringing Together Computer Vision, Sensor Networks and Machine Learning – SmartSys

Pedro Cardoso
Roberto Lam

João Rodrigues
Jânio Monteiro

Software Engineering for Computational Science – SE4Science

Jeffrey Carver
Neil Chue Hong
Anna-Lena Lamprecht

Solving Problems with Uncertainty – SPU

Vassil Alexandrov
Aneta Karaivanova

Teaching Computational Science – WTCS

Angela Shiflet
Nia Alexandrov
Alfredo Tirado-Ramos

Uncertainty Quantification for Computational Models – UNEQUIvOCAL

Wouter Edeling
Anna Nikishova

Reviewers

Ahmad Abdelfattah
Samsul Ariffin Abdul
Karim
Tesfamariam Mulugeta
Abuhay
Giuseppe Agapito
Elisabete Alberdi
Luis Alexandre
Vassil Alexandrov
Nia Alexandrov
Julen Alvarez-Aramberri
Sergey Alyaev
Tomasz Andrysiak
Samuel Aning
Michael Antolovich
Hideo Aochi
Hamid Arabnejad
Rossella Arcucci
Costin Badica
Marina Balakhontceva

Bartosz Balis
Krzysztof Banas
Dariusz Barbucha
Valeria Bartsch
Dominik Bartuschat
Pouria Behnodfaur
Joern Behrens
Adrian Bekasiewicz
Gebrail Bekdas
Mehmet Belen
Stefano Beretta
Benjamin Berkels
Daniel Berrar
Sanjukta Bhowmick
Georgiy Bobashev
Bartosz Bosak
Isabel Sofia Brito
Marc Brittain
Jérémy Buisson
Robert Burduk

Michael Burkhart
Allah Bux
Krisztian Buza
Aleksander Byrski
Cristiano Cabrita
Xing Cai
Barbara Calabrese
Jose Camata
Almudena Campuzano
Mario Cannataro
Alberto Cano
Pedro Cardoso
Alberto Carrassi
Alfonso Carriazo
Jeffrey Carver
Manuel Castañón-Puga
Mauro Castelli
Eduardo Cesar
Nicholas Chancellor
Patrikakis Charalampos

Henri-Pierre Charles	Christian Engelmann	Pietro Hiram Guzzi
Ehtaz Chaudhry	Roberto R. Expósito	Zulfiqar Habib
Long Chen	Fangxin Fang	Panagiotis Hadjidoukas
Sibo Cheng	Antonino Fiannaca	Susanne Halstead
Siew Ann Cheong	Christos	Feilin Han
Lock-Yue Chew	Filelis-Papadopoulos	Masatoshi Hanai
Marta Chinnici	Martin Frank	Habibollah Haron
Sung-Bae Cho	Alberto Freitas	Ali Hashemian
Michal Choras	Ruy Freitas Reis	Carina Haupt
Neil Chue Hong	Karl Frinkle	Claire Heaney
Svetlana Chuprina	Kohei Fujita	Alexander Heinecke
Paola Cinnella	Hiroshi Fujiwara	Marcin Hernes
Noélia Correia	Takeshi Fukaya	Bogumila Hnatkowska
Adriano Cortes	Włodzimierz Funika	Maximilian Hüb
Ana Cortes	Takashi Furumura	Jori Hoencamp
Enrique	Ernst Fusch	Paul Hofmann
Costa-Montenegro	David Gal	Claudio Iacopino
David Coster	Teresa Galvão	Andres Iglesias
Carlos Cotta	Akemi Galvez-Tomida	Takeshi Iwashita
Helene Coullon	Ford Lumban Gaol	Alireza Jahani
Daan Crommelin	Luis Emilio	Momin Jamil
Attila Csikasz-Nagy	Garcia-Castillo	Peter Janku
Loïc Cudennec	Frédéric Gava	Jiri Jaros
Javier Cuenca	Piotr Gawron	Caroline Jay
António Cunha	Alex Gerbessiotis	Fabienne Jezequel
Bogusław Cyganek	Agata Gielczyk	Shalu Jhanwar
Ireneusz Czarnowski	Adam Glos	Tao Jiang
Paweł Czarnul	Sergiy Gogolenko	Chao Jin
Lisandro Dalcin	Jorge	Zhong Jin
Bhaskar Dasgupta	González-Domínguez	David Johnson
Konstantinos Demestichas	Yuriy Gorbachev	Guido Juckeland
Quanling Deng	Paweł Gorecki	George Kampis
Tiziana Di Matteo	Michael Gowanlock	Aneta Karaivanova
Eric Dignum	Ewa Grabska	Takahiro Katagiri
Jamie Diner	Manuel Graña	Timo Kehler
Riccardo Dondi	Derek Groen	Christoph Kessler
Craig Douglas	Joanna Grzyb	Jakub Klikowski
Li Douglas	Pedro Guerreiro	Alexandra Klimova
Rafał Drezewski	Tobias Guggemos	Harald Koestler
Vitor Duarte	Federica Gugole	Ivana Kolingerova
Thomas Dufaud	Bogdan Gulowaty	Georgy Kopanitsa
Wouter Edeling	Shihui Guo	Sotiris Kotsiantis
Nasir Eisty	Xiaohu Guo	Sergey Kovalchuk
Kareem El-Safty	Manish Gupta	Michał Koziarski
Amgad Elsayed	Piotr Gurgul	Slawomir Koziel
Nahid Emad	Filip Guzy	Rafał Kozik

Bartosz Krawczyk	Laura Lyman	Sinh Van Nguyen
Dariusz Krol	Scott MacLachlan	Nancy Nichols
Valeria Krzhizhanovskaya	Lukasz Madej	Anna Nikishova
Adam Krzyzak	Lech Madeyski	Hitoshi Nishizawa
Pawel Ksieniewicz	Luca Magri	Algirdas Noreika
Marek Kubalcik	Imran Mahmood	Manuel Núñez
Sebastian Kuckuk	Peyman Mahouti	Krzysztof Okarma
Eileen Kuehn	Marcin Maleszka	Pablo Oliveira
Michael Kuhn	Alexander Malyshev	Javier Omella
Michal Kulczewski	Livia Marcellino	Kenji Ono
Julian Martin Kunkel	Tomas Margalef	Eneko Osaba
Krzysztof Kurowski	Tiziana Margaria	Aziz Ouaraab
Marcin Kuta	Osni Marques	Raymond Padmos
Bogdan Kwolek	M. Carmen Márquez	Marek Palicki
Panagiotis Kyziropoulos	García	Junjun Pan
Massimo La Rosa	Paula Martins	Rongjiang Pan
Roberto Lam	Jaime Afonso Martins	Nikela Papadopoulou
Anna-Lena Lamprecht	Pawel Matuszyk	Marcin Paprzycki
Rubin Landau	Valerie Maxville	David Pardo
Johannes Langguth	Pedro Medeiros	Anna Paszynska
Shin-Jye Lee	Fernando-César	Maciej Paszynski
Mike Lees	Meira-Menandro	Abani Patra
Leifur Leifsson	Roderick Melnik	Dana Petcu
Kenneth Leiter	Valentin Melnikov	Serge Petiton
Florin Leon	Ivan Merelli	Bernhard Pfahringer
Vasiliy Leonenko	Marianna Milano	Toby Phillips
Roy Lettieri	Leandro Minku	Frank Phillipson
Jake Lever	Jaroslav Mischczak	Juan C. Pichel
Andrew Lewis	Kourosh Modarresi	Anna
Jingfa Li	Jânio Monteiro	Pietrenko-Dabrowska
Hui Liang	Fernando Monteiro	Laércio L. Pilla
James Liu	James Montgomery	Yuri Pirola
Yen-Chen Liu	Dariusz Mrozek	Nadia Pisanti
Zhao Liu	Peter Mueller	Sabri Pllana
Hui Liu	Ignacio Muga	Mihail Popov
Pengcheng Liu	Judit Munoz-Matute	Simon Portegies Zwart
Hong Liu	Philip Nadler	Roland Potthast
Marcelo Lobosco	Hiromichi Nagao	Malgorzata
Robert Lodder	Jethro Nagawkar	Przybyla-Kasperek
Chu Kiong Loo	Kengo Nakajima	Ela Pustulka-Hunt
Marcin Los	Grzegorz J. Nalepa	Alexander Pyayt
Stephane Louise	I. Michael Navon	Kun Qian
Frederic Loulergue	Philipp Neumann	Yipeng Qin
Hatem Ltaief	Du Nguyen	Rick Quax
Paul Lu	Ngoc Thanh Nguyen	Cesar Quilodran Casas
Stefan Luding	Quang-Vu Nguyen	Enrique S. Quintana-Orti

Ewaryst Rafajlowicz	Vaclav Skala	Paolo Trunfio
Ajaykumar Rajasekharan	Ewa	Ka-Wai Tsang
Raul Ramirez	Skubalska-Rafajlowicz	Hassan Ugail
Célia Ramos	Peter Sloot	Eirik Valseth
Marcus Randall	Renata Slota	Ben van Werkhoven
Lukasz Rauch	Oskar Slowik	Vítor Vasconcelos
Vishal Raul	Grazyna Slusarczyk	Alexandra Vatan
Robin Richardson	Sucha Smanchat	Raja Velu
Sophie Robert	Maciej Smolka	Colin Venters
João Rodrigues	Thiago Sobral	Milana Vuckovic
Daniel Rodriguez	Robert Speck	Jianwu Wang
Albert Romkes	Katarzyna Stapor	Meili Wang
Debraj Roy	Robert Staszewski	Peng Wang
Jerzy Rozenblit	Steve Stevenson	Jaroslav Watróbski
Konstantin Ryabinin	Tomasz Stopa	Holger Wendland
Katarzyna Rycerz	Achim Streit	Lars Wienbrandt
Khalid Saeed	Barbara Strug	Izabela Wierzbowska
Ozlem Salehi	Patricia Suarez Valero	Peter Woehrmann
Alberto Sanchez	Vishwas Hebbur Venkata	Szymon Wojciechowski
Aysin Sanci	Subba Rao	Michal Wozniak
Gabriele Santin	Bongwon Suh	Maciej Wozniak
Rodrigo Santos	Diana Suleimenova	Dunhui Xiao
Robert Schaefer	Shuyu Sun	Huilin Xing
Karin Schiller	Ray Sun	Wei Xue
Ulf D. Schiller	Vaidy Sunderam	Abuzer Yakaryilmaz
Bertil Schmidt	Martin Swain	Yoshifumi Yamamoto
Martin Schreiber	Jerzy Swiatek	Xin-She Yang
Gabriela Schütz	Piotr Szczepaniak	Dongwei Ye
Christoph Schweimer	Tadeusz Szuba	Hujun Yin
Marinella Sciortino	Ryszard Tadeusiewicz	Lihua You
Diego Sevilla	Daisuke Takahashi	Han Yu
Mostafa Shahriari	Zaid Tashman	Drago Žagar
Abolfazi	Osamu Tatebe	Michal Zak
Shahzadeh-Fazeli	Carlos Tavares Calafate	Gabor Závodszy
Vivek Sheraton	Andrei Tchernykh	Yao Zhang
Angela Shiflet	Kasim Tersic	Wenshu Zhang
Takashi Shimokawabe	Jannis Teunissen	Wenbin Zhang
Alexander Shukhman	Nestor Tigla	Jian-Jun Zhang
Marcin Sieniek	Alfredo Tirado-Ramos	Jinghui Zhong
Nazareen	Zainab Titus	Sotirios Ziavras
Sikkandar Basha	Pawel Topa	Zoltan Zimboras
Anna Sikora	Mariusz Topolski	Italo Zoppis
Diana Sima	Pawel Trajdos	Chiara Zucco
Robert Sinkovits	Bogdan Trawinski	Pavel Zun
Haozhen Situ	Jan Treur	Pawel Zyblewski
Leszek Siwik	Leonardo Trujillo	Karol Zyczkowski

Contents – Part IV

Computational Methods for Emerging Problems in (dis-)Information Analysis

The Methods and Approaches of Explainable Artificial Intelligence.	3
<i>Mateusz Szczepański, Michał Choraś, Marek Pawlicki, and Aleksandra Pawlicka</i>	
Fake or Real? The Novel Approach to Detecting Online Disinformation Based on Multi ML Classifiers	18
<i>Martyna Tarczewska, Anna Marciniak, and Agata Gielczyk</i>	
Transformer Based Models in Fake News Detection	28
<i>Sebastian Kula, Rafał Kozik, Michał Choraś, and Michał Woźniak</i>	
Towards Model-Agnostic Ensemble Explanations	39
<i>Szymon Bobek, Paweł Bałaga, and Grzegorz J. Nalepa</i>	

Computational Methods in Smart Agriculture

Bluetooth Low Energy Livestock Positioning for Smart Farming Applications	55
<i>Maciej Nikodem</i>	
Monitoring the Uniformity of Fish Feeding Based on Image Feature Analysis.	68
<i>Piotr Lech, Krzysztof Okarma, Agata Korzelecka-Orkisz, Adam Tański, and Krzysztof Formicki</i>	
A New Multi-objective Approach to Optimize Irrigation Using a Crop Simulation Model and Weather History	75
<i>Mikhail Gasanov, Daniil Merkulov, Artyom Nikitin, Sergey Matveev, Nikita Stasenkov, Anna Petrovskaya, Mariia Pukalchik, and Ivan Oseledets</i>	

Computational Optimization, Modelling and Simulation

Expedited Trust-Region-Based Design Closure of Antennas by Variable-Resolution EM Simulations.	91
<i>Slawomir Koziel, Anna Pietrenko-Dabrowska, and Leifur Leifsson</i>	
Optimum Design of Tuned Mass Dampers for Adjacent Structures via Flower Pollination Algorithm	105
<i>Sinan Melih Nigdeli, Gebrail Bekdas, and Xin-She Yang</i>	

On Fast Multi-objective Optimization of Antenna Structures Using Pareto Front Triangulation and Inverse Surrogates.	116
<i>Anna Pietrenko-Dabrowska, Slawomir Koziel, and Leifur Leifsson</i>	
Optimizations of a Generic Holographic Projection Model for GPU's	131
<i>Mark Voschezang and Martin Fransen</i>	
Similarity and Conformity Graphs in Lighting Optimization and Assessment	145
<i>Artur Basiura, Adam Sędziwy, and Konrad Komnata</i>	
Pruned Simulation-Based Optimal Sailboat Path Search Using Micro HPC Systems	158
<i>Roman Dębski and Bartłomiej Sniezynski</i>	
Two Stage Approach to Optimize Electricity Contract Capacity Problem for Commercial Customers.	173
<i>Rafik Nafkha, Tomasz Ząbkowski, and Krzysztof Gajowniczek</i>	
Improved Design Closure of Compact Microwave Circuits by Means of Performance Requirement Adaptation	185
<i>Slawomir Koziel, Anna Pietrenko-Dabrowska, and Leifur Leifsson</i>	
Graph-Grammar Based Longest-Edge Refinement Algorithm for Three-Dimensional Optimally p Refined Meshes with Tetrahedral Elements	200
<i>Albert Mosialek, Andrzej Szaflarski, Rafał Pych, Marek Kisiel-Dorohinicki, Maciej Paszyński, and Anna Paszyńska</i>	
Elitism in Multiobjective Hierarchical Strategy	214
<i>Michał Idzik, Radosław Łazarz, and Aleksander Byrski</i>	
Modelling and Forecasting Based on Recurrent Pseudoinverse Matrices.	229
<i>Christos K. Filelis-Papadopoulos, Panagiotis E. Kyziropoulos, John P. Morrison, and Philip O'Reilly</i>	
Semi-analytical Monte Carlo Optimisation Method Applied to the Inverse Poisson Problem	243
<i>Slawomir Milewski</i>	
Modeling the Contribution of Agriculture Towards Soil Nitrogen Surplus in Iowa	257
<i>Vishal Raul, Yen-Chen Liu, Leifur Leifsson, and Amy Kaleita</i>	
An Attempt to Replace System Dynamics with Discrete Rate Modeling in Demographic Simulations.	269
<i>Jacek Zabawa and Bożena Mielczarek</i>	

New On-line Algorithms for Modelling, Identification and Simulation of Dynamic Systems Using Modulating Functions and Non-asymptotic State Estimators: Case Study for a Chosen Physical Process	284
<i>Witold Byrski, Michał Drapała, and Jędrzej Byrski</i>	
Iterative Global Sensitivity Analysis Algorithm with Neural Network Surrogate Modeling	298
<i>Yen-Chen Liu, Jethro Nagawkar, Leifur Leifsson, Sławomir Koziel, and Anna Pietrenko-Dabrowska</i>	
Forecasting Electricity Prices: Autoregressive Hybrid Nearest Neighbors (ARHNN) Method	312
<i>Weronika Nitka, Tomasz Serafin, and Dimitrios Sotiros</i>	
Data-Driven Methods for Weather Forecast	326
<i>Elias David Nino-Ruiz and Felipe J. Acevedo García</i>	
Generic Case of Leap-Frog Algorithm for Optimal Knots Selection in Fitting Reduced Data	337
<i>Ryszard Kozera, Lyle Noakes, and Artur Wiliński</i>	
Intelligent Planning of Logistic Networks to Counteract Uncertainty Propagation	351
<i>Przemysław Ignaciuk and Adam Dziomdziora</i>	
Modeling Traffic Forecasts with Probability in DWDM Optical Networks . . .	365
<i>Stanisław Kozdrowski, Piotr Sliwka, and Sławomir Sujecki</i>	
Endogenous Factors Affecting the Cost of Large-Scale Geo-Stationary Satellite Systems	379
<i>Nazareen Sikkandar Basha, Leifur Leifsson, and Christina Bloebaum</i>	
Description of Electricity Consumption by Using Leading Hours Intra-day Model	392
<i>Krzysztof Karpio, Piotr Łukasiewicz, Rafik Nafkha, and Arkadiusz Orłowski</i>	
The Problem of Tasks Scheduling with Due Dates in a Flexible Multi-machine Production Cell	405
<i>Wojciech Bożejko, Piotr Nadybski, Paweł Rajba, and Mieczysław Wodecki</i>	
Discovering the Influence of Interruptions in Cycling Training: A Data Science Study	420
<i>Alen Rajšp and Iztok Fister Jr.</i>	

Analysis of Complex Partial Seizure Using Non-linear Duffing Van der Pol Oscillator Model	433
<i>Beata Szuflitowska and Przemyslaw Orlowski</i>	
Computational Science in IoT and Smart Systems	
A Review on Visual Programming for Distributed Computation in IoT	443
<i>Margarida Silva, João Pedro Dias, André Restivo, and Hugo Sereno Ferreira</i>	
Data Preprocessing, Aggregation and Clustering for Agile Manufacturing Based on Automated Guided Vehicles	458
<i>Rafal Cupek, Marek Drewniak, and Tomasz Steclik</i>	
Comparison of Speech Recognition and Natural Language Understanding Frameworks for Detection of Dangers with Smart Wearables	471
<i>Dariusz Mrozek, Szymon Kwaśnicki, Vaidy Sunderam, Bożena Małyśiak-Mrozek, Krzysztof Tokarz, and Stanisław Kozielski</i>	
A Decision Support System Based on Augmented Reality for the Safe Preparation of Chemotherapy Drugs	485
<i>Sarah Ben Othman, Hayfa Zgaya, Michèle Vasseur, Bertrand Décaudin, Pascal Odou, and Slim Hammadi</i>	
Metagenomic Analysis at the Edge with Jetson Xavier NX	500
<i>Piotr Grzesik and Dariusz Mrozek</i>	
Programming IoT-Spaces: A User-Survey on Home Automation Rules	512
<i>Danny Soares, João Pedro Dias, André Restivo, and Hugo Sereno Ferreira</i>	
Application of the Ant Colony Algorithm for Routing in Next Generation Programmable Networks	526
<i>Stanisław Kozdrowski, Magdalena Banaszek, Bartosz Jedrzejczak, Mateusz Żotkiewicz, and Zbigniew Kopertowski</i>	
Scalable Computing System with Two-Level Reconfiguration of Multi-channel Inter-Node Communication	540
<i>Mirosław Hajder, Piotr Hajder, Mateusz Liput, and Janusz Kolbusz</i>	
Real-Time Object Detection for Smart Connected Worker in 3D Printing.	554
<i>Shijie Bian, Tiancheng Lin, Chen Li, Yongwei Fu, Mengrui Jiang, Tongzi Wu, Xiyi Hang, and Bingbing Li</i>	
Object-Oriented Internet Cloud Interoperability	568
<i>Mariusz Postół and Piotr Szymczak</i>	

Static and Dynamic Comparison of Pozyx and DecaWave UWB Indoor Localization Systems with Possible Improvements.	582
<i>Barbara Morawska, Piotr Lipiński, Krzysztof Lichy, Piotr Koch, and Marcin Leplawy</i>	
Challenges Associated with Sensors and Data Fusion for AGV-Driven Smart Manufacturing.	595
<i>Adam Ziebinski, Dariusz Mrozek, Rafal Cupek, Damian Grzechca, Marcin Fojcik, Marek Drewniak, Erik Kyrkjebø, Jerry Chun-Wei Lin, Knut Øvsthus, and Piotr Biernacki</i>	
Dynamic Pricing and Discounts by Means of Interactive Presentation Systems in Stationary Point of Sales	609
<i>Marcin Lewicki, Tomasz Kajdanowicz, Piotr Bródka, and Janusz Sobecki</i>	
Profile-Driven Synthetic Trajectories Generation to Enhance Smart System Solutions	623
<i>Radosław Klimek and Arkadiusz Olesek</i>	
Augmenting Automatic Clustering with Expert Knowledge and Explanations.	631
<i>Szymon Bobek and Grzegorz J. Nalepa</i>	
Renewable Energy-Aware Heuristic Algorithms for Edge Server Selection for Stream Data Processing	639
<i>Tomasz Szydło and Chris Gniady</i>	
Dataset for Anomalies Detection in 3D Printing	647
<i>Tomasz Szydło, Joanna Sendorek, Mateusz Windak, and Robert Brzoza-Woch</i>	
Correction to: Computational Science – ICCS 2021.	C1
<i>Maciej Paszynski, Dieter Kranzlmüller, Valeria V. Krzhizhanovskaya, Jack J. Dongarra, and Peter M. A. Sloot</i>	
Author Index	655