

Oswaldo Gervasi · Beniamino Murgante ·
Sanjay Misra · Ana Maria A. C. Rocha ·
Chiara Garau (Eds.)

LNCS 13380

Computational Science and Its Applications – ICCSA 2022 Workshops

Malaga, Spain, July 4–7, 2022
Proceedings, Part IV

4
Part IV



 Springer

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

Moti Yung 

Columbia University, New York, NY, USA


More information about this series at <https://link.springer.com/bookseries/558>

Oswaldo Gervasi · Beniamino Murgante ·
Sanjay Misra · Ana Maria A. C. Rocha ·
Chiara Garau (Eds.)

Computational Science and Its Applications – ICCSA 2022 Workshops


Malaga, Spain, July 4–7, 2022
Proceedings, Part IV


Editors

Oswaldo Gervasi 
University of Perugia
Perugia, Italy

Sanjay Misra 
Østfold University College
Halden, Norway

Chiara Garau 
University of Cagliari
Cagliari, Italy

Beniamino Murgante 
University of Basilicata
Potenza, Potenza, Italy

Ana Maria A. C. Rocha 
University of Minho
Braga, Portugal

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Computer Science
ISBN 978-3-031-10541-8 ISBN 978-3-031-10542-5 (eBook)
<https://doi.org/10.1007/978-3-031-10542-5>

© The Editor(s) (if applicable) and The Author(s), under exclusive license
to Springer Nature Switzerland AG 2022

Chapter “Finite Element Model for Wind Comfort Around a Tall Building: A Case Study of Tower of Qazaqstan” is 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 chapter.

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

These six volumes (LNCS 13377–13382) consist of the peer-reviewed papers from the workshops at the 22nd International Conference on Computational Science and Its Applications (ICCSA 2022), which took place during July 4–7, 2022. The peer-reviewed papers of the main conference tracks are published in a separate set consisting of two volumes (LNCS 13375–13376).

This year, we again decided to organize a hybrid conference, with some of the delegates attending in person and others taking part online. Despite the enormous benefits achieved by the intensive vaccination campaigns in many countries, at the crucial moment of organizing the event, there was no certainty about the evolution of COVID-19. Fortunately, more and more researchers were able to attend the event in person, foreshadowing a slow but gradual exit from the pandemic and the limitations that have weighed so heavily on the lives of all citizens over the past three years.

ICCSA 2022 was another successful event in the International Conference on Computational Science and Its Applications (ICCSA) series. Last year, the conference was held as a hybrid event in Cagliari, Italy, and in 2020 it was organized as virtual event, whilst earlier editions took place in Saint Petersburg, Russia (2019), Melbourne, Australia (2018), Trieste, Italy (2017), Beijing, China (2016), Banff, Canada (2015), Guimaraes, Portugal (2014), Ho Chi Minh City, Vietnam (2013), Salvador, Brazil (2012), Santander, Spain (2011), Fukuoka, Japan (2010), Suwon, South Korea (2009), Perugia, Italy (2008), Kuala Lumpur, Malaysia (2007), Glasgow, UK (2006), Singapore (2005), Assisi, Italy (2004), Montreal, Canada (2003), and (as ICCS) Amsterdam, The Netherlands (2002) and San Francisco, USA (2001).

Computational science is the main pillar of most of the present research, and industrial and commercial applications, and plays a unique role in exploiting ICT innovative technologies. The ICCSA conference series provides a venue to researchers and industry practitioners to discuss new ideas, to share complex problems and their solutions, and to shape new trends in computational science.

Apart from the 52 workshops, ICCSA 2022 also included six main tracks on topics ranging from computational science technologies and application in many fields to specific areas of computational sciences, such as software engineering, security, machine learning and artificial intelligence, and blockchain technologies. For the 52 workshops we have accepted 285 papers. For the main conference tracks we accepted 57 papers and 24 short papers out of 279 submissions (an acceptance rate of 29%). We would like to express our appreciation to the Workshops chairs and co-chairs for their hard work and dedication.

The success of the ICCSA conference series in general, and of ICCSA 2022 in particular, vitally depends on the support of many people: authors, presenters, participants, keynote speakers, workshop chairs, session chairs, organizing committee members, student volunteers, Program Committee members, advisory committee

members, international liaison chairs, reviewers, and others in various roles. We take this opportunity to wholeheartedly thank them all.

We also wish to thank our publisher, Springer, for their acceptance to publish the proceedings, for sponsoring some of the best papers awards, and for their kind assistance and cooperation during the editing process.

We cordially invite you to visit the ICCSA website <https://iccsa.org> where you can find all the relevant information about this interesting and exciting event.

July 2022

Oswaldo Gervasi
Beniamino Murgante
Sanjay Misra

Welcome Message from Organizers

The ICCSA 2021 conference in the Mediterranean city of Cagliari provided us with inspiration to offer the ICCSA 2022 conference in the Mediterranean city of Málaga, Spain. The additional considerations due to the COVID-19 pandemic, which necessitated a hybrid conference, also stimulated the idea to use the School of Informatics of the University of Málaga. It has an open structure where we could take lunch and coffee outdoors and the lecture halls have open windows on two sides providing optimal conditions for meeting more safely.

The school is connected to the center of the old town via a metro system, for which we offered cards to the participants. This provided the opportunity to stay in lodgings in the old town close to the beach because, at the end of the day, that is the place to be to exchange ideas with your fellow scientists. The social program allowed us to enjoy the history of Malaga from its founding by the Phoenicians...

In order to provoke as much scientific interaction as possible we organized online sessions that could easily be followed by all participants from their own devices. We tried to ensure that participants from Asia could participate in morning sessions and those from the Americas in evening sessions. On-site sessions could be followed and debated on-site and discussed online using a chat system. To realize this, we relied on the developed technological infrastructure based on open source software, with the addition of streaming channels on YouTube. The implementation of the software infrastructure and the technical coordination of the volunteers were carried out by Damiano Perri and Marco Simonetti. Nine student volunteers from the universities of Málaga, Minho, Almeria, and Helsinki provided technical support and ensured smooth interaction during the conference.

A big thank you goes to all of the participants willing to exchange their ideas during their daytime. Participants of ICCSA 2022 came from 58 countries scattered over many time zones of the globe. Very interesting keynote talks were provided by well-known international scientists who provided us with more ideas to reflect upon, and we are grateful for their insights.

Eligius M. T. Hendrix

Organization

ICCSA 2022 was organized by the University of Malaga (Spain), the University of Perugia (Italy), the University of Cagliari (Italy), the University of Basilicata (Italy), Monash University (Australia), Kyushu Sangyo University (Japan), and the University of Minho, (Portugal).

Honorary General Chairs

Norio Shiratori	Chuo University, Japan
Kenneth C. J. Tan	Sardina Systems, UK

General Chairs

Oswaldo Gervasi	University of Perugia, Italy
Eligius Hendrix	University of Malaga, Italy
Bernady O. Apduhan	Kyushu Sangyo University, Japan

Program Committee Chairs

Beniamino Murgante	University of Basilicata, Italy
Inmaculada Garcia Fernandez	University of Malaga, Spain
Ana Maria A. C. Rocha	University of Minho, Portugal
David Taniar	Monash University, Australia

International Advisory Committee

Jemal Abawajy	Deakin University, Australia
Dharma P. Agarwal	University of Cincinnati, USA
Rajkumar Buyya	Melbourne University, Australia
Claudia Bauzer Medeiros	University of Campinas, Brazil
Manfred M. Fisher	Vienna University of Economics and Business, Austria
Marina L. Gavrilova	University of Calgary, Canada
Sumi Helal	University of Florida, USA, and University of Lancaster, UK
Yee Leung	Chinese University of Hong Kong, China

International Liaison Chairs

Ivan Blečić	University of Cagliari, Italy
Giuseppe Borruso	University of Trieste, Italy

Elise De Donker	Western Michigan University, USA
Maria Irene Falcão	University of Minho, Portugal
Robert C. H. Hsu	Chung Hua University, Taiwan
Tai-Hoon Kim	Beijing Jiaotong University, China
Vladimir Korkhov	St Petersburg University, Russia
Sanjay Misra	Østfold University College, Norway
Takashi Naka	Kyushu Sangyo University, Japan
Rafael D. C. Santos	National Institute for Space Research, Brazil
Maribel Yasmina Santos	University of Minho, Portugal
Elena Stankova	St Petersburg University, Russia

Workshop and Session Organizing Chairs

Beniamino Murgante	University of Basilicata, Italy
Chiara Garau	University of Cagliari, Italy
Sanjay Misra	Ostfold University College, Norway

Award Chair

Wenny Rahayu	La Trobe University, Australia
--------------	--------------------------------

Publicity Committee Chairs

Elmer Dadios	De La Salle University, Philippines
Nataliia Kulabukhova	St Petersburg University, Russia
Daisuke Takahashi	Tsukuba University, Japan
Shangwang Wang	Beijing University of Posts and Telecommunications, China

Local Arrangement Chairs

Eligius Hendrix	University of Malaga, Spain
Inmaculada Garcia Fernandez	University of Malaga, Spain
Salvador Merino Cordoba	University of Malaga, Spain
Pablo Guerrero-García	University of Malaga, Spain

Technology Chairs

Damiano Perri	University of Florence, Italy
Marco Simonetti	University of Florence, Italy

Program Committee

Vera Afreixo	University of Aveiro, Portugal
Filipe Alvelos	University of Minho, Portugal

Hartmut Asche	Hasso-Plattner-Institut für Digital Engineering gGmbH, Germany
Ginevra Balletto	University of Cagliari, Italy
Michela Bertolotto	University College Dublin, Ireland
Sandro Bimonte	TSCF, INRAE, France
Rod Blais	University of Calgary, Canada
Ivan Blečić	University of Sassari, Italy
Giuseppe Borruso	University of Trieste, Italy
Ana Cristina Braga	University of Minho, Portugal
Massimo Cafaro	University of Salento, Italy
Yves Caniou	ENS Lyon, France
Ermanno Cardelli	University of Perugia, Italy
José A. Cardoso e Cunha	Universidade Nova de Lisboa, Portugal
Rui Cardoso	University of Beira Interior, Portugal
Leocadio G. Casado	University of Almeria, Spain
Carlo Cattani	University of Salerno, Italy
Mete Celik	Erciyes University, Turkey
Maria Cerreta	University of Naples Federico II, Italy
Hyunseung Choo	Sungkyunkwan University, South Korea
Rachel Chieng-Sing Lee	Sunway University, Malaysia
Min Young Chung	Sungkyunkwan University, South Korea
Florbela Maria da Cruz Domingues Correia	Polytechnic Institute of Viana do Castelo, Portugal
Gilberto Corso Pereira	Federal University of Bahia, Brazil
Alessandro Costantini	INFN, Italy
Carla Dal Sasso Freitas	Universidade Federal do Rio Grande do Sul, Brazil
Pradesh Debba	Council for Scientific and Industrial Research (CSIR), South Africa
Hendrik Decker	Instituto Tecnológico de Informática, Spain
Robertas Damaševičius	Kaunas University of Technology, Lithuania
Frank Devai	London South Bank University, UK
Rodolphe Devillers	Memorial University of Newfoundland, Canada
Joana Matos Dias	University of Coimbra, Portugal
Paolino Di Felice	University of L'Aquila, Italy
Prabu Dorairaj	NetApp, India/USA
M. Noelia Faginas Lago	University of Perugia, Italy
M. Irene Falcao	University of Minho, Portugal
Florbela P. Fernandes	Polytechnic Institute of Bragança, Portugal
Jose-Jesus Fernandez	National Centre for Biotechnology, Spain
Paula Odete Fernandes	Polytechnic Institute of Bragança, Portugal
Adelaide de Fátima Baptista Valente Freitas	University of Aveiro, Portugal
Manuel Carlos Figueiredo	University of Minho, Portugal
Maria Celia Furtado Rocha	Federal University of Bahia, Brazil
Chiara Garau	University of Cagliari, Italy
Paulino Jose Garcia Nieto	University of Oviedo, Spain

Raffaele Garrisi	Polizia di Stato, Italy
Jerome Gensel	LSR-IMAG, France
Maria Giaoutzi	National Technical University of Athens, Greece
Arminda Manuela Andrade Pereira Gonçalves	University of Minho, Portugal
Andrzej M. Goscinski	Deakin University, Australia
Sevin Gümğüm	Izmir University of Economics, Turkey
Alex Hagen-Zanker	University of Cambridge, UK
Shanmugasundaram Hariharan	B.S. Abdur Rahman Crescent Institute of Science and Technology, India
Eligius M. T. Hendrix	University of Malaga, Spain and Wageningen University, The Netherlands
Hisamoto Hiyoshi	Gunma University, Japan
Mustafa Inceoglu	Ege University, Turkey
Peter Jimack	University of Leeds, UK
Qun Jin	Waseda University, Japan
Yeliz Karaca	UMass Chan Medical School, USA
Farid Karimipour	Vienna University of Technology, Austria
Baris Kazar	Oracle Corp., USA
Maulana Adhinugraha Kiki	Telkom University, Indonesia
DongSeong Kim	University of Canterbury, New Zealand
Taihoon Kim	Hannam University, South Korea
Ivana Kolingerova	University of West Bohemia, Czech Republic
Nataliia Kulabukhova	St. Petersburg University, Russia
Vladimir Korkhov	St. Petersburg University, Russia
Rosa Lasaponara	National Research Council, Italy
Maurizio Lazzari	National Research Council, Italy
Cheng Siong Lee	Monash University, Australia
Sangyoun Lee	Yonsei University, South Korea
Jongchan Lee	Kunsan National University, South Korea
Chendong Li	University of Connecticut, USA
Gang Li	Deakin University, Australia
Fang (Cherry) Liu	Ames Laboratory, USA
Xin Liu	University of Calgary, Canada
Andrea Lombardi	University of Perugia, Italy
Savino Longo	University of Bari, Italy
Tinghuai Ma	Nanjing University of Information Science and Technology, China
Ernesto Marcheggiani	Katholieke Universiteit Leuven, Belgium
Antonino Marvuglia	Public Research Centre Henri Tudor, Luxembourg
Nicola Masini	National Research Council, Italy
Ilaria Matteucci	National Research Council, Italy
Nirvana Meratnia	University of Twente, The Netherlands
Fernando Miranda	University of Minho, Portugal
Giuseppe Modica	University of Reggio Calabria, Italy
Josè Luis Montaña	University of Cantabria, Spain

Maria Filipa Mourão	Instituto Politécnico de Viana do Castelo, Portugal
Louiza de Macedo Mourelle	State University of Rio de Janeiro, Brazil
Nadia Nedjah	State University of Rio de Janeiro, Brazil
Laszlo Neumann	University of Girona, Spain
Kok-Leong Ong	Deakin University, Australia
Belen Palop	Universidad de Valladolid, Spain
Marcin Paprzycki	Polish Academy of Sciences, Poland
Eric Pardede	La Trobe University, Australia
Kwangjin Park	Wonkwang University, South Korea
Ana Isabel Pereira	Polytechnic Institute of Bragança, Portugal
Massimiliano Petri	University of Pisa, Italy
Telmo Pinto	University of Coimbra, Portugal
Maurizio Pollino	Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
Alenka Poplin	University of Hamburg, Germany
Vidyasagar Potdar	Curtin University of Technology, Australia
David C. Prospero	Florida Atlantic University, USA
Wenny Rahayu	La Trobe University, Australia
Jerzy Respondek	Silesian University of Technology, Poland
Humberto Rocha	INESC-Coimbra, Portugal
Jon Rokne	University of Calgary, Canada
Octavio Roncero	CSIC, Spain
Maytham Safar	Kuwait University, Kuwait
Chiara Saracino	A.O. Ospedale Niguarda Ca' Granda, Italy
Marco Paulo Seabra dos Reis	University of Coimbra, Portugal
Jie Shen	University of Michigan, USA
Qi Shi	Liverpool John Moores University, UK
Dale Shires	U.S. Army Research Laboratory, USA
Inês Soares	University of Coimbra, Portugal
Elena Stankova	St Petersburg University, Russia
Takuo Suganuma	Tohoku University, Japan
Eufemia Tarantino	Polytechnic University of Bari, Italy
Sergio Tasso	University of Perugia, Italy
Ana Paula Teixeira	University of Trás-os-Montes and Alto Douro, Portugal
M. Filomena Teodoro	Portuguese Naval Academy and University of Lisbon, Portugal
Parimala Thulasiraman	University of Manitoba, Canada
Carmelo Torre	Polytechnic University of Bari, Italy
Javier Martinez Torres	Centro Universitario de la Defensa Zaragoza, Spain
Giuseppe A. Trunfio	University of Sassari, Italy
Pablo Vanegas	University of Cuenca, Ecuador
Marco Vizzari	University of Perugia, Italy
Varun Vohra	Merck Inc., USA
Koichi Wada	University of Tsukuba, Japan
Krzysztof Walkowiak	Wroclaw University of Technology, Poland

Zequn Wang	Intelligent Automation Inc, USA
Robert Weibel	University of Zurich, Switzerland
Frank Westad	Norwegian University of Science and Technology, Norway
Roland Wismüller	Universität Siegen, Germany
Mudasser Wyne	National University, USA
Chung-Huang Yang	National Kaohsiung Normal University, Taiwan
Xin-She Yang	National Physical Laboratory, UK
Salim Zahir	France Telecom Japan Co., Japan
Haifeng Zhao	University of California, Davis, USA
Fabiana Zollo	Ca' Foscari University of Venice, Italy
Albert Y. Zomaya	University of Sydney, Australia

Workshop Organizers

International Workshop on Advances in Artificial Intelligence Learning Technologies: Blended Learning, STEM, Computational Thinking and Coding (AAILT 2022)

Alfredo Milani	University of Perugia, Italy
Valentina Franzoni	University of Perugia, Italy
Oswaldo Gervasi	University of Perugia, Italy

International Workshop on Advancements in Applied Machine-Learning and Data Analytics (AAMDA 2022)

Alessandro Costantini	INFN, Italy
Davide Salomoni	INFN, Italy
Doina Cristina Duma	INFN, Italy
Daniele Cesini	INFN, Italy

International Workshop on Advances in Information Systems and Technologies for Emergency Management, Risk Assessment and Mitigation Based on the Resilience (ASTER 2022)

Maurizio Pollino	ENEA, Italy
Marco Vona	University of Basilicata, Italy
Sonia Giovanazzi	ENEA, Italy
Benedetto Manganelli	University of Basilicata, Italy
Beniamino Murgante	University of Basilicata, Italy

International Workshop on Advances in Web Based Learning (AWBL 2022)

Birol Ciloglulil
Mustafa Inceoglu

Ege University, Turkey
Ege University, Turkey

International Workshop on Blockchain and Distributed Ledgers: Technologies and Applications (BDLTA 2022)

Vladimir Korkhov
Elena Stankova
Nataliia Kulabukhova

St Petersburg State University, Russia
St Petersburg State University, Russia
St Petersburg State University, Russia

International Workshop on Bio and Neuro Inspired Computing and Applications (BIONCA 2022)

Nadia Nedjah
Luiza De Macedo Mourelle

State University of Rio De Janeiro, Brazil
State University of Rio De Janeiro, Brazil

International Workshop on Configurational Analysis For Cities (CA CITIES 2022)

Claudia Yamu
Valerio Cutini
Beniamino Murgante
Chiara Garau

Oslo Metropolitan University, Norway
Università di Pisa, Italy
University of Basilicata, Italy
Dicaar, University of Cagliari, Italy

International Workshop on Computational and Applied Mathematics (CAM 2022)

Maria Irene Falcão
Fernando Miranda

University of Minho, Portugal
University of Minho, Portugal

International Workshop on Computational and Applied Statistics (CAS 2022)

Ana Cristina Braga

University of Minho, Portugal

International Workshop on Computational Mathematics, Statistics and Information Management (CMSIM 2022)

Maria Filomena Teodoro

University of Lisbon and Portuguese Naval Academy,
Portugal

International Workshop on Computational Optimization and Applications (COA 2022)

Ana Maria A. C. Rocha University of Minho, Portugal
Humberto Rocha University of Coimbra, Portugal

International Workshop on Computational Astrochemistry (CompAstro 2022)

Marzio Rosi University of Perugia, Italy
Nadia Balucani University of Perugia, Italy
Cecilia Ceccarelli Université Grenoble Alpes, France
Stefano Falcinelli University of Perugia, Italy

International Workshop on Computational Methods for Porous Geomaterials (CompPor 2022)

Vadim Lisitsa Sobolev Institute of Mathematics, Russia
Evgeniy Romenski Sobolev Institute of Mathematics, Russia

International Workshop on Computational Approaches for Smart, Conscious Cities (CASCC 2022)

Andreas Fricke University of Potsdam, Germany
Juergen Doellner University of Potsdam, Germany
Salvador Merino University of Malaga, Spain
Jürgen Bund Graphics Vision AI Association, Germany/Portugal
Markus Jobst Federal Office of Metrology and Surveying, Austria
Francisco Guzman University of Malaga, Spain

International Workshop on Computational Science and HPC (CSHPC 2022)

Elise De Doncker Western Michigan University, USA
Fukuko Yuasa High Energy Accelerator Research Organization (KEK), Japan
Hideo Matsufuru High Energy Accelerator Research Organization (KEK), Japan

International Workshop on Cities, Technologies and Planning (CTP 2022)

Giuseppe Borruso University of Trieste, Italy
Malgorzata Hanzl Lodz University of Technology, Poland
Beniamino Murgante University of Basilicata, Italy

Anastasia Stratigea	National Technical University of Athens, Grece
Ginevra Balletto	University of Cagliari, Italy
Ljiljana Zivkovic	Republic Geodetic Authority, Serbia

International Workshop on Digital Sustainability and Circular Economy (DiSCE 2022)

Giuseppe Borruso	University of Trieste, Italy
Stefano Epifani	Digital Sustainability Institute, Italy
Ginevra Balletto	University of Cagliari, Italy
Luigi Mundula	University of Cagliari, Italy
Alessandra Milesi	University of Cagliari, Italy
Mara Ladu	University of Cagliari, Italy
Stefano De Nicolai	University of Pavia, Italy
Tu Anh Trinh	University of Economics Ho Chi Minh City, Vietnam

International Workshop on Econometrics and Multidimensional Evaluation in Urban Environment (EMEUE 2022)

Carmelo Maria Torre	Polytechnic University of Bari, Italy
Maria Cerreta	University of Naples Federico II, Italy
Pierluigi Morano	Polytechnic University of Bari, Italy
Giuliano Poli	University of Naples Federico II, Italy
Marco Locurcio	Polytechnic University of Bari, Italy
Francesco Tajani	Sapienza University of Rome, Italy

International Workshop on Ethical AI Applications for a Human-Centered Cyber Society (EthicAI 2022)

Valentina Franzoni	University of Perugia, Italy
Alfredo Milani	University of Perugia, Italy

International Workshop on Future Computing System Technologies and Applications (FiSTA 2022)

Bernady Apduhan	Kyushu Sangyo University, Japan
Rafael Santos	INPE, Brazil

International Workshop on Geodesign in Decision Making: Meta Planning and Collaborative Design for Sustainable and Inclusive Development (GDM 2022)

Francesco Scorza	University of Basilicata, Italy
Michele Campagna	University of Cagliari, Italy
Ana Clara Mourão Moura	Federal University of Minas Gerais, Brazil

International Workshop on Geomatics in Agriculture and Forestry: New Advances and Perspectives (GeoForAgr 2022)

Maurizio Pollino	ENEA, Italy
Giuseppe Modica	University of Reggio Calabria, Italy
Marco Vizzari	University of Perugia, Italy

International Workshop on Geographical Analysis, Urban Modeling, Spatial Statistics (Geog-An-Mod 2022)

Giuseppe Borruso	University of Trieste, Italy
Beniamino Murgante	University of Basilicata, Italy
Harmut Asche	Hasso-Plattner-Institut für Digital Engineering gGmbH, Germany

International Workshop on Geomatics for Resource Monitoring and Management (GRMM 2022)

Alessandra Capolupo	Polytechnic of Bari, Italy
Eufemia Tarantino	Polytechnic of Bari, Italy
Enrico Borgogno Mondino	University of Turin, Italy

International Workshop on Information and Knowledge in the Internet of Things (IKIT 2022)

Teresa Guarda	State University of Santa Elena Peninsula, Ecuador
Filipe Portela	University of Minho, Portugal
Maria Fernanda Augusto	Bitrum Research Center, Spain

13th International Symposium on Software Quality (ISSQ 2022)

Sanjay Misra	Østfold University College, Norway
--------------	------------------------------------

International Workshop on Machine Learning for Space and Earth Observation Data (MALSEOD 2022)

Rafael Santos	INPE, Brazil
Karine Reis Ferreira Gomes	INPE, Brazil

International Workshop on Building Multi-dimensional Models for Assessing Complex Environmental Systems (MES 2022)

Vanessa Assumma	Politecnico di Torino, Italy
Caterina Caprioli	Politecnico di Torino, Italy
Giulia Datola	Politecnico di Torino, Italy

Federico Dell'Anna	Politecnico di Torino, Italy
Marta Dell'Ovo	Politecnico di Milano, Italy

International Workshop on Models and Indicators for Assessing and Measuring the Urban Settlement Development in the View of ZERO Net Land Take by 2050 (MOVEto 2022)

Lucia Saganeiti	University of L'Aquila, Italy
Lorena Fiorini	University of L'aquila, Italy
Angela Pilogallo	University of Basilicata, Italy
Alessandro Marucci	University of L'Aquila, Italy
Francesco Zullo	University of L'Aquila, Italy

International Workshop on Modelling Post-Covid Cities (MPCC 2022)

Beniamino Murgante	University of Basilicata, Italy
Ginevra Balletto	University of Cagliari, Italy
Giuseppe Borruso	University of Trieste, Italy
Marco Dettori	Università degli Studi di Sassari, Italy
Lucia Saganeiti	University of L'Aquila, Italy

International Workshop on Ecosystem Services: Nature's Contribution to People in Practice. Assessment Frameworks, Models, Mapping, and Implications (NC2P 2022)

Francesco Scorza	University of Basilicata, Italy
Sabrina Lai	University of Cagliari, Italy
Silvia Ronchi	University of Cagliari, Italy
Dani Broitman	Israel Institute of Technology, Israel
Ana Clara Mourão Moura	Federal University of Minas Gerais, Brazil
Corrado Zoppi	University of Cagliari, Italy

International Workshop on New Mobility Choices for Sustainable and Alternative Scenarios (NEWMOB 2022)

Tiziana Campisi	University of Enna Kore, Italy
Socrates Basbas	Aristotle University of Thessaloniki, Greece
Aleksandra Deluka T.	University of Rijeka, Croatia
Alexandros Nikitas	University of Huddersfield, UK
Ioannis Politis	Aristotle University of Thessaloniki, Greece
Georgios Georgiadis	Aristotle University of Thessaloniki, Greece
Irena Ištoka Otković	University of Osijek, Croatia
Sanja Surdonja	University of Rijeka, Croatia

International Workshop on Privacy in the Cloud/Edge/IoT World (PCEIoT 2022)

Michele Mastroianni	University of Campania Luigi Vanvitelli, Italy
Lelio Campanile	University of Campania Luigi Vanvitelli, Italy
Mauro Iacono	University of Campania Luigi Vanvitelli, Italy

International Workshop on Psycho-Social Analysis of Sustainable Mobility in the Pre- and Post-Pandemic Phase (PSYCHE 2022)

Tiziana Campisi	University of Enna Kore, Italy
Socrates Basbas	Aristotle University of Thessaloniki, Greece
Dilum Dissanayake	Newcastle University, UK
Nurten Akgün Tanbay	Bursa Technical University, Turkey
Elena Cocuzza	University of Catania, Italy
Nazam Ali	University of Management and Technology, Pakistan
Vincenza Torrisi	University of Catania, Italy

International Workshop on Processes, Methods and Tools Towards Resilient Cities and Cultural Heritage Prone to SOD and ROD Disasters (RES 2022)

Elena Cantatore	Polytechnic University of Bari, Italy
Alberico Sonnessa	Polytechnic University of Bari, Italy
Dario Esposito	Polytechnic University of Bari, Italy

International Workshop on Scientific Computing Infrastructure (SCI 2022)

Elena Stankova	St Petersburg University, Russia
Vladimir Korkhov	St Petersburg University, Russia

International Workshop on Socio-Economic and Environmental Models for Land Use Management (SEMLUM 2022)

Debora Anelli	Polytechnic University of Bari, Italy
Pierluigi Morano	Polytechnic University of Bari, Italy
Francesco Tajani	Sapienza University of Rome, Italy
Marco Locurcio	Polytechnic University of Bari, Italy
Paola Amoruso	LUM University, Italy

14th International Symposium on Software Engineering Processes and Applications (SEPA 2022)

Sanjay Misra	Østfold University College, Norway
--------------	------------------------------------

International Workshop on Ports of the Future – Smartness and Sustainability (SmartPorts 2022)

Giuseppe Borruso	University of Trieste, Italy
Gianfranco Fancello	University of Cagliari, Italy
Ginevra Balletto	University of Cagliari, Italy
Patrizia Serra	University of Cagliari, Italy
Maria del Mar Munoz Leonisio	University of Cadiz, Spain
Marco Mazzarino	University of Venice, Italy
Marcello Tadini	Università del Piemonte Orientale, Italy

International Workshop on Smart Tourism (SmartTourism 2022)

Giuseppe Borruso	University of Trieste, Italy
Silvia Battino	University of Sassari, Italy
Ainhoa Amaro Garcia	Universidad de Alcalà and Universidad de Las Palmas, Spain
Maria del Mar Munoz Leonisio	University of Cadiz, Spain
Carlo Donato	University of Sassari, Italy
Francesca Krasna	University of Trieste, Italy
Ginevra Balletto	University of Cagliari, Italy

International Workshop on Sustainability Performance Assessment: Models, Approaches and Applications Toward Interdisciplinary and Integrated Solutions (SPA 2022)

Francesco Scorza	University of Basilicata, Italy
Sabrina Lai	University of Cagliari, Italy
Jolanta Dvarioniene	Kaunas University of Technology, Lithuania
Iole Cerminara	University of Basilicata, Italy
Georgia Pozoukidou	Aristotle University of Thessaloniki, Greece
Valentin Grecu	Lucian Blaga University of Sibiu, Romania
Corrado Zoppi	University of Cagliari, Italy

International Workshop on Specifics of Smart Cities Development in Europe (SPEED 2022)

Chiara Garau	University of Cagliari, Italy
Katarína Vitálišová	Matej Bel University, Slovakia
Paolo Nesi	University of Florence, Italy
Anna Vanova	Matej Bel University, Slovakia
Kamila Borsekova	Matej Bel University, Slovakia
Paola Zamperlin	University of Pisa, Italy

Federico Cugurullo Trinity College Dublin, Ireland
Gerardo Carpentieri University of Naples Federico II, Italy

International Workshop on Smart and Sustainable Island Communities (SSIC 2022)

Chiara Garau University of Cagliari, Italy
Anastasia Stratigea National Technical University of Athens, Greece
Paola Zamperlin University of Pisa, Italy
Francesco Scorza University of Basilicata, Italy

International Workshop on Theoretical and Computational Chemistry and Its Applications (TCCMA 2022)

Noelia Faginas-Lago University of Perugia, Italy
Andrea Lombardi University of Perugia, Italy

International Workshop on Transport Infrastructures for Smart Cities (TISC 2022)

Francesca Maltinti University of Cagliari, Italy
Mauro Coni University of Cagliari, Italy
Francesco Pinna University of Cagliari, Italy
Chiara Garau University of Cagliari, Italy
Nicoletta Rassu University of Cagliari, Italy
James Rombi University of Cagliari, Italy
Benedetto Barabino University of Brescia, Italy

14th International Workshop on Tools and Techniques in Software Development Process (TTSDP 2022)

Sanjay Misra Østfold University College, Norway

International Workshop on Urban Form Studies (UForm 2022)

Malgorzata Hanzl Lodz University of Technology, Poland
Beniamino Murgante University of Basilicata, Italy
Alessandro Camiz Özyeğin University, Turkey
Tomasz Bradecki Silesian University of Technology, Poland

International Workshop on Urban Regeneration: Innovative Tools and Evaluation Model (URITEM 2022)

Fabrizio Battisti University of Florence, Italy
Laura Ricci Sapienza University of Rome, Italy
Orazio Campo Sapienza University of Rome, Italy

International Workshop on Urban Space Accessibility and Mobilities (USAM 2022)

Chiara Garau	University of Cagliari, Italy
Matteo Ignaccolo	University of Catania, Italy
Enrica Papa	University of Westminster, UK
Francesco Pinna	University of Cagliari, Italy
Silvia Rossetti	University of Parma, Italy
Wendy Tan	Wageningen University and Research, The Netherlands
Michela Tiboni	University of Brescia, Italy
Vincenza Torrisi	University of Catania, Italy

International Workshop on Virtual Reality and Augmented Reality and Applications (VRA 2022)

Oswaldo Gervasi	University of Perugia, Italy
Damiano Perri	University of Florence, Italy
Marco Simonetti	University of Florence, Italy
Sergio Tasso	University of Perugia, Italy

International Workshop on Advanced and Computational Methods for Earth Science Applications (WACM4ES 2022)

Luca Piroddi	University of Cagliari, Italy
Sebastiano Damico	University of Malta, Malta

International Workshop on Advanced Mathematics and Computing Methods in Complex Computational Systems (WAMCM 2022)

Yeliz Karaca	UMass Chan Medical School, USA
Dumitru Baleanu	Cankaya University, Turkey
Oswaldo Gervasi	University of Perugia, Italy
Yudong Zhang	University of Leicester, UK
Majaz Moonis	UMass Chan Medical School, USA

Additional Reviewers

Akshat Agrawal	Amity University, Haryana, India
Waseem Ahmad	National Institute of Technology Karnataka, India
Vladimir Alarcon	Universidad Diego Portales, Chile
Oylum Alath	Ege University, Turkey
Raffaele Albano	University of Basilicata, Italy
Abraham Alfa	FUT Minna, Nigeria
Diego Altafini	Università di Pisa, Italy
Filipe Alvelos	Universidade do Minho, Portugal

Marina Alexandra Pedro Andrade	ISCTE-IUL, Portugal
Debora Anelli	Polytechnic University of Bari, Italy
Gennaro Angiello	Almaviva de Belgique, Belgium
Alfonso Annunziata	Università di Cagliari, Italy
Bernady Apduhan	Kyushu Sangyo University, Japan
Daniela Ascenzi	Università degli Studi di Trento, Italy
Burak Galip Aslan	Izmir Institute of Technology, Turkey
Vanessa Assumma	Politecnico di Torino, Italy
Daniel Atzberger	Hasso-Plattner-Institute für Digital Engineering gGmbH, Germany
Dominique Aury	École Polytechnique Fédérale de Lausanne, Switzerland
Joseph Awotumde	University of Alcalá, Spain
Birim Balci	Celal Bayar University, Turkey
Juliana Balera	INPE, Brazil
Ginevra Balletto	University of Cagliari, Italy
Benedetto Barabino	University of Brescia, Italy
Kaushik Barik	University of Alcalá, Spain
Carlo Barletta	Politecnico di Bari, Italy
Socrates Basbas	Aristotle University of Thessaloniki, Greece
Rosaria Battarra	ISMed-CNR, Italy
Silvia Battino	University of Sassari, Italy
Chiara Bedan	University of Trieste, Italy
Ranjan Kumar Behera	National Institute of Technology Rourkela, India
Gulmira Bekmanova	L.N. Gumilyov Eurasian National University, Kazakhstan
Mario Bentivenga	University of Basilicata, Italy
Asrat Mulatu Beyene	Addis Ababa Science and Technology University, Ethiopia
Tiziana Binda	Politecnico di Torino, Italy
Giulio Biondi	University of Firenze, Italy
Alexander Bogdanov	St Petersburg University, Russia
Costanza Borghesi	University of Perugia, Italy
Giuseppe Borruso	University of Trieste, Italy
Marilisa Botte	University of Naples Federico II, Italy
Tomasz Bradecki	Silesian University of Technology, Poland
Ana Cristina Braga	University of Minho, Portugal
Luca Braidotti	University of Trieste, Italy
Bazon Brock	University of Wuppertal, Germany
Dani Broitman	Israel Institute of Technology, Israel
Maria Antonia Brovelli	Politecnico di Milano, Italy
Jorge Buele	Universidad Tecnológica Indoamérica, Ecuador
Isabel Cacao	University of Aveiro, Portugal
Federica Cadamuro Morgante	Politecnico di Milano, Italy

Rogério Calazan	IEAPM, Brazil
Michele Campagna	University of Cagliari, Italy
Lelio Campanile	Università degli Studi della Campania Luigi Vanvitelli, Italy
Tiziana Campisi	University of Enna Kore, Italy
Antonino Canale	University of Enna Kore, Italy
Elena Cantatore	Polytechnic University of Bari, Italy
Patrizia Capizzi	University of Palermo, Italy
Alessandra Capolupo	Polytechnic University of Bari, Italy
Giacomo Caporusso	Politecnico di Bari, Italy
Caterina Caprioli	Politecnico di Torino, Italy
Gerardo Carpentieri	University of Naples Federico II, Italy
Martina Carra	University of Brescia, Italy
Pedro Carrasqueira	INESC Coimbra, Portugal
Barbara Caselli	Università degli Studi di Parma, Italy
Cecilia Castro	University of Minho, Portugal
Giulio Cavana	Politecnico di Torino, Italy
Iole Cerminara	University of Basilicata, Italy
Maria Cerreta	University of Naples Federico II, Italy
Daniele Cesini	INFN, Italy
Jabed Chowdhury	La Trobe University, Australia
Birol Ciloglulil	Ege University, Turkey
Elena Cocuzza	University of Catania, Italy
Emanuele Colica	University of Malta, Malta
Mauro Coni	University of Cagliari, Italy
Elisete Correia	Universidade de Trás-os-Montes e Alto Douro, Portugal
Florbela Correia	Polytechnic Institute of Viana do Castelo, Portugal
Paulo Cortez	University of Minho, Portugal
Lino Costa	Universidade do Minho, Portugal
Alessandro Costantini	INFN, Italy
Marilena Cozzolino	Università del Molise, Italy
Alfredo Cuzzocrea	University of Calabria, Italy
Sebastiano D'amico	University of Malta, Malta
Gianni D'Angelo	University of Salerno, Italy
Tijana Dabovic	University of Belgrade, Serbia
Hiroshi Daisaka	Hitotsubashi University, Japan
Giulia Datola	Politecnico di Torino, Italy
Regina De Almeida	University of Trás-os-Montes and Alto Douro, Portugal
Maria Stella De Biase	Università della Campania Luigi Vanvitelli, Italy
Elise De Doncker	Western Michigan University, USA
Itamir De Moraes Barroca Filho	Federal University of Rio Grande do Norte, Brazil
Samuele De Petris	University of Turin, Italy
Alan De Sá	Marinha do Brasil, Brazil
Alexander Degtyarev	St Petersburg University, Russia

Federico Dell’Anna	Politecnico di Torino, Italy
Marta Dell’Ovo	Politecnico di Milano, Italy
Ahu Dereli Dursun	Istanbul Commerce University, Turkey
Giulia Desogus	University of Cagliari, Italy
Piero Di Bonito	Università degli Studi della Campania, Italia
Paolino Di Felice	University of L’Aquila, Italy
Felicia Di Liddo	Polytechnic University of Bari, Italy
Isabel Dimas	University of Coimbra, Portugal
Doina Cristina Duma	INFN, Italy
Aziz Dursun	Virginia Tech University, USA
Jaroslav Dvořák	Klaipėda University, Lithuania
Dario Esposito	Polytechnic University of Bari, Italy
M. Noelia Faginas-Lago	University of Perugia, Italy
Stefano Falcinelli	University of Perugia, Italy
Falcone Giacomo	University of Reggio Calabria, Italy
Maria Irene Falcão	University of Minho, Portugal
Stefano Federico	CNR-ISAC, Italy
Marcin Feltynowski	University of Lodz, Poland
António Fernandes	Instituto Politécnico de Bragança, Portugal
Florbela Fernandes	Instituto Politecnico de Braganca, Portugal
Paula Odete Fernandes	Instituto Politécnico de Bragança, Portugal
Luis Fernandez-Sanz	University of Alcalá, Spain
Luís Ferrás	University of Minho, Portugal
Ângela Ferreira	Instituto Politécnico de Bragança, Portugal
Lorena Fiorini	University of L’Aquila, Italy
Hector Florez	Universidad Distrital Francisco Jose de Caldas, Colombia
Stefano Franco	LUISS Guido Carli, Italy
Valentina Franzoni	Perugia University, Italy
Adelaide Freitas	University of Aveiro, Portugal
Andreas Fricke	Hasso Plattner Institute, Germany
Junpei Fujimoto	KEK, Japan
Federica Gaglione	Università del Sannio, Italy
Andrea Gallo	Università degli Studi di Trieste, Italy
Luciano Galone	University of Malta, Malta
Adam Galuszka	Silesian University of Technology, Poland
Chiara Garau	University of Cagliari, Italy
Ernesto Garcia Para	Universidad del Pais Vasco, Spain
Aniket A. Gaurav	Østfold University College, Norway
Marina Gavrilova	University of Calgary, Canada
Oswaldo Gervasi	University of Perugia, Italy
Andrea Ghirardi	Università di Brescia, Italy
Andrea Gioia	Politecnico di Bari, Italy
Giacomo Giorgi	Università degli Studi di Perugia, Italy
Stanislav Glubokovskikh	Lawrence Berkeley National Laboratory, USA
A. Manuela Gonçalves	University of Minho, Portugal

Leocadio González Casado	University of Almería, Spain
Angela Gorgoglione	Universidad de la República Uruguay, Uruguay
Yusuke Gotoh	Okayama University, Japan
Daniele Granata	Università degli Studi della Campania, Italy
Christian Grévisse	University of Luxembourg, Luxembourg
Silvana Grillo	University of Cagliari, Italy
Teresa Guarda	State University of Santa Elena Peninsula, Ecuador
Carmen Guida	Università degli Studi di Napoli Federico II, Italy
Kemal Güven Gülen	Namık Kemal University, Turkey
Ipek Guler	Leuven Biostatistics and Statistical Bioinformatics Centre, Belgium
Sevin Gumgum	Izmir University of Economics, Turkey
Martina Halásková	VSB Technical University in Ostrava, Czech Republic
Peter Hegedus	University of Szeged, Hungary
Eligius M. T. Hendrix	Universidad de Málaga, Spain
Mauro Iacono	Università degli Studi della Campania, Italy
Oleg Yakushkin	St Petersburg University, Russia
Matteo Ignaccolo	University of Catania, Italy
Mustafa Inceoglu	Ege University, Turkey
Markus Jobst	Federal Office of Metrology and Surveying, Austria
Issaku Kanamori	RIKEN Center for Computational Science, Japan
Yeliz Karaca	UMass Chan Medical School, USA
Aarti Karande	Sardar Patel Institute of Technology, India
András Kicsi	University of Szeged, Hungary
Vladimir Korkhov	St Petersburg University, Russia
Nataliia Kulabukhova	St Petersburg University, Russia
Claudio Ladisa	Politecnico di Bari, Italy
Mara Ladu	University of Cagliari, Italy
Sabrina Lai	University of Cagliari, Italy
Mark Lajko	University of Szeged, Hungary
Giuseppe Francesco Cesare Lama	University of Napoli Federico II, Italy
Vincenzo Laporta	CNR, Italy
Margherita Lasorella	Politecnico di Bari, Italy
Francesca Leccis	Università di Cagliari, Italy
Federica Leone	University of Cagliari, Italy
Chien-sing Lee	Sunway University, Malaysia
Marco Locurcio	Polytechnic University of Bari, Italy
Francesco Loddo	Henge S.r.l., Italy
Andrea Lombardi	Università di Perugia, Italy
Isabel Lopes	Instituto Politécnico de Bragança, Portugal
Fernando Lopez Gayarre	University of Oviedo, Spain
Vanda Lourenço	Universidade Nova de Lisboa, Portugal
Jing Ma	Luleå University of Technology, Sweden
Helmuth Malonek	University of Aveiro, Portugal
Francesca Maltinti	University of Cagliari, Italy

Benedetto Manganelli	Università degli Studi della Basilicata, Italy
Krassimir Markov	Institute of Electric Engineering and Informatics, Bulgaria
Alessandro Marucci	University of L'Aquila, Italy
Alessandra Mascitelli	Italian Civil Protection Department and ISAC-CNR, Italy
Michele Mastroianni	University of Campania Luigi Vanvitelli, Italy
Hideo Matsufuru	High Energy Accelerator Research Organization (KEK), Japan
Chiara Mazzarella	University of Naples Federico II, Italy
Marco Mazzarino	University of Venice, Italy
Paolo Mengoni	University of Florence, Italy
Alfredo Milani	University of Perugia, Italy
Fernando Miranda	Universidade do Minho, Portugal
Augusto Montisci	Università degli Studi di Cagliari, Italy
Ricardo Moura	New University of Lisbon, Portugal
Ana Clara Mourao Moura	Federal University of Minas Gerais, Brazil
Maria Mourao	Polytechnic Institute of Viana do Castelo, Portugal
Eugenio Muccio	University of Naples Federico II, Italy
Beniamino Murgante	University of Basilicata, Italy
Giuseppe Musolino	University of Reggio Calabria, Italy
Stefano Naitza	Università di Cagliari, Italy
Naohito Nakasato	University of Aizu, Japan
Roberto Nardone	University of Reggio Calabria, Italy
Nadia Nedjah	State University of Rio de Janeiro, Brazil
Juraj Nemeč	Masaryk University in Brno, Czech Republic
Keigo Nitadori	RIKEN R-CCS, Japan
Roseline Ogundokun	Kaunas University of Technology, Lithuania
Francisco Henrique De Oliveira	Santa Catarina State University, Brazil
Irene Oliveira	Univesidade Trás-os-Montes e Alto Douro, Portugal
Samson Oruma	Østfold University College, Norway
Antonio Pala	University of Cagliari, Italy
Simona Panaro	University of Portsmouth, UK
Dimos Pantazis	University of West Attica, Greece
Giovanni Paragliola	ICAR-CNR, Italy
Eric Pardede	La Trobe University, Australia
Marco Parriani	University of Perugia, Italy
Paola Perchinunno	Uniersity of Bari, Italy
Ana Pereira	Polytechnic Institute of Bragança, Portugal
Damiano Perri	University of Perugia, Italy
Marco Petrelli	Roma Tre University, Italy
Camilla Pezzica	University of Pisa, Italy
Angela Pilogallo	University of Basilicata, Italy
Francesco Pinna	University of Cagliari, Italy
Telmo Pinto	University of Coimbra, Portugal

Fernando Pirani	University of Perugia, Italy
Luca Piroddi	University of Cagliari, Italy
Bojana Pjanović	University of Belgrade, Serbia
Giuliano Poli	University of Naples Federico II, Italy
Maurizio Pollino	ENEA, Italy
Salvatore Praticò	University of Reggio Calabria, Italy
Zbigniew Przygodzki	University of Lodz, Poland
Carlotta Quagliolo	Politecnico di Torino, Italy
Raffaele Garrisi	Polizia Postale e delle Comunicazioni, Italy
Mariapia Raimondo	Università della Campania Luigi Vanvitelli, Italy
Deep Raj	IIIT Naya Raipur, India
Buna Ramos	Universidade Lusíada Norte, Portugal
Nicoletta Rassu	University of Cagliari, Italy
Michela Ravanelli	Sapienza Università di Roma, Italy
Roberta Ravanelli	Sapienza Università di Roma, Italy
Pier Francesco Recchi	University of Naples Federico II, Italy
Stefania Regalbuto	University of Naples Federico II, Italy
Marco Reis	University of Coimbra, Portugal
Maria Reitano	University of Naples Federico II, Italy
Anatoly Resnyansky	Defence Science and Technology Group, Australia
Jerzy Respondek	Silesian University of Technology, Poland
Isabel Ribeiro	Instituto Politécnico Bragança, Portugal
Albert Rimola	Universitat Autònoma de Barcelona, Spain
Corrado Rindone	University of Reggio Calabria, Italy
Ana Maria A. C. Rocha	University of Minho, Portugal
Humberto Rocha	University of Coimbra, Portugal
Maria Clara Rocha	Instituto Politécnico de Coimbra, Portugal
James Rombi	University of Cagliari, Italy
Elisabetta Ronchieri	INFN, Italy
Marzio Rosi	University of Perugia, Italy
Silvia Rossetti	Università degli Studi di Parma, Italy
Marco Rossitti	Politecnico di Milano, Italy
Mária Rostašová	Universtiy of Žilina, Slovakia
Lucia Saganeiti	University of L'Aquila, Italy
Giovanni Salzillo	Università degli Studi della Campania, Italy
Valentina Santarsiero	University of Basilicata, Italy
Luigi Santopietro	University of Basilicata, Italy
Stefania Santoro	Politecnico di Bari, Italy
Rafael Santos	INPE, Brazil
Valentino Santucci	Università per Stranieri di Perugia, Italy
Mirko Saponaro	Polytechnic University of Bari, Italy
Filippo Sarvia	University of Turin, Italy
Andrea Scianna	ICAR-CNR, Italy
Francesco Scorza	University of Basilicata, Italy
Ester Scotto Di Perta	University of Naples Federico II, Italy
Ricardo Severino	University of Minho, Portugal

Jie Shen	University of Michigan, USA
Luneque Silva Junior	Universidade Federal do ABC, Brazil
Carina Silva	Instituto Politécnico de Lisboa, Portugal
Joao Carlos Silva	Polytechnic Institute of Cavado and Ave, Portugal
Ilya Silvestrov	Saudi Aramco, Saudi Arabia
Marco Simonetti	University of Florence, Italy
Maria Joana Soares	University of Minho, Portugal
Michel Soares	Federal University of Sergipe, Brazil
Alberico Sonnessa	Politecnico di Bari, Italy
Lisete Sousa	University of Lisbon, Portugal
Elena Stankova	St Petersburg University, Russia
Jan Stejskal	University of Pardubice, Czech Republic
Silvia Stranieri	University of Naples Federico II, Italy
Anastasia Stratigea	National Technical University of Athens, Greece
Yue Sun	European XFEL GmbH, Germany
Anthony Suppa	Politecnico di Torino, Italy
Kirill Sviatov	Ulyanovsk State Technical University, Russia
David Taniar	Monash University, Australia
Rodrigo Tapia-McClung	Centro de Investigación en Ciencias de Información Geoespacial, Mexico
Eufemia Tarantino	Politecnico di Bari, Italy
Sergio Tasso	University of Perugia, Italy
Vladimir Tcheverda	Institute of Petroleum Geology and Geophysics, SB RAS, Russia
Ana Paula Teixeira	Universidade de Trás-os-Montes e Alto Douro, Portugal
Tengku Adil Tengku Izhar	Universiti Teknologi MARA, Malaysia
Maria Filomena Teodoro	University of Lisbon and Portuguese Naval Academy, Portugal
Yiota Theodora	National Technical University of Athens, Greece
Graça Tomaz	Instituto Politécnico da Guarda, Portugal
Gokchan Tonbul	Atilim University, Turkey
Rosa Claudia Torcasio	CNR-ISAC, Italy
Carmelo Maria Torre	Polytechnic University of Bari, Italy
Vincenza Torrisi	University of Catania, Italy
Vincenzo Totaro	Politecnico di Bari, Italy
Pham Trung	HCMUT, Vietnam
Po-yu Tsai	National Chung Hsing University, Taiwan
Dimitrios Tsoukalas	Centre of Research and Technology Hellas, Greece
Toshihiro Uchibayashi	Kyushu University, Japan
Takahiro Ueda	Seikei University, Japan
Piero Ugliengo	Università degli Studi di Torino, Italy
Gianmarco Vanuzzo	University of Perugia, Italy
Clara Vaz	Instituto Politécnico de Bragança, Portugal
Laura Verde	University of Campania Luigi Vanvitelli, Italy
Katarína Vitálišová	Matej Bel University, Slovakia

Daniel Mark Vitiello	University of Cagliari, Italy
Marco Vizzari	University of Perugia, Italy
Alexander Vodyaho	St. Petersburg State Electrotechnical University “LETI”, Russia
Agustinus Borgy Waluyo	Monash University, Australia
Chao Wang	USTC, China
Marcin Wozniak	Silesian University of Technology, Poland
Jitao Yang	Beijing Language and Culture University, China
Fenghui Yao	Tennessee State University, USA
Fukuko Yuasa	KEK, Japan
Paola Zamperlin	University of Pisa, Italy
Michal Žemlička	Charles University, Czech Republic
Nataly Zhukova	ITMO University, Russia
Alcinia Zita Sampaio	University of Lisbon, Portugal
Ljiljana Zivkovic	Republic Geodetic Authority, Serbia
Floriana Zucaro	University of Naples Federico II, Italy
Marco Zucca	Politecnico di Milano, Italy
Camila Zygier	Ibmec, Belo Horizonte, Brazil

Sponsoring Organizations

ICCSA 2022 would not have been possible without tremendous support of many organizations and institutions, for which all organizers and participants of ICCSA 2022 express their sincere gratitude:



Springer International Publishing AG,
Germany (<https://www.springer.com>)



Computers Open Access Journal
(<https://www.mdpi.com/journal/computers>)



Computation Open Access Journal
(<https://www.mdpi.com/journal/computation>)



University of Malaga, Spain
(<https://www.uma.es/>)



University of Perugia, Italy
(<https://www.unipg.it>)



University of Basilicata, Italy
(<http://www.unibas.it>)



Monash University, Australia
(<https://www.monash.edu/>)



Kyushu Sangyo University, Japan
(<https://www.kyusan-u.ac.jp/>)



University of Minho, Portugal
(<https://www.uminho.pt/>)

Universidade do Minho
Escola de Engenharia

Contents – Part IV

International Workshop on Information and Knowledge in the Internet of Things (IKIT 2022)

The Impact of Quantum Computing on Businesses	3
<i>Teresa Guarda, Washington Torres, and Maria Fernanda Augusto</i>	
Educational Resource Recommender Systems Using Python and Moodle	15
<i>Alicia Andrade Vera and Carlos Mendoza González</i>	
Systematic Literature Review on Data Provenance in Internet of Things	31
<i>Emrullah Gultekin and Mehmet S. Aktas</i>	

13th International Symposium on Software Quality (ISSQ 2022)

A Feature Selection-Based K-NN Model for Fast Software Defect Prediction.	49
<i>Joseph Bamidele Awotunde, Sanjay Misra, Abidemi Emmanuel Adeniyi, Moses Kazeem Abiodun, Manju Kaushik, and Morolake Oladayo Lawrence</i>	
Comparing Univariate and Multivariate Time Series Models for Technical Debt Forecasting.	62
<i>Maria Mathioudaki, Dimitrios Tsoukalas, Miltiadis Siavvas, and Dionysios Kehagias</i>	
Fine-Tuning GPT-2 to Patch Programs, Is It Worth It?	79
<i>Márk Lajkó, Dániel Horváth, Viktor Csuvik, and László Vidács</i>	
Comparing ML-Based Predictions and Static Analyzer Tools for Vulnerability Detection.	92
<i>Norbert Vándor, Balázs Mosolygó, and Péter Hegelűs</i>	
A Line-Level Explainable Vulnerability Detection Approach for Java	106
<i>Balázs Mosolygó, Norbert Vándor, Péter Hegedűs, and Rudolf Ferenc</i>	
Role of Serverless Computing in Healthcare Systems: Case Studies.	123
<i>Anisha Kumari, Ranjan Kumar Behera, Bibhudatta Sahoo, and Sanjay Misra</i>	

Securing Digital Transaction Using a Three-Level Authentication System . . .	135
<i>Moses Kazeem Abiodun, Joseph Bamidele Awotunde, Abidemi Emmanuel Adeniyi, David Ademuagun, and Dayo Reuben Aremu</i>	

**International Workshop on Building Multi-dimensional Models
for Assessing Complex Environmental Systems (MES 2022)**

Supporting the EU Mission “100 Climate-Neutral Cities by 2030”: A Review of Tools to Support Decision-Making for the Built Environment at District or City Scale	151
<i>Anthony Robert Suppa, Giulio Cavana, and Tiziana Binda</i>	

Urban Metabolism: Definition of an Integrated Framework to Assess and Plan Cities and Territories	169
<i>Vanessa Assumma and Francesco Pittau</i>	

Assessing the Impacts of a Social Housing Project Through the Community Impact Evaluation (CIE) Methodology.	183
<i>Marta Bottero, Caterina Caprioli, Giulia Datola, and Nadia Caruso</i>	

Assessing the Potential of a Disused Shopping Village by Comparing Adaptive Reuse Scenarios	195
<i>Federica Cadamuro Morgante, Marta Dell’Ovo, Luca Tamini, and Alessandra Oppio</i>	

Spatial Econometric Analysis of Multi-family Housing Prices in Turin: The Heterogeneity of Preferences for Energy Efficiency.	211
<i>Federico Dell’Anna</i>	

Definition of an Integrated Theoretical Framework to Assess the NBS Suitability in Flood Risk Areas.	228
<i>Vanessa Assumma, Carlotta Quagliolo, Elena Comino, and Giulio Mondini</i>	

**International Workshop on Models and Indicators for Assessing
and Measuring the Urban Settlement Development in the View
of ZERO Net Land Take by 2050 (MOVEto0 2022)**

Ecosystem Services for Planning Impacts Assessment on Urban Settlement Development	241
<i>Angela Pilogallo, Lucia Saganeiti, Lorena Fiorini, and Alessandro Marucci</i>	

International Workshop on Modelling Post-Covid Cities (MPCC 2022)

- Sustainable Urban Mobility Planning and Walkability in the Post Pandemic era. Assessing the Role of Urban Enclaves 257
Ginevra Balletto, Mara Ladu, and Federico Camerin
- City Form, Mobility and University Students in Post Pandemic Era. 267
Ginevra Balletto, Tiziana Campisi, Giuseppe Borruso, Italo Meloni, and Beatrice Scappini

International Workshop on Ecosystem Services: Nature’s Contribution to People in Practice. Assessment Frameworks, Models, Mapping, and Implications (NC2P 2022)

- Spatial Features of a Regional Green Infrastructure and Identification of Ecological Corridors: A Study Related to Sardinia 285
Federica Isola, Sabrina Lai, Federica Leone, and Corrado Zoppi
- The Provision of Ecosystem Services Along the Italian Coastal Areas: A Correlation Analysis Between Environmental Quality and Urbanization . . . 298
Giampiero Lombardini, Angela Pilogallo, and Giorgia Tucci
- Multiscale Planning Approach in the Analysis and Proposition of Ecosystem Services 315
Camila Fernandes de Moraes, Tiago Augusto Gonçalves Mello, and Ana Clara Mourão Moura

International Workshop on New Mobility Choices For Sustainable and Alternative Scenarios (NEWMOB 2022)

- Users’ Socio-economic Factors to Choose Electromobility for Future Smart Cities 331
Ankit R. Patel, Giovanni Tesoriere, and Tiziana Campisi
- A Holistic Approach to SUMP Strategies and Actions in the Post-pandemic and Energy Crisis Era 345
Ines Charradi, Tiziana Campisi, Giovanni Tesoriere, and Khaled Ben Abdallah
- A Design Method for Pedestrian Areas by a Simplified Approach to Predict the Future Traffic Scenarios 360
Mauro D’Apuzzo, Giuseppe Cappelli, Azzurra Evangelisti, and Daniela Santilli

International Workshop on Privacy in the Cloud/Edge/IoT World (PCEIoT 2022)

Sensitive Information Detection Adopting Named Entity Recognition: A Proposed Methodology	377
<i>Lelio Campanile, Maria Stella de Biase, Stefano Marrone, Fiammetta Marulli, Mariapia Raimondo, and Laura Verde</i>	
Evaluating the Impact of Data Anonymization in a Machine Learning Application	389
<i>Lelio Campanile, Fabio Forgione, Michele Mastroianni, Gianfranco Palmiero, and Carlo Sanghez</i>	
On IoT Localization Architectures Comparison and Privacy Concerns in the Healthcare Sector	401
<i>Antonio Scarfò</i>	
TruthSeekers Chain: Leveraging Invisible CAPPCHA, SSI and Blockchain to Combat Disinformation on Social Media	419
<i>Meriem Guerar and Mauro Migliardi</i>	
AKMA for Secure Multi-access Edge Computing Mobility in 5G	432
<i>Gizem Akman, Philip Ginzboorg, and Valteri Niemi</i>	

International Workshop on Psycho-Social Analysis of Sustainable Mobility in The Pre- and Post-Pandemic Phase (PSYCHE 2022)

Modelling of Interactions Between Pedestrians and Vehicular Traffic to Promote Active Mobility: The Case of San Benedetto Neighbourhood in Cagliari (Italy)	453
<i>Vincenza Torrisi, Chiara Garau, Antonio Barbagallo, Pierfrancesco Leonardi, and Matteo Ignaccolo</i>	
The Rise of E-scooters in Palermo: A SWOT Analysis and Travel Time Study	469
<i>Tiziana Campisi, Alexandros Nikitas, Muhammad Ahmad Al-Rashid, Andreas Nikiforiadis, Giovanni Tesoriere, and Socrates Basbas</i>	
Estimation of Pedestrian Flows in Urban Context: A Comparison Between the Pre and Post Pandemic Period	484
<i>Mauro D'Apuzzo, Daniela Santilli, Azzurra Evangelisti, Vittorio Nicolosi, and Giuseppe Cappelli</i>	

An Analysis of the Integration of DRT Services with Local Public Transport in Post-pandemic Period: Some of the Preliminary Insights in the Italian Context.	496
<i>Tiziana Campisi, Antonino Canale, Giovanni Tesoriere, Nazam Ali, Matteo Ignaccolo, and Elena Cocuzza</i>	

International Workshop on Processes, Methods and Tools Towards Resilient Cities and Cultural Heritage Prone to SOD and ROD Disasters (RES 2022)

Resilience of Cultural Heritage in Extreme Weather Conditions: The Case of the UNESCO Villa Romana del Casale Archaeological Site’s Response to the Apollo Medicane in October 2021	511
<i>Fernanda Prestileo, Alessandra Mascitelli, Guido Meli, Marco Petracca, Claudio Giorgi, Davide Melfi, Silvia Puca, and Stefano Dietrich</i>	

Preliminary Results of the AEROMET Project on the Assimilation of the Rain-Rate from Satellite Observations	527
<i>Stefano Federico, Rosa Claudia Torcasio, Alessandra Mascitelli, Fabio Del Frate, and Stefano Dietrich</i>	

Finite Element Model for Wind Comfort Around a Tall Building: A Case Study of Tower of Qazaqstan	540
<i>Bakdauren Narbayev and Yerlan Amanbek</i>	

International Workshop on Scientific Computing Infrastructure (SCI 2022)

Parametric Identification of a Dynamical System with Switching.	557
<i>Anna Golovkina and Vladimir Kozynchenko</i>	

Impact of Reduced and Mixed-Precision on the Efficiency of a Multi-GPU Platform on CFD Applications	570
<i>Gabriel Freytag, João V. F. Lima, Paolo Rech, and Philippe O. A. Navaux</i>	

NoSql Database Optimization Based on Metadata About Queries and Relationships Between Objects	588
<i>Muon Ha, Yulia Shichkina, and Roza Fatkueva</i>	

Differential Privacy for Statistical Data of Educational Institutions	603
<i>Ivan Podsevalov, Alexei Podsevalov, and Vladimir Korkhov</i>	

A Systematic Literature Review on Numerical Weather Prediction Models and Provenance Data	616
<i>Alper Tufek and Mehmet S. Aktas</i>	

“Smart Habitat”: Features of Building It Infrastructure, Main Problems
of Building Data Networks Using 5G (6G) Technologies 628
*Alexander Bogdanov, Nadezhda Shchegoleva, Gennady Dik,
Valery Khvatov, and Aleksandr Dik*

L3NS: Large Scale Network Simulation for Testing Distributed
Applications 639
Daniil Malevanni, Oleg Iakushkin, and Vladimir Korkhov

Investigating Oil and Gas CSEM Application on Vector Architectures 650
Félix D. P. Michels, Lucas Mello Schnorr, and Philippe O. A. Navaux

Virtual Testbed: Computational Component of Wind Waves – Ship
Interaction 668
Alexander Degtyarev and Vasily Khramushin

New Technologies for Storing and Transferring Personal Data 680
*Nadezhda Shchegoleva, Natalia Zalutskaya, Alina Dambaeva,
Jasur Kiyamov, and Aleksandr Dik*

Use of Digital Twins and Digital Threads for Subway Infrastructure
Monitoring 693
*Alexander Vodyaho, Elena Stankova, Nataly Zhukova, Alexey Subbotin,
and Michael Chervontsev*

Author Index 709



Sustainable Urban Mobility Planning and Walkability in the Post Pandemic era. Assessing the Role of Urban Enclaves

Ginevra Balletto¹(✉), Mara Ladu¹, and Federico Camerin²

¹ Department of Civil, Environmental Engineering and Architecture, University of Cagliari,
09100 Cagliari, Italy

{balletto, mara.ladu}@unica.it

² Departamento de Urbanística y Ordenación Territorial (GIAU+S), University UVA
of Valladolid/University UPM of Madrid, Madrid, Spain

fcamerin@iuav.it

Abstract. The process of economic, social, and cultural development leads to relevant changes in urban areas. Urban transformations usually generate a series of public and private real estate compounds which constitute real obstacles to urban walkability. The growing attention towards the sustainable development goals established on a global scale introduced new contents in urban redevelopment policies, aimed at favoring higher levels of accessibility in the consolidated fabric, particularly that of the pedestrian type. In addition, the recent pandemic has recently reassessed the role of pedestrian mobility as a primary way of moving instead of using other means of transport. As a result, urban walkability has moved at the core of the sustainable city paradigm. More precisely, issues related to accessibility and walkability should be considered when addressing the obstacle generated by those sites that can be properly defined ‘urban enclaves’, especially when abandoned or under redevelopment. These conditions may encourage the gradual reopening of these areas for citizens. Within this framework, the Sustainable Urban Mobility Plan (SUMP) can represent a strategic tool for identifying the critical aspects to face for the creation of a new network of pedestrian routes aimed at improving urban walkability. The objective of this study is to define a set of principles and criteria, both tangible and intangible, for calculating the proximity index (PI). The PI may consequently drive urban regeneration projects also through the design of new paths for crossing the enclaves to improve urban permeability and, therefore, the level of walkability (This paper is the result of the joint work of the authors. In particular: Sect. 1 and 3 have been written by M. Ladu; Sect. 2 by F. Camerin; Sect. 4 and 5 by G. Balletto and M. Ladu.).

Keywords: Sustainable mobility · Walkability · Urban enclaves

1 Introduction

The current health crisis has made even more evident specific problems affecting contemporary urban areas. Various levels of government have addressed them to promote

sustainable development models. Environmental crisis and, more precisely, atmospheric pollution, stands out because it influences the health condition of people [1, 2], so it requires new urban planning paradigms based on the theories of the 15 min City [3] and the Proximity and Health City [4]. These solutions, in turn, bring the challenges related to walkability and accessibility back to the center of the recent urban debate.

Mobility plays a fundamental role in this context as it is the result of a complex phenomenon of economic and social interaction between various territorial-scaled activities and the transport system, which responds to a derived need. The latter is generated by the physical form and the organizational and functional structure of the territory.

Within this framework, if mobility represents the potential ability to travel, accessibility is the measure of this attitude and represents an interaction between people, goods and activities located in different places. Accessibility has historically been defined as the degree of ease with which an individual can reach a spatially distant place using a specific transport system [5]. It means that accessibility depends on four main factors:

- characteristics of the individual;
- distribution of activities on the territory;
- place of departure and arrival; and
- transport system that connects a specific area to the other located in the territory.

Until the 1990s, accessibility was linked to a dual concept that led to the recognition of the transport system as the main response to the demand for local mobility. From the 1990s, web technology and, in general, ICT systems, have led to major changes in the ways of relating and using activities located in the territories, transforming the consolidated dual paradigm (spatial proximity-physical mobility) into a tripolar system (spatial proximity-physical mobility-digital connection) [6]. The pandemic has then increased the value of digital connection systems in guaranteeing adequate accessibility to primary services and more. At the same time, the need to ensure inclusive, safe, healthy, and sustainable cities has brought attention back to open spaces and sustainable urban mobility, including slow and pedestrian mobility. The health crisis has indeed highlighted the need of individuals to move on foot to reach the main urban facilities



Fig. 1. The walkability as a transversal element of the tripolar system of accessibility (spatial proximity- physical mobility-digital connection). Author: Ladu M. (2022).

[7], making pedestrian mobility a transversal element of the tripolar system (spatial proximity-physical mobility-digital connection) (see Fig. 1).

Within this framework, the Urban Sustainable Mobility Plan (SUMP) may represent a stimulating planning tool for achieving the Proximity City, guaranteeing higher levels of pedestrian accessibility and, therefore, quality of urban life. The promotion of urban walkability, to achieve also by expanding bike and pedestrian paths to reduce vehicular traffic, contributes not only to decrease air pollution levels but also to responding to the need for healthier lifestyles. Despite this growing awareness, a significant obstacle to the realization of the urban walkability project is represented by the public or private real estate sites often unused [8]. Due to their size and architectural features, these areas represent impenetrable places, a sort of real enclave in the urban fabric.

Starting from these assumptions and the analysis of the potential role that the Urban Sustainable Mobility Plan (SUMP) plays to face the new challenges of the sustainable city in Italy, this paper proposes a methodology for calculating an index aimed at measuring the degree of transformability of urban enclaves. It is believed that the attribution of the degree of transformability can prove to be functional to the definition of urban planning strategies aimed at improving and increasing the existing pedestrian network.

After the first section (Introduction), the rest of the paper is organized as follows: second section: Literature review, dedicated to an in-depth study of the concept of urban enclaves, especially in reference to the case of the military settlements (Sects. 2); third section: Materials, where the opportunities of the Sustainable urban mobility plan and the most relevant aspects of a recent planning experience in Italy are discussed (Sects. 3); fourth section: Method, which focuses on a methodological proposal to improve urban walkability through the Proximity Index (PI) (Sects. 4); Results and Conclusions are drawn in the fifth section, where the main research results carried out are presented, together with the future developments of the study (Sects. 5).

2 Urban Enclaves. The Case of the Military Settlements

Enclave is a term derived from the French *eclaver*, i.e. “to close with a key”, and from the vulgar Latin *inclavare*, “to lock up”. It defines closed and sheltered spaces that can be possibly opened with an entrance from the outside to the inside and vice versa. Due to their condition and position, enclaves maintain a close relationship with their surrounding context. The notion of enclave, which is significantly reviewed by Aiello [9], is often applied to research on gated communities. In this field of study, enclaves are pretty much defined by the presence of “gates, walls, and guards” [10]. From a spatial planning point of view, this definition can be quite literally applied to a specific kind of enclave in urban environments, i.e. military settlements, which are large land-consuming spaces immured. Their relevant presence in the Italian cities relied on the need to provide accommodation and training areas for soldiers since the Italian Unification. The realization of these settlements followed specific architectural and urban schemes according to an international debate among military engineers [11]. The condition of enclosures was also characterized by their location at the border of the 19th-century Italian city centers and their condition of a large piece of land excluded from the real estate dynamics. These factors have strongly contributed to making them drivers of

urbanization patterns over decades. As a matter of fact, urban historians [12, 13] claimed that quartering usually overcame planning rationales due to national security needs and provided ad hoc enclosures that have been both physical and conceptual barriers that separate the military from civil society. It is in this sense that military settlements cannot be considered only topographical locations in the city, but the military interacts with the local population, even though the latter is usually forbidden to enter the military enclosure.

The end of the Cold War and the dissolution of the Soviet Union in 1991 was a pivotal event that implied strong geopolitical changes and territorial repercussions such as the Forced Army's reorganization and rationalization. As a result, thousands of military settlements have faced closure since the 1990s [14]. The conversion of former defense sites became a significant challenge in terms of urban regeneration that took decades to complete due to a variety of factors [15]. In particular, once abandoned, military enclosures may lose their meaning as immured spaces for fostering new mobility patterns. Behind the perimetral wall, the morphology of military sites is made up of precise layouts. Wide-open and green areas for circulation and training give military enclosures the potential value for developing new urban mobility planning schemes on the basis of slow-mobility routes. This, in turn, may improve urban permeability and thus the level of walkability. The same opportunities may be tied to other public-owned sites that, like military sites, show similar architectural and urban planning schemes that give them the status of proper "urban enclaves" (see Fig. 2 and 3).



Fig. 2. Abandoned “Tommaso Salsa” barracks as urban enclave, Treviso (IT). Source: photo by F. Camerin.



Fig. 3. Abandoned “Tommaso Salsa” barracks as urban enclave, Treviso (IT). The perimeter wall of the military site. Source: photo by F. Camerin.

The focus of this study is precisely on the appropriateness of the regeneration of such sites with the aim of providing useful tools to guide the proximity city project.

3 The Opportunities of the Sustainable Urban Mobility Plan

In Italy, the Sustainable Urban Mobility Plan (SUMP) is a strategic planning tool based on the principles of integration, participation, monitoring, and evaluation drafted to meet the demand of mobility for people and goods. The SUMP aims to ensure the right to mobility, without burdening, as far as possible, in terms of air and noise pollution, traffic and road accidents. It is a tool that contributes significantly to improving the quality of life and the environmental performance of urban areas in order to ensure a healthier urban system within an overall framework of sustainable economic and social development. In contemporary times, characterized by a return to the principles of the Walkable City, the SUMP can represent a strategic planning tool to support the realization of new scenarios of walkability.

The case of Modena stands out within recent experiences of sustainable urban mobility planning (see Fig. 4). Here was made an attempt to ensure the integration of the two forms of active urban mobility, i.e. walking and cycling. More precisely, the creation of a new network of pedestrian paths was highly integrated with the cycle paths' one. Another relevant aspect of this experience concerns the ability to recognize the strong interactions between mobility systems and urban development issues. The SUMP [16] was developed in full synergy with the local development plan (LDP) of the Municipality of Modena. This approach is at the base of the sustainable urban planning that tends to manage the demand for mobility, coordinate development policies, contain land consumption, and pursue urban quality.

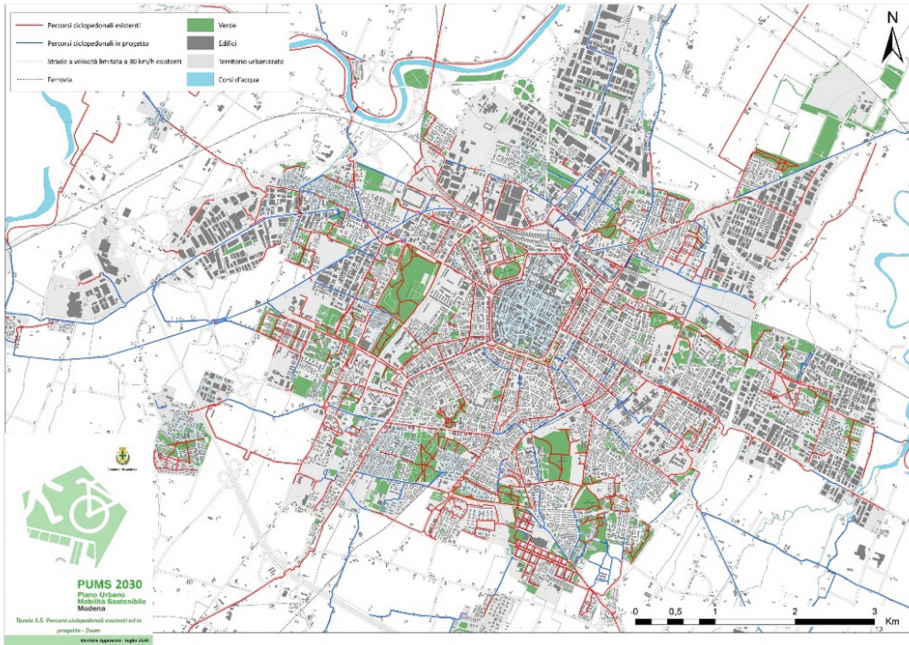


Fig. 4. Existing and planned pedestrian and cycle paths, SUMP, City of Modena (July, 2020). Source: <https://www.comune.modena.it/servizi/mobilita-e-trasporti/pums/documenti-pums>

Considering the obstacles generated by the urban enclaves in the development of a Walkable City, the authors argue that the SUMP should become a strategic tool to highlight and address these critical issues, especially regarding the positive externalities that the opening of pedestrian and/or cycle paths could generate in the urban environment. These types of interventions affect urban morphologies so may contribute to transform immured sites into opportunities for mobility [17]. The creation of new networks of pedestrian and/or cycle paths ensures higher levels of urban walkability, as well as proximity to urban facilities, in line with the 15-min city paradigm [18, 19].

4 A Methodological Proposal to Improve Urban Walkability: The Proximity Index (PI)

The need to guide design choices aimed at creating new pedestrian paths within the city led the authors to develop a methodology for calculating the proximity index [20]. It required the definition of a series of indicators to evaluate the positive externalities generated by the opening of a pedestrian and cycle path within an enclave.

The method used is based on the Deming Cycle framework [21] which allows a continuous monitoring process and result.

In particular, the method is divided into the following phases (see Fig. 5): i) Plan: phenomenon observation (survey and analysis of urban enclaves) and goal definition;

ii) Do: desk analysis and dataset evaluation to define a set of indicators and index construction (PI); iii) Check: comparison of the results (values of the PI associated with each enclave) and intervention priority assessment; iv) Act: promotion of urban regeneration policies (definition of a time schedule of interventions according to the priorities identified by the PI).

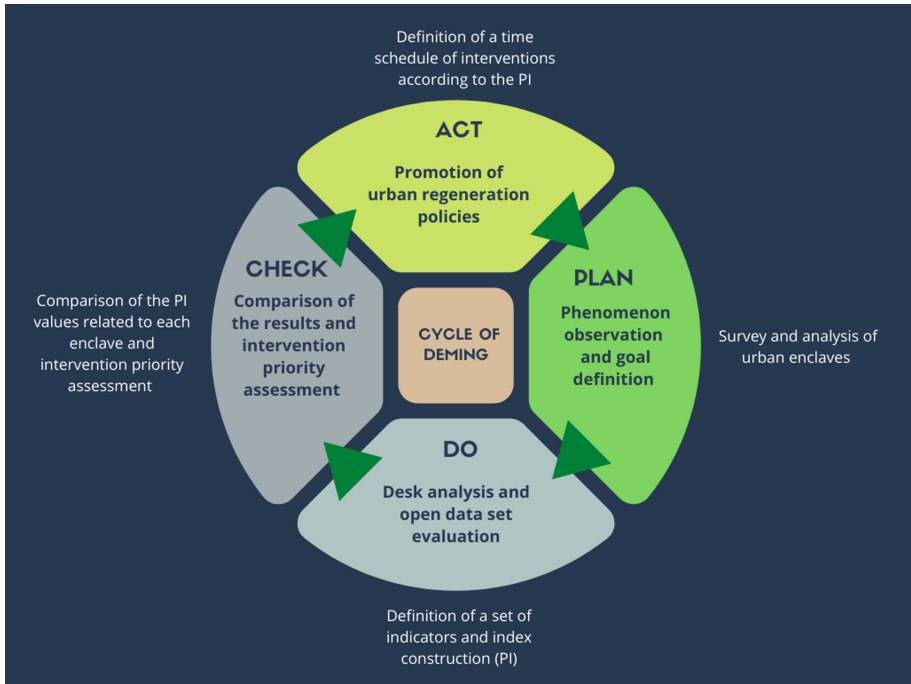


Fig. 5. Methodological framework based on the Deming Cycle. Authors: Balletto G., Ladu M. (2022).

The five indicators we are proposing are fundamental to represent the characteristics of a single building or public real estate complex (intrinsic characteristics), and those of its context (extrinsic characteristics):

- 1) Attractiveness indicator (A): this is given by the product between the number of functions located in the context and the weight (w_a) from 1 to 10, which increases as the variety of functions increases;
- 2) Uniqueness indicator (U_n): this is given by the product between the number of potentially feasible crossings in the enclave and the weight (w_{un}) from 1 to 10, which reaches the maximum value if there are no alternative crossings in the immediate vicinity and there is no possibility of make new ones;
- 3) Usability indicator (U_s): this is defined as the degree of difficulty in walking the crossing, determined by the physical characteristics of the space to be crossed,

- whether it is open or closed. It assumes a value between 1 and 10 (w_{us}), where 1 represents the maximum degree of difficulty and 10 the minimum degree of difficulty.
- 4) Satisfaction indicator (S): this is given by the product between the number of inhabitants who would benefit from the opening of the crossing in the neighborhood and the weight (w_s) from 1 to 10;
 - 5) Feasibility indicator (F): this is defined as the degree of technical and economic difficulty in making the crossing. It assumes a value between 1 and 10, where 1 represents the maximum degree of difficulty and 10 the minimum degree of difficulty (w_f).

The Proximity Index (PI) is given by the sum of these indicators, according to the following formula:

$$PI = \sum_{i=5}^n I_i/50 \quad (1)$$

where: $I_i = A, Un, Us, S, F$ for $i = 1, 2, 3, \dots, 5$ and, consequently, $0 \leq PI \leq 1$.

5 Results and Conclusions

The analysis of the indicators of attractiveness (A), uniqueness (Un), usability (Us), satisfaction (S), and feasibility (F), appropriately weighted, and the subsequent calculation of the Proximity Index (PI), provide an assessment of the degree of transformability of the urban enclaves in relation to the possibility of creating a network of pedestrian paths. More precisely, after selecting sites having the characteristics of “urban enclaves”, the PI assigns a different degree of priority of intervention to each of these parts of the city. It defines a hierarchy in terms of positive externalities that can be generated by the progressive opening of the immured sites for the construction of pedestrian and / or cycle paths. In this sense, the PI represents a useful tool to support the decision-making process in the implementation of urban regeneration projects aimed at pursuing the model of Proximity City.

Moreover, this index may stimulate the introduction of temporary and/or transitory interventions in urban governance. As a matter of fact, the indicator referring to the feasibility informs about the possibility of creating new pedestrian crossings in certain urban enclaves, even before defining an overall redevelopment scheme for the entire site. It is believed that such transitory interventions, aimed at promoting urban walkability, can increase the attractiveness of the property, give it a new identity, and facilitate the choice of new uses.

The present study recognizes the role of the SUMP as a strategic tool to integrate the issues concerning the regeneration of urban enclaves within the more complex framework of objectives to achieve through the sustainable urban mobility planning. In line with this renewed perspective, the SUMP could indicate the most critical enclaves and the related proximity indexes to guide the realization of a new network of pedestrian paths, in line with the provision of the local development plan.

The next steps of this study can be the following: choosing an urban setting for the application of the proposed methodology; tests on urban enclaves, also taking into

consideration the scenarios proposed by the planning tools in force, as the local plan and the Metropolitan Strategic Plan [22]; and defining a time schedule of interventions according to the priorities identified by the PI and the offer of local public transport (LPT).

Acknowledgments. The authors Balletto G. and Ladu M. took part in the following research activities: Strategic Plan of the Metropolitan City of Cagliari, commissioned to the Temporary Business Association (ATI), constituted by Lattanzio Advisory and Lattanzio Communication in 2019: Luigi Mundula (PI) University of Cagliari, “Investigating in the relationships between knowledge-building and design and decision-making in spatial planning with geodesign—CUP F74I19001040007—financed by Sardinia Foundation—Annuity 2018’”. Professor Michele Campagna (PI) University of Cagliari: Italian National Institute for Urban Planning (INU) and Jane’s Walk Festival. Balletto G.: City organizer for Cagliari, Cagliari Accessibility Lab, interdepartmental center of the University of Cagliari. This paper is part of the research carried out by Mara Ladu for the following research scholarships under the supervision of prof. Ginevra Balletto: “The role of the public real estate for the governance of the Metropolitan City of Cagliari” (n.13_2020); “Research and cataloguing of abandoned real estate assets within the Metropolitan City of Cagliari” (n.44_2020).

Federico Camerin has participated as co-author within the research project “La Regeneración Urbana como una nueva versión de los Programas de Renovación Urbana. Logros y fracasos”.

This project is co-funded by the Spanish Ministry of Universities in the framework of the Recovery, Transformation and Resilience Plan, by the European Union – NextGenerationEU and by the Universidad de Valladolid.

References

1. Murgante, B., et al.: Health hazard scenarios in Italy after the COVID-19 outbreak: A methodological proposal. *Scienze Regionali*, 1–27 (2021)
2. Murgante, B., et al.: A methodological proposal to evaluate the health hazard scenario from COVID-19 in Italy. *Environ. Res.* **209**, 112873 (2022)
3. Balletto, G., Pezzagno, M., Richiedei, A.: 15-minute city in urban regeneration perspective: Two methodological approaches compared to support decisions. In: Gervasi, O., et al. (eds.) ICCSA 2021. LNCS, vol. 12953, pp. 535–548. Springer, Cham (2021). https://doi.org/10.1007/978-3-030-86976-2_36
4. Ladu, M., Balletto, G., Borruso, G.: Sport and smart communities. Assessing the sporting attractiveness and community perceptions of Cagliari (Sardinia, Italy). In: Proceedings of the International Conference on Computational Science and Its Applications, pp. 200–215. Springer, Cham (2019, July)
5. Dalvi, M.Q., Martin, K.M.: The measurement of accessibility: Some preliminary results. *Transportation* **5**(1), 17–42 (1976)
6. Ladu, M., Milesi, A., Balletto, G., Borruso, G.: Urban enclaves and accessibility. The role of walkability in sustainable urban mobility planning. In: Proceedings of the En SUPTM 2022: 1st Conference on Future Challenges in Sustainable Urban Planning & Territorial Management, 17–19 Jan 2022. <https://repositorio.upct.es/handle/10317/10585> (2021)
7. Campisi, T., Ignaccolo, M., Inturri, G., Tesoriere, G., Torrisi, V.: Evaluation of walkability and mobility requirements of visually impaired people in urban spaces. *Res. Transp. Bus. Manag.* **40**, 100592 (2021)

8. Rusci, S.: *La città senza valore: Dall'urbanistica dell'espansione all'urbanistica della demolizione*. FrancoAngeli, Milan (2021)
9. Aiello, G.: From wound to enclave: The visual-material performance of urban renewal in bologna's manifattura delle arti. *West. J. Commun.* **75**(4), 341–366 (2011)
10. Low, S.M.: The edge and the center: Gated communities and the discourse of urban fear. *Am. Anthropol.* **103**(1), 45–58 (2001)
11. Turri, F., Zamperini, E.: The military engineers and hygiene in barracks in the second half of the 19th century. In: Carvais, R., et al. (eds.) *Nuts and Bolts of Construction History. Culture, Technology and Society*, vol. 3, pp. 309–316. Picard, Paris (2012)
12. Insolera, I.: Insediamenti militari e trasformazioni urbane. In: Antonelli, G., Grispo, R. (eds.) *Esercito e città. Dall'Unità agli anni Trenta*. Tomo II, pp. 663–676. Ministero per i beni culturali e ambientali, Rome (1989)
13. Savorra, M., Zucconi, G.: Spazi e cultura militare nella città dell'Ottocento. *Città e Storia* **4**(2). Croma, Rome (2009)
14. BICC: *Study on the Re-use of Former Military Lands*. Bonn International Center for Conversion, Germany (1997)
15. Touchton, M., Ashley, A.J.: *Salvaging Community. How American Cities Rebuild Closed Military Bases*. Cornell University Press
16. City of Modena. PUMS <https://www.comune.modena.it/servizi/mobilita-e-trasporti/pums/cose-il-pums>
17. Balletto, G., Ladu, M., Milesi, A., Borruso, G.: Methodological approach on disused public properties in the 15-minute city perspective. *Sustainability* **13**(2), 593 (2021)
18. Scorza, F., Fortunato, G., Carbone, R., Murgante, B., Pontrandolfi, P.: Increasing urban walkability through citizens' participation processes. *Sustainability*. **13**(11), 5835 (2021)
19. Meng, L.I.: The planning strategies of a 15-minute community life circle based on behaviors of residents. *Urban Plann. Forum* **1**, 111–118 (2017)
20. Balletto, G., Ladu, M., Milesi, A., Camerin, F., Borruso, G.: Walkable city and military enclaves: Analysis and decision-making approach to support the proximity connection in urban regeneration. *Sustainability* **14**(1), 457 (2022)
21. Walton, M.: *The deming management method: The bestselling classic for quality management!* Penguin (1988)
22. Palumbo, M.E., Mundula, L., Balletto, G., Bazzato, E., Marignani, M.: Environmental dimension into strategic planning. The case of metropolitan city of Cagliari. In: *Proceedings of the International Conference on Computational Science and Its Applications*, pp. 456–471. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-58820-5_34