

Gregor Rozinaj  
Radoslav Vargic (Eds.)

Communications in Computer and Information Science

1527

# Systems, Signals and Image Processing

28th International Conference, IWSSIP 2021  
Bratislava, Slovakia, June 2–4, 2021  
Revised Selected Papers

 Springer

 **IWSSIP 2021**  
BRATISLAVA, SLOVAKIA

Editorial Board Members

Joaquim Filipe 

*Polytechnic Institute of Setúbal, Setúbal, Portugal*

Ashish Ghosh

*Indian Statistical Institute, Kolkata, India*

Raquel Oliveira Prates 

*Federal University of Minas Gerais (UFMG), Belo Horizonte, Brazil*

Lizhu Zhou

*Tsinghua University, Beijing, China*

More information about this series at <https://link.springer.com/bookseries/7899>

Gregor Rozinaj · Radoslav Vargic (Eds.)

# Systems, Signals and Image Processing

28th International Conference, IWSSIP 2021  
Bratislava, Slovakia, June 2–4, 2021  
Revised Selected Papers

*Editors*

Gregor Rozinaj   
Slovak University of Technology in Bratislava  
Bratislava, Slovakia

Radoslav Vargic   
Slovak University of Technology in Bratislava  
Bratislava, Slovakia

ISSN 1865-0929 ISSN 1865-0937 (electronic)  
Communications in Computer and Information Science  
ISBN 978-3-030-96877-9 ISBN 978-3-030-96878-6 (eBook)  
<https://doi.org/10.1007/978-3-030-96878-6>

© Springer Nature Switzerland AG 2022

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

Signal processing is a phenomenon which is a principal tool for all applications based on computer technologies for an interaction with the real world. Data/signal retrieval, processing, and visualization comprise the general methodology in most scientific areas. From filter design, Fourier and other transforms, feature extraction, etc. through machine learning and system adaptation to user-oriented products like 5G networks, IoT, virtual teleoperation, or tele-surgery operations, this is a very brief resume of the power of signal processing. Advanced signal processing is therefore a very complex topic with deeply structuralized content.

The International Conference for Systems, Signal and Image Processing (IWSSIP) is a well-established event with traditional participation of people from all continents. In 2021, the 28th IWSSIP conference was organized by the Slovak University of Technology, Bratislava, Slovakia, following the previous successful IWSSIP 2020 event in Rio de Janeiro, Brazil, and past conferences in various countries.

We are proud of having outstanding invited speakers who significantly increased the scientific quality of this event. Touradj Ebrahimi from École Polytechnique Fédérale de Lausanne, Switzerland, presented the state of the art in image compression standards based on artificial intelligence. Gabriel Miro-Muntean from Dublin City University, Ireland, gave a deep introduction to “Delivering High Quality Rich Media Content in Current Network Environment: Challenges and Solutions”. Abir Hussain from Liverpool John Moores University, UK spoke about the “Detection and Localization of Objects Within Images Using Computer Vision and Machine Learning”. We are deeply thankful to all three speakers for their valuable time and invited lectures.

Due to special COVID-19 pandemic regulations the presentations of all three keynote speakers, as well as the whole conference, was organized in a strictly online format with the stress on full interaction among IWSSIP participants. The whole conference was powered by underline.io and we would like to express our gratitude for their professional help with organizing the online event.

Despite the fact that one of the main goals of scientific conferences is to gather researchers working in similar areas in one place, there was still huge interest in the online IWSSIP 2021 event. We received 76 paper proposals from authors in 17 countries. The best 20 papers were accepted and selected for this publication. These papers are closely related to advances in signal processing. The orientation of presented papers shows the huge diversity and complexity of advanced signal processing.

We would like to thank all participants of IWSSIP 2021, as well as everyone who helped to make this conference successful.

June 2021

Gregor Rozinaj  
Radoslav Vargic

# Organization

## Honorary Chairs

Branka Zovko-Cihlar	University of Zagreb, Croatia
Pavol Podhradský	Slovak University of Technology, Slovakia

## General Chair

Gregor Rozinaj	Slovak University of Technology, Slovakia
----------------	---

## Program Committee Chair

Radoslav Vargic	Slovak University of Technology, Slovakia
-----------------	---

## Steering Committee

Aura Conci	Universidade Federal Fluminense, Brazil
Mislav Grgić	University of Zagreb, Croatia
Sonja Grgić	University of Zagreb, Croatia
Fabiana Leta	Universidade Federal Fluminense, Brazil
Panos Liatsis	Khalifa University of Science and Technology, United Arab Emirates
Pavol Podhradsky	Slovak University of Technology, Slovakia
Snjezana Rimac-Drlje	University of Osijek, Croatia
Gregor Rozinaj	Slovak University of Technology, Slovakia
Markus Rupp	Technische Universität Wien, Austria
Radoslav Vargic	Slovak University of Technology, Slovakia
Branka Zovko-Cihlar	University of Zagreb, Croatia

## Program Committee

Narcis Behlilovic	University of Sarajevo, Bosnia and Hercegovina
Ángel Sánchez Calle	Universidad Rey Juan Carlos de Madrid, Spain
Aura Conci	Universidade Federal Fluminense, Brazil
Jan Cornelis	Vrije Universiteit Brussel, Belgium
Žarko Čučej	University of Maribor, Slovenia
Marek Domański	Poznań University of Technology, Poland
Touradj Ebrahimi	EPFL, Switzerland

Irena Galic	University of Osijek, Croatia
Dušan Gleich	University of Maribor, Slovenia
Mislav Grgić	University of Zagreb, Croatia
Sonja Grgić	University of Zagreb, Croatia
Yo-Sung Ho	Gwangju Institute of Science and Technology, South Korea
Ebroul Izquierdo	Queen Mary University of London, UK
Dimitrios Karras	National and Kapodistrian University of Athens, Greece
Erich Leitgeb	Graz University of Technology, Austria
Fabiana Leta	Universidade Federal Fluminense, Brazil
Panos Liatsis	Khalifa University of Science and Technology, United Arab Emirates
Rastislav Lukac	Intel Corporation, Canada
Galia Marinova	Technical University of Sofia, Bulgaria
Marta Mrak	Queen Mary University of London, UK
Peter Planinšič	University of Maribor, Slovenia
Pavol Podhradsky	Slovak University of Technology, Slovakia
Snježana Rimac-Drlje	University of Osijek, Croatia
Gregor Rozinaj	Slovak University of Technology, Slovakia
Markus Rupp	Technische Universität Wien, Austria
Ryszard Stasiński	Poznan University of Technology, Poland
Boris Šimak	Czech Technical University in Prague, Czech Republic
Rodica Tuduce	University Politehnica of Bucharest, Romania
Ján Turán	Technical University of Košice, Slovakia
Radoslav Vargic	Slovak University of Technology, Slovakia
Stamatis Voliotis	Technological Educational Institute of Chalkida, Greece
Krzysztof Wajda	AGH University of Science and Technology, Poland
Drago Zagar	University of Osijek, Croatia
Theodore Zahariadis	National and Kapodistrian University of Athens, Greece
Branka Zovko-Cihlar	University of Zagreb, Croatia

## **Additional Reviewers**

Abreu, Raphael	Bergo, Felipe
Aguilera, Cristhian A.	Bezerra, Eduardo
Araújo, José Denes	Bozek, Jelena
Aung, Zeyar	Bravenec, Tomas
Bergamasco, Leila	Bujok, Petr



Burget, Radim  
 Casaca, Wallace  
 Ciarelli, Patrick Marques  
 Copetti, Alessandro  
 Costa, Tales Fernandes  
 Čepko, Jozef  
 Davidková Antošová, Marcela  
 Devamane, Shridhar  
 Gonçalves, Vagner Mendonça  
 Habijan, Marija  
 Haddad, Diego Barreto  
 Henriques, Felipe  
 Hocenski, Zeljko  
 Hrad, Jaromír  
 Jakóbczak, Dariusz Jacek  
 Juhár, Jozef  
 Kačur, Juraj  
 Karwowski, Damian  
 Kominkova Oplatkova, Zuzana  
 Körting, Thales Sehn  
 Kos, Marko  
 Kultan, Matej  
 Laguna, Juana Martinez  
 Latkoski, Pero  
 Lima, Alan  
 Londák, Juraj  
 Lopes, Bruno  
 Lopes, Guilherme Wachs  
 Lourenço, Vítor  
 Malajner, Marko  
 Mandic, Lidija

Marana, Aparecido Nilceu  
 Marchevský, Stanislav  
 Markovska, Marija  
 Matos, Caio  
 Medvecký, Martin  
 Minárik, Ivan  
 Mocanu, Stefan  
 Mustra, Mario  
 Nyarko, Emmanuel Karlo  
 Paiva, Anselmo  
 Papa, Joao Paulo  
 Polak, Ladislav  
 Prinosil, Jiri  
 Rakús, Martin  
 Rodriguez, Denis Delisle  
 Rybárová, Renata  
 Silva, Aristófanés  
 Silvestre, Santiago  
 Slanina, Martin  
 Sousa De Almeida, Joao Dallyson  
 Sousa, Azael Melo E.  
 Tcheou, Michel  
 Toledo, Yanexis Pupo  
 Trúchly, Peter  
 Veras, Rodrigo  
 Vitas, Dijana  
 Vlaj, Damjan  
 Vukovic, Josip  
 Zamuda, Ales  
 Zeman, Tomas

## Organizing Committee

Zuzana Brunclíková, Slovakia  
 Lucia Hlinková, Slovakia  
 Juraj Kačur, Slovakia  
 Juraj Londák, Slovakia  
 Ivan Minárik, Slovakia  
 Pavol Podhradský, Slovakia  
 Šimon Tibenský, Slovakia  
 Marek Vančo, Slovakia  
 Radoslav Vargic, Slovakia

# Contents

## Advanced Signal Processing

Segmentation and Quantification of Bi-Ventricles and Myocardium Using 3D SERes-U-Net .....	3
<i>Marija Habijan, Irena Galić, Hrvoje Leventić, Krešimir Romić, and Danilo Babin</i>	
Fingerprint Classification Based on the Henry System via ResNet .....	15
<i>João W. Mendes de Souza, Aldisio G. Medeiros, Gabriel B. Holanda, Paulo A. L. Rego, and Pedro P. Rebouças Filho</i>	
Segmentation of Significant Regions in Retinal Images: Perspective of U-Net Network Through a Comparative Approach .....	29
<i>Matej Pirhala, Jozef Goga, Veronika Kurilova, Jarmila Pavlovicova, and Slavomir Kajan</i>	
Presenting a System to Aid on the Examination of Scintigraphy Bone Analysis Using DICOM Files .....	41
<i>José M. Carneiro da Silva, Fernando Fernandes, Heron Botelho, Cláudio T. Mesquita, and Aura Conci</i>	
Viewpoint Selection for Fibrous Structures in a Pre-operative Context: Application to Cranial Nerves Surrounding Skull Base Tumors .....	53
<i>Méghane Decroocq, Morgane Des Ligneris, Timothée Jacquesson, and Carole Frindel</i>	
Gait Recognition with DensePose Energy Images .....	65
<i>Philipp Schwarz, Josef Scharinger, and Philipp Hofer</i>	
Adaptive IIR Filtering for System Identification Applying the Method by Nelder and Mead .....	71
<i>Vassil Guliashki and Galia Marinova</i>	
Event-Based Looming Objects Detection .....	82
<i>Behnam Kamranian and Howard Cheng</i>	
Moment Transform-Based Compressive Sensing in Image Processing .....	96
<i>Theofanis Kalampokas and George A. Papakostas</i>	

Classification of Toxic Ornamental Plants for Domestic Animals Using CNN .....	108
<i>Sara S. Satake, Rodrigo Calvo, Alceu S. Britto Jr., and Yandre M. G. Costa</i>	
Deep Learning-Based Detection of Seedling Development from Indoor to Outdoor .....	121
<i>Hadhami Garbousse, Pejman Rasti, and David Rousseau</i>	
Banana Ripening Classification Using Computer Vision: Preliminary Results .....	132
<i>Matheus T. Araujo, Miguel W. de V. Santos, Flávio F. Feliciano, Pedro B. Costa, and Fabiana R. Leta</i>	
Energy Reconstruction Techniques in TileCal Under High Pile-Up Conditions .....	140
<i>Guilherme Inácio Gonçalves and on behalf of the ATLAS Tile Calorimeter Group</i>	
Fast Algorithm for Dyslexia Detection .....	152
<i>Boris Nerusil, Jaroslav Polec, and Juraj Skunda</i>	
Automatic Recognition of Native Advertisements for the Slovak Language .....	161
<i>Vanesa Andicsova, Zuzana Bukvcikova, Dominik Sopiak, and Milos Oravec</i>	
Document Filter for Writer Identification .....	172
<i>Fabio Pignelli, Luiz S. Oliveira, Alceu S. Britto Jr., Yandre M. G. Costa, and Diego Bertolini</i>	
An Approach for BCI Using Motor Imagery Based on Wavelet Transform and Convolutional Neural Network .....	185
<i>Lenka Rabčanová and Radoslav Vargic</i>	
Advanced Scene Sensing for Virtual Teleconference .....	198
<i>Ivan Minárik, Marek Vančo, and Gregor Rozinaj</i>	
Supervised Mixture Analysis and Source Detection from Multimodal Measurements .....	210
<i>Johan Lefevre, Saïd Moussaoui, Laurent Grosset, Anna Luiza Mendes Siqueira, and Franck Delayens</i>	
<b>Author Index</b> .....	223