

# Computer Systems and Technologies

22<sup>nd</sup> International Conference *CompSysTech'21*

Ruse, Bulgaria, June 2021

Proceedings

Tzvetomir Vassilev  
Roumen Trifonov (Eds.)



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**22<sup>nd</sup> International Conference, *CompSysTech'21***

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**Tzvetomir Vassilev  
Roumen Trifonov (Eds.)**

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## Volume Editors

Tzvetomir Vassilev  
Department of Informatics and IT  
University of Ruse  
8 Studentska St, Ruse, 7017 Bulgaria  
e-mail: [TVassilev@uni-ruse.bg](mailto:TVassilev@uni-ruse.bg)

Roumen Trifonov  
Department of IT in Industry  
Technical University of Sofia  
8 St Kliment Ohridski blvd, Sofia, Bulgaria  
e-mail: [R\\_Trifonov@tu-sofia.bg](mailto:R_Trifonov@tu-sofia.bg)



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*Papers included in these Proceedings were triple reviewed by independent referees.*

The International Conference on Computer Systems and Technologies - ***CompSysTech'21***, 18-19 June 2021, was held in a mixed mode (face-to-face and online) with a conference server at the University of Ruse, Bulgaria. This Conference is a well-known International event in Computing in Europe and the rest of the world.

## PREFACE

**CompSysTech'21** is the *Twenty second* International Computer Science and Technologies Conference, organized by the Bulgarian Academic Society of Computer Systems and Information Technologies and the Bulgarian Union of Automation & Informatics (UAI). This Conference is the first Bulgarian Conference in Computing.

Many thanks are due to all Programme Committee Members for the huge and very strong work again. Over 65 papers from 11 countries around the world were submitted to the PC. The experts in computing, from 25 countries, wrote more than 195 reviews.

The Conference topics include the following fields of the latest achievements in Computing:

- *Computer Hardware*
- *Network And Information Security*
- *Artificial Intelligence And Machine Learning*
- *Computer Software*
- *Image, Time Series And Signal Processing*
- *Application Aspects Of Computer Systems And Technologies*
- *Data Management And Information Retrieval*
- *Educational Aspects of Computer Systems and Technologies*

The **CompSysTech'21** PC Jury selected the best Papers for each session. The results are given below.

Over 80 participants from many countries around the world had the chance to get acquainted and exchange ideas on the topics concerned, as well as on some of the latest advancements in Computing.

Special thanks should be extended to the International Organizing Committee and to all sponsors of **CompSysTech'21**.

Many thanks are also due to the **CompSysTech'21** Proceedings Publisher - **ACM Inc.**, especially Scott E. Delman, Director of Publications, Azzedine Boukerche, ICPS Editor-in-Chief, and also Craig Rodkin, Publications Operations Manager, Barbara Ryan Rights & Permissions, Anna Lacson, Bibliographic Processing Coordinator, all from the Office of Publications, Office of Marketing and Membership for setting such a high success and their support to this event.

Finally, thanks are also due to the **CompSysTech'21** PC Secretary Pavel Zlatanov, **CompSysTech'21** Submission&Review System Administrator and SAI staff, especially Eugenia Dimitrova, who helped with the organization, and of course to all presenters, authors and participants who took the trouble to prepare papers for inclusion in these proceedings.

The **CompSysTech** Series of Conferences is most well-known activity of Bulgarian Academic Society of Computer Systems and Information Technologies, established 22 years ago.

**Tzvetomir Vassilev - Editor-in-Chief**  
**Roumen Trifonov - Editor**



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**WELCOME**

**RECTOR OF THE UNIVERSITY OF RUSE  
REPUBLIC OF BULGARIA**

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**Dear Guests, Dear Colleagues,**

Please, allow me on behalf of the academic community of the University of Ruse and on my behalf to WELCOME you to the 22-nd edition of the International research conference CompSysTech, which for known reasons this year is held in a mixed mode: face-to-face and online! But for the Academic Society of Computing this is not a problem at all, because you are the driving force of the digital transformation of education in the country.

We highly appreciate the efforts of the Academic Society of Computing to have an active scientific life and will support all your research contributions. I'd like to express special gratitude to the conference organizers.

We are glad that the CompSysTech conference is already well recognised and gets more popular in Bulgaria and Europe. The fact that today in this virtual hall there are scientists from several countries is an eloquent evidence for this. Another evidence for the attractive power and the level of the conference is the fact that for more than 13 years the CompSysTech papers have been published in the Digital Library of the Association for Computing Machinery, the most prestigious organization in the field of Computing, and are indexed by SCOPUS. The profile of the conference in Google Scholar is also very impressive.

The fact that the conference has an impact rank is also worth mentioning.

I wish all participants in the conference beneficial and successful work and may the conference achieve its aims!

**Prof. DSc. Hristo Beloev**  
**Rector of the University of Ruse**



# ORGANIZATION

The **CompSysTech'21** International conference is organized by **THE BULGARIAN ACADEMIC SOCIETY OF COMPUTING** and its OBJECTIVE is to intensify the information exchange of the results in theoretical research and practical developments in this field.

The *CompSysTech'21* is held under the patronage of:

- **Bulgarian Ministry of Education and Science.**
- **John Atanasoff Society of Automation and Informatics;**
- **University of Ruse**

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## AWARDED PAPERS

The *CompSysTech'21* best papers are:

### For Session Hardware & Network and Information Security:

- **Detection and Classification of Malicious Software based on Regional Matching of Temporal Graphs**  
*Helen Maria Dounavi, Anna Mpanti, Stavros D. Nikolopoulos and Iosif Polenakis*
- **Acoustic Event Detection and Sound Separation for security systems and IoT devices**  
*Alexander Iliev, Mayank Dewli, Muhsin Kalkan, Preeti Prakash Kudva and Rekha Turkar*

### For Session Artificial Intelligence and Machine Learning:

- **Rule Based System Against Reinforcement Learning**  
*Bozhan Orozov and Daniela Orozova*
- **Preliminary Study on Motion Planning with Obstacle Avoidance for Hard Constrained Redundant Robotic Manipulators**  
*Lyubomira Miteva, Kaloyan Yovchev and Ivan Chavdarov*

### For Session Computer Software, Image Processing & Visualization :

- **The effect of time drift in source code authorship attribution**  
*Juraj Petrik and Daniela Chuda*
- **Increasing quality in fingerprint images by Implementing wavelet transform based fusion technique**  
*Indrit Enesi, Betim Çiço and Miranda Harizaj*

### For Session Application Aspects of Computer Systems and Technologies:

- **Automatic analysis of ECG signals based on their fractal and multifractal properties**  
*Evgeniya Gospodinova, Penio Lebamovski and Mitko Gospodinov*
- **Analysis of the kinematic characteristics of a 3D printed finger of robotic humanoid hand**  
*Ivan Chavdarov, Ivaylo Georgiev, Lyubomira Miteva, Roumen Trifonov and Galya Pavlova*

### For Session Educational Aspects of Computer Systems and Technologies:

- **Programming-based laboratory assignments for undergraduate students of power engineering fields**  
*Serdar Nazarov and Bayram Jumayev*
- **Solving Classical Problem in New Context as Constructive Model of Training**  
*Milen Loukantchevsky*
- **Planning and Developing Courses in Distance Learning Environments: a training course for HiEdTec Project**  
*Joana Neto, Sílvia Nolan and António Mendes*
- **Exploring Learning Analytics on YouTube: a tool to support students' interactions analysis**  
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