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Special section

IMAGE ANALYSIS, CLASSIFICATION AND PROTECTION

Guest editors

Marcin NIEMIEC
Andrzej DZIECH
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University of Zielona Góra Press, Poland

Profile

About

The *International Journal of Applied Mathematics and Computer Science* is a quarterly published in Poland since 1991 by the University of Zielona Góra in partnership with De Gruyter Poland (Sciendo) and historically with Lubuskie Scientific Society, under the auspices of the Committee on Automatic Control and Robotics of the Polish Academy of Sciences. It strives to meet the demand for the presentation of interdisciplinary research in various fields related to control theory, applied mathematics, scientific computing, and computer science.

In particular, *AMCS* publishes original, high-quality full-length research papers in the following areas: *modern control theory and practice; artificial intelligence methods and their applications; applied mathematics and mathematical optimisation techniques; and mathematical methods in engineering, computer science and biology.*

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AIMS & SCOPE

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- modern control theory and practice
- artificial intelligence methods and their applications
- applied mathematics and mathematical optimisation techniques
- mathematical methods in engineering, computer science, and biology.

We are primarily interested in presenting theoretical and application-oriented full-length research papers dealing with the following topics:

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- classification and pattern recognition
- biomedical engineering and biomathematics
- applications in engineering and medicine.

The editors welcome proposals for exchange between similar journals. Also, all persons interested in bringing out special issues of *AMCS* are encouraged to contact the Editor-in-Chief. Such issues may be published on any important and timely subject within the scope of the journal. All papers proposed for specials should be refereed and meet the same criteria for scientific quality as articles presented in regular issues.

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PREFACE

Special section on

Image Analysis, Classification and Protection

The rapid development of machine learning for image classification and recognition results in their efficient application in many areas of human activity, such as healthcare and security. Also, protection of digital content is crucial for development of modern services and networks. In recent years, multimedia and cybersecurity have been contributing extensively to our life experience and are expected to be among the most important applications in the future. This special section is focused on recent advances in image analysis and processing to ensure efficiency and high level of data security.

The section presents five theoretical and experimental papers related to digital image analysis, especially machine learning techniques and convolutional neural networks for object detection and classification, multimedia applications, as well as data protection and cybersecurity challenges. The authors of the papers introduce novel algorithms, models and methods. It is worth mentioning that three papers are directly connected with the European project *ECHO* (*European Network of Cybersecurity Centers and Competence Hub for Innovation and Operations*). This EU H2020 project connects and shares knowledge across multiple domains to develop a common cybersecurity strategy for Europe.

The first paper, entitled *Efficient face detection based crowd density estimation using convolutional neural networks and an improved sliding window strategy*, proposes a new approach for face detection-based crowd estimation under significant occlusion and head posture variations. This solution for training various detectors is introduced to address the problem with detection of excessively occluded faces. A special data set is used to train and test the model. Detecting faces in crowded scenes cannot be handled using a single face detection method, thus a robust technique for counting visible faces in a crowd is proposed by combining different machine learning and convolutional neural network algorithms. The proposed solution is efficient and outperforms various state-of-the-art algorithms in detecting faces.

The problem of reliable face detection and recognition is also considered in the paper entitled *A genetic algorithm based optimized convolutional neural network for face recognition*. The authors focus on hyperparameter optimization of convolutional neural networks to increase model performance. A genetic algorithm is used for optimization of various hyperparameters like filter siz as wel as the number of filters of hidden layers. The experiments indicate that the proposed approach generates an improved model accuracy in comparison with other solutions. It is proven that the genetic algorithm is able to minimize the objective function by selecting the best combination set of a neural network's hyperparameters in each iteration.

The paper entitled *Infrared small-target detection under a complex background based on a local gradient contrast method* considers another problem of image processing—small target detection under a complex background and a low signal-to-noise ratio. The authors propose a local gradient contrast method to address this challenge. The optimal scale for each pixel can be obtained by calculating a multiscale salient map. Then, a subblock-based local gradient measure can be designed to construct the local gradient contrast method. An adaptive threshold is employed to extract the final detection result. The experiments confirm that the designed method can discard clutters and obtain superior results compared to other approaches.

Effective compression is an important requirement of multimedia data storage and transmission, especially regarding digital images. Therefore, the section includes the paper entitled *Lightweight compression with encryption based on asymmetric numeral systems*. This work discusses asymmetric numeral systems—an innovative approach to entropy coding which can be used for compression with lightweight encryption. This solution provides a compression ratio comparable with arithmetic coding at a speed similar to that of Huffman. However, coding tables of the asymmetric numeral system make it possible to simultaneously encrypt the compressed message without additional cost. The authors introduce this approach and analyze its security level to find trade-offs between security, cost and performance, especially for battery-powered devices with limited resources.

The paper entitled *Implications of the arithmetic ratio of prime numbers for RSA security* also concerns the problem of data confidentiality. The authors emphasize the importance of following strict rules related to key generation of encryption algorithms (sufficiently large length of the key, reliable generation of prime numbers, etc.). The popular

asymmetric cryptography algorithm (RSA cipher) is considered in detail. Firstly, the importance of the arithmetic ratio between the prime numbers which create the modular number of the RSA key is presented as a new approach. The question whether all necessary requirements regarding key generation rules applied up to now are sufficient is clarified. All this aims to ensure a high level of data confidentiality, also for multimedia images.

The editors hope that all readers of the papers published in this special section will find that the detailed and careful presentation of ideas, methods and results achieved by the authors broadens their knowledge. We would like to thank all the authors of submitted papers as well as the reviewers, who provided constructive comments and suggestions. We also wish to acknowledge the journal's Editor-in-Chief, Professor Józef Korbicz, for the acceptance of this special section, fruitful cooperation, and constant support during the entire publication process.

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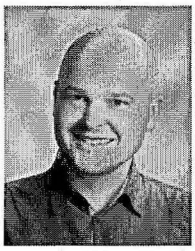
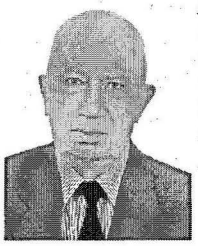
March 2023



Marcin Niemiec is a university professor at the Institute of Telecommunications, AGH University of Science and Technology, Kraków, Poland. His research interests focus on cybersecurity, especially security services, symmetric ciphers, network security, intrusion detection, and quantum cryptography. He has actively participated in the 6th and 7th FP European programs (*ePhoton/ONE+, BONE, SmoothIT, INDECT*), the Horizon 2020 Framework Programme (*SCISSOR, ECHO*), Eureka–Celtic (*DESYME*), and many national research projects. He has coauthored over 100 publications.



Andrzej Dziech is a full professor at the Institute of Telecommunications, AGH University of Science and Technology, Kraków, Poland. His fields of interest are related to digital communication, image and data processing, intelligent monitoring, security systems, information and coding theories, random signals, computer communications networks, and signal processing. He has worked at a number of foreign universities and has coauthored over 200 publications. He has been awarded gold medals for his innovative solutions at several international exhibitions (Brussels, Paris, Kraków). He has been the coordinator of many national as well as six international projects, including the FP7 integrated project *INDECT*.

Jakob Wassermann is a professor at the Audio Video Department of the University of Applied Sciences in Vienna and the head of the Austrian Section of FKTG (Film Kino Technischnische Gesellschaft), the leading organization and platform of TV broadcasters as well as audio and video research institutes in German speaking countries (Germany, Austria, Switzerland). His research fields include video and audio signal processing, compression, error correcting and watermarking technologies, especially related to applications in security areas.