

# PREFACE

## Special section on *Advanced Machine Learning Techniques in Data Analysis*

Machine learning (ML) addresses the task of exploring the capabilities of algorithms to automatically improve themselves on the basis of gained experience and data availability, and it is one of the most active and rapidly developing areas of artificial intelligence. Up to this date, an immense number of ML algorithms have been proposed. Naturally, this does not mean that there is no room for novel, useful solutions to be introduced. On the contrary, the impressive computing speed of present day computers allows various computationally demanding tasks to be solved relatively quickly. This, in turn, attracts scientists to develop and implement their new ML approaches.

This special section presents five research articles that focus on proposing and applying modern ML techniques and decision algorithms in various data analysis tasks. The authors target the issues of real medical data classification, group decision-making problems, optimization of a neural network structure in function approximation tasks, object identification and state detection.

In the article entitled *A hybrid two-stage SqueezeNet and support vector machine system for Parkinson's disease detection based on handwritten spiral patterns*, the authors analyze differences between the spiral trajectory handmade drawings made by Parkinson's disease patients and healthy subjects. Such analysis is conducted by creating a hybrid model composed of the SqueezeNet convolutional neural network for feature extraction and a support vector machine for pattern recognition. The efficiency of the proposed approach is compared with state-of-the-art models.

The article *New transitivity of Atanassov's intuitionistic fuzzy sets in a decision making model* introduces the new concepts of the transitivity problem of Atanassov's intuitionistic fuzzy relations in an epistemic aspect. A new optimistic and pessimistic transitivity among the preference of alternatives considered is proposed. This new transitivity and intuitionistic fuzzy negations, initiated in optimistic and pessimistic aspects, are then used together with the adequate aggregation functions for the decision-making model.

The authors of the article *A modified particle swarm optimisation procedure for triggering fuzzy flip-flop neural networks* investigate the application of the swarm intelligence-based algorithm in the configuration of the fuzzy flip-flop neural network. They analyze internal neural network parameters and how they can be adjusted by a particle swarm optimization (PSO) procedure. Some modifications of PSO are also introduced and utilized in the function approximation task performed by the neural network.

In the article *Forensic driver identification considering an unknown suspect*, the potential of using in-vehicle digital data to capture the natural driving behavior of individuals for their recognition is assessed. For this purpose, a forensic scenario of a hit and run car accident with a known and an unknown suspect being the actual driver during the accident is formulated. A workflow for driver identification is created, which allows formulating a one- and multi-class classification task.

The article entitled *An effective data reduction model for machine emergency states detection from big data tree topology structures* presents a system for detecting machine tool anomalies and emergency states through operation data processing. It incorporates a principal component analysis based effective data reduction solution and the technique for segmentation of operating machine data relying on dynamic time distortion and hierarchical clustering. In this way, various signal accident characteristics are computed and used in an effective and robust operating machine detection system.

As the guest editors of the section, we would like to take this opportunity to thank the authors for their work and effort while submitting papers to this special publication. We believe that the presented articles will be of great interest and will make valuable contributions to the development of future machine learning techniques in data analysis. We would also like to acknowledge all the anonymous referees for their time devoted to reviewing the submitted contributions. Finally, we would like to express our deep appreciation to Professor Józef Korbicz, the journal's Editor-in-Chief, for accepting this special section as well as for his cooperation, support and assistance.



**Maciej Kusy** received his MSc degree in electrical engineering from the Rzeszów University of Technology, Poland, in 2000, his PhD degree in biocybernetics and biomedical engineering from the Warsaw University of Technology, Poland, in 2008 and his DSc degree in information and communication technology from the Systems Research Institute, Polish Academy of Sciences, Warsaw, Poland, in 2019. He is an associate professor with the Faculty of Electrical and Computer Engineering, Rzeszów University of Technology. He is a member of the Polish Artificial Intelligence Society and the Polish Neural Networks Society. His current research interests include computational and artificial intelligence, machine learning, and data mining.



**Rafał Scherer** is a full professor at the Częstochowa University of Technology, Poland. His research focuses on developing new methods in neural networks, computer vision, computational intelligence and data mining, ensembling methods in machine learning, and content-based image indexing. He has authored more than 150 research papers and two books: on multiple classification techniques (2012) and *Computer Vision Methods for Fast Image Classification and Retrieval* (Springer, 2020). He annually co-organizes the International Conference on *Artificial Intelligence and Soft Computing* in Zakopane (<http://www.icaisc.eu/>), which is a major event on computational intelligence.



**Adam Krzyżak** received his MSc and PhD degrees in computer engineering in 1977 and 1980, respectively, both from the Wrocław University of Technology, Poland, and his DSc degree in signal processing in 1998 from the Warsaw University of Technology, Poland. He received the professorial title in 2003 from the President of the Republic of Poland. He is a full professor of computer science in the Department of Computer Science and Software Engineering, Concordia University, Montreal, Canada. He has published over 350 papers on neural networks, pattern recognition, machine learning, biomedical applications, image processing, computer vision, control and nonparametric estimation. He has been an associate editor of *IEEE Transactions on Neural Networks* and *IEEE Transactions on Information Theory*, and is presently an associate editor-in-chief of the *Pattern Recognition* journal. He is a co-author of the book *A Distribution-Free Theory of Nonparametric Regression* (Springer, 2002). He has served on program committees of many conferences, including the International Conference on *Pattern Recognition* and the International Joint Conference on *Neural Networks*. He is a Fellow of the IEEE and a Fellow of the IAPR.

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