

p-ISSN 1641-876X e-ISSN 2083-8492 QUARTERLY September 2021

applied mathematics and computer science



Indexation

About AMCS

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 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.

Indexing and abstracting

ACM Digital Library, Applied Mechanics Reviews, Clarivate Analytics (formerly Thomson Reuters), Current Mathematical Publications (AMS), DBLP Computer Science Bibliography, EBSCO, Elsevier, Google Scholar, Inspec, Mathematical Reviews (MathSciNet), Proquest, Zentralblatt MATH, and others.

Current journal metrics

JCR Journal Impact Factor: 1.417 (2020) JCR 5-Year Impact Factor: 1.475 (2020) SCImago Journal Rank: 0.416 (2020)

Source Normalized Impact per Paper: 1.375 (2020)

CiteScore: 3.0 (2020)

Polish ministerial points: 100 (2021)



Editor-in-Chief

Józef KORBICZ University of Zielona Góra, Poland

Deputy Editor

Dariusz UCIŃSKI University of Zielona Góra, Poland

Associate Editors

Jérôme CIESLAK University of Bordeaux, France Stefan DOMEK West Pomeranian University of Technology in Szczecin, Poland Marios M. POLYCARPOU University of Cyprus, Nicosia, Cyprus Vincenç PUIG
Technical University of Catalonia, Barcelona, Spain Silvio SIMANI University of Ferrara, Italy Jerzy STEFANOWSKI Poznań University of Technology, Poland **Guisheng ZHAI**

Board Members

Shibaura Institute of Technology, Tokyo, Japan

Harald ASCHEMANN University of Rostock, German Cherukuri ASWANI KUMAR VIT University, Vellore, India Czesław BAJER Polish Academy of Sciences, Warsaw, Poland Andrzej BARTOSZEWICZ Technical University of Łódź, Poland Miguel BERNAL Sonora Institute of Technology (ITSON), Obregón, Mexico Paolo CASTALDI University of Bologna, Italy Zhaohui CEN Qatar Environment and Energy Research Institute, Ar Rayyan, Qatar Julio CLEMPNER National Polytechnic Institute, Mexico City, Mexico **Bogusław CYGANEK** AGH University of Science and Technology, Cracow, Poland

Andrzej DZIELIŃSKI Warsaw University of Technology, Poland Anna FABIJAŃSKA Lodz University of Technology, Poland Marcin GORAWSKI Silesian University of Technology, Gliwice, Poland Martin GUGAT Friedrich-Alexander University of Erlangen-Nuremberg, Germany Xiao HE Tsinghua University, Beijing, China Janusz KACPRZYK Polish Academy of Sciences, Warsaw, Poland Jerzy KLAMKA Silesian University of Technology, Gliwice, Poland Jacek KLUSKA Rzeszów University of Technology, Poland Joanna KOŁODZIEJ Cracow University of Technology, Poland Jan M. KOŚCIELNY Warsaw University of Technology, Poland Zdzisław KOWALCZUK Gdańsk University of Technology, Poland Adam KRZYZAK Concordia University, Montreal, Canada Piotr KULCZYCKI AGH University of Science and Technology, Cracow, Poland Marek KURZYŃSKI Wrocław University of Technology, Poland Maciej KUSY Rzeszów University of Technology, Polana Francisco-Ronay LÓPEZ-ESTRADA Technological Institute of Tuxtla Gutiérrez, Mexico Maciej ŁAWRYŃCZUK Warsaw University of Technology, Poland Vyacheslav MAKSIMOV Russian Academy of Sciences, Ural Branch, Ekaterinburg, Russia Krzysztof MALINOWSKI Warsaw University of Technology, Poland Wojciech MITKOWSKI AGH University of Science and Technology, Cracow, Poland Gang NIU Tongji University, Shanghai, China Ronald J. PATTON University of Hull, UK Jimoh O. PEDRO University of the Witwatersrand, Johannesburg, South Africa Witold PEDRYCZ University of Alberta, Edmonton, Canada Piotr PORWIK University of Silesia in Katowice, Poland Jianbin QIU Harbin Institute of Technology, China

Ewaryst RAFAJŁOWICZ

Rotislav RAZUMCHIK

Wrocław University of Technology, Poland

Russian Academy of Sciences, Moscow, Russia

Leszek RUTKOWSKI Technical University of Częs chowa, Poland Andrey V. SAVCHENKO National Research University HSE, Nizhny Novgorod, Russia Piotr SKRZYPCZYŃSKI Poznań University of Technology, Poland Roman SŁOWIŃSKI Poznań University of Technology, Poland Florin STOICAN University POLITEHNICA of Bucharest, Romania Andrzej ŚWIERNIAK Silesian University of Technology, Gliwice, Poland Zoltán SZABÓ Hungarian Academy of Sciences, Budapest, Hungary Ryszard TADEUSIEWICZ AGH University of Science and Technology, Cracow, Poland Didier THEILLIOL University of Lorraine, Nancy, France Haoping WANG Nanjing University of Science and Technology, China Marcin WITCZAK University of Zielona Góra, Poland Baozhen YAO Dalian University of Technology, China Shen YIN Harbin Institute of Technology, China Alexey ZHIRABOK Far Eastern Federal University, Vladivostok, Russia Teresa ZIELIŃSKA Warsaw University of Technology, Poland Jacek M. ZURADA University of Louisville, USA

Editorial Office

University of Zielona Góra Institute of Control & Computation Engineering ul. prof. Z. Szafrana 2 65-516 Zielona Góra Poland

**** +48 683282506** ⊠ amcs@uz.zgora.pl www.amcs.uz.zgora.pl

Agnieszka ROŻEWSKA

Agata WIŚNIEWSKA-KUBICKA Technical Editor



International Journal of applied mathematics and computer science



AIMS & SCOPE

The International Journal of Applied Mathematics and Computer Science 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, it publishes high quality original research results in the following areas:

- · 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:

- control theory, including optimal control, system identification, adaptive and robust control, multivariable control, and non-linear systems
- dynamical systems, including spatiotemporal processes, control problems, state and parameter estimation, and sensor networks
- · fault detection and diagnosis, including model-based approaches, observers, and classifiers
- fault-tolerant control, including the control of continuous-variable and quantised systems
- · robotics, including modelling and simulation, mobile robots, and optimal trajectory planning
- mathematical modelling and simulation, including numerical algorithms
- optimisation, including mathematical optimisation techniques, global optimisation, and evolutionary algorithms
- · artificial intelligence, including machine and deep learning, neural networks, fuzzy systems, and search methods
- data mining, data and image processing, and big data
- · 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 referred and meet the same criteria for scientific quality as articles presented in regular issues.

AMCS is published in Poland by the University of Zielona Góra in partnership with De Gruyter Poland (Sciendo) and Lubuskie Scientific Society, under the auspices of the Committee on Automatic Control and Robotics of the Polish Academy of Sciences.

For more information, visit our website at www.amcs.uz.zgora.pl.



Ca 28307

CONTENTS

Matychyn, I. and Onyshchenko, V. Time-optimal control of linear fractional systems with variable coefficients	375
Bingi, K. and Prusty, B.R. Forecasting models for chaotic fractional-order oscillators using neural networks	387
Rauh, A. and Jaulin, L. A computationally inexpensive algorithm for determining outer and inner enclosures of nonlinear mappings of ellipsoidal domains	399
Xia, S., Yang, H. and Chen, L. An incomplete soft set and its application in MCDM problems with redundant and incomplete information	417
Kudłacik, P. Uncertainty in the conjunctive approach to fuzzy inference	431
Siminski, K. GrNFS: A granular neuro-fuzzy system for regression in large volume data	445
Zhang, M., Wan, X., Gang, L., Lv, X., Wu, Z. and Liu, Z. An automated driving strategy generating method based on WGAIL–DDPG	461
Tikhonenko, O., Ziółkowski, M. and Kempa, W.M. Queueing systems with random volume customers and a sectorized unlimited memory buffer	471
López-Lobato, A.L. and Avendaño-Garrido, M.L. Fitting a Gaussian mixture model through the Gini index	487
Kotan, M., Öz, C. and Kahraman, A. A linearization-based hybrid approach for 3D reconstruction of objects in a single image.	501
Oz, M.A.N., Kaymakci, O.T. and Mercimek, M. A nested autoencoder approach to automated defect inspection on textured surfaces	515
Šarčavić A. Vranić M. and Pintar D. A combinatorial approach in predicting the outcome of tennis matches	525