



# 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
- classification and pattern recognition
- artificial intelligence, including neural networks, knowledge engineering, reasoning and learning models, expert and decision support systems, fuzzy systems, and search methods
- mathematical biology
- 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.

*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.





#### 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 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.

#### Chief indexing and abstracting services

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.

Leszek RUTKOWSKI

Technical University of Czestochowa, Poland

#### Impact Factor

Journal IF: **0.967** (2019) 5-Year IF: **1.105** (2019)



Bogusław CYGANEK

#### Editor-in-Chief

Józef KORBICZ University of Zielona Góra, Poland

### **Deputy Editor**

Dariusz UCIŃSKI University of Zielona Góra, Poland

#### **Associate Editors**

Stefan DOMEK
West Pomeranian University of Technology in Szczecin, Poland
Miroslav FIKAR
Slovak University of Technology in Bratislava, Slovakia
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
Shibaura Institute of Technology, Tokyo, Japan

# **Board Members**

Harald ASCHEMANN
University of Rostock, Germany
Cherukuri ASWANI KUMAR
VIT University, Vellore, India
Czesław BAJER
Polish Academy of Sciences, Warsaw, Poland
Andrzej BARTOSZEWICZ
Technical University of Łódź, Poland
Marek BODNAR
University of Warsaw, Poland
Paolo CASTALDI
University of Bologna, Italy
Zhaohui CEN
Qatar Environment and Energy Research Institute, Ar Rayyan, Qatar
Jérôme CIESLAK
University of Bordeaux, France
Julio CLEMPNER

National Polytechnic Institute, Mexico City, Mexico

AGH University of Science and Technology, Cracow, Poland Andrzej DZIELIŃSKI Warsaw University of Technology, Poland Anna FABIJAŃSKA Marcin GORAWSKI Silesian University of Technology, Gliwice, Poland Martin GUGAT Friedrich-Alexander University of Erlangen—Nuremberg, Germany Xiao HE Tsinghua University, Beijing, China Bin JIANG Nanjing University of Aeronautics and Astronautics, 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 Piotr KULCZYCKI AGH University of Science and Technology, Cracow, Poland Marek KURZYŃSKI Wrocław University of Technology, Poland Maciej KUSY Rzeszów University of Technology, Poland Francisco-Ronay LÓPEZ-ESTRADA Technological Instituté 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

AGH University of Science and Technology, Cracow, Poland

Wojciech MITKOWSKI

Tongji University, Shanghai, China Ronald J. PATTON

University of Alberta, Edmonton, Canada

University of Silesia in Katowice, Poland

Ewaryst RAFAJŁOWICZ Wrocław University of Technology, Poland

Russian Academy of Sciences, Moscow, Russia

Harbin Institute of Technology, China

Rotislav RAZUMCHIK

University of Hull, UK
Witold PEDRYCZ

Piotr PORWIK

Jianbin QIU

Gang NIU

Andrey V. SAVCHENKO
National Research University HSE, Nizhny Novgorod, Russia Horst SCHULTE HTW Berlin, Germany Piotr SKRZYPCZYŃSKI Poznań University of Technology, Poland Roman SŁOWIŃSKI Poznań University of Technology, Poland Florin STOICAN University POLITEHNICA of Bucharest, Romania Andrzéj ŚWIERNIÁK Silesian University of Technology, Gliwice, Poland Zoltán SZABÓ Hungarian Academy of Sciences, Budapest, Hungary Rvszard 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 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

#### **Editorial Office**

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

Agnieszka ROŻEWSKA Manager

Agata WIŚNIEWSKA-KUBICKA Technical Editor



# Requirements in brief

Our basic rules include electronic paper submission and processing, the LaTeX format following a special AMCS style, a license to publish, and a publication charge.

#### Paper submission

Paper proposals may be submitted only through our on-line submission system. If suitable for our journal, the papers will be subject to a full review procedure, and a decision on whether or not to accept the paper will be made based on the reviewers' comments.

#### Paper style

The style of papers to be published in AMCS is determined by a special LaTeX class, which is described in detail in our instructions for authors. No other formats are accepted.

#### License to publish

Authors must sign a license to publish upon paper acceptance. The license governs in detail the commercial and non-commercial use of papers published by our journal, and determines user and author rights.

#### Publication charge

Authors are expected to pay page charges, which cover the costs of the publishing process and will be processed following paper acceptance.

#### **Provisions**

One sample copy of the journal and the electronic version of the paper are provided for authors once the issue has been published.

# Details, submission and downloads

The complete guide for authors can be found on our website at www.amcs.uz.zgora.pl.

# Present your research with us!



Our subscription is annual and covers four printed issues.

#### 2021 Rates

#### Domestic

Individuals & scientific institutions: 180 PLN Other customers: 480 PLN

Foreign

Individuals: 120 EUR Institutions: 200 EUR

Prices exclusive of VAT. Postage free for standard delivery.

#### Payment methods

We accept bank transfers and off-line credit card payments.

#### **Orders**

Please contact the Editorial Office for subscription orders.



#### Recent special issues and sections

2019, Vol. 29, No. 4: Special section

C. Solis et al.

2020, Vol. 30, No. 3: Special section BIG DATA AND SIGNAL PROCESSING Editors: Joanna KOŁODZIEJ, Sabri PLLANA, Salvatore VITABILE Authors: Y. Wang et al., S. Franchini et al., J. Chen et al. K.A. Ciecierski, A. Plichta

NEW PERSPECTIVES IN NONLINEAR AND INTELLIGENT CONTROL (In Honor of Alexander P. Kurdyukov))

Editors: Julio B. CLEMPNER, Enso IKONEN, Alexander P. KURDYUKOV Authors: I. Selek and E. Ikonen, W. Khaksar et al., J.P. Flores-Flores and R. Martinez-Guerra, A.P. Kurdyukov and V.A. Boichenko, E. Estrada et al., C. Aguilar-Ibanez and M.S. Suarez-Castanon,

2019, Vol. 29, No. 3: Special section INFORMATION TECHNOLOGY FOR SYSTEMS RESEARCH Editors: Piotr KULCZYCKI, Janusz KACPRZYK, László T. KÓCZY, Radko MESIAR Authors: K. Kulinowski et al., D. Kołaczek et al., I.Á. Harmati and

Authors: K. Kulinowski et al., D. Kołaczek et al., I.A. Harmati and L.T. Kóczy, S. Łukasik et al., Y.V. Bodyanskiy and O.K. Tyshchenko, E. Rakovská and M. Hudec, M. Wielgosz and A. Skoczeń

2019, Vol. 29, No. 2: Special section ADVANCES IN COMPLEX CLOUD AND SERVICE ORIENTED COMPUTING *Editors*: Anna KOBUSIŃSKA, Ching-Hsien HSU, Kwei-Jay LIN *Authors*: B.-J. Chang *et al.*, V. Podolskiy *et al.*, J.-J. Chou *et al.*, Y. Ngoko *et al.* 

# **CONTENTS**

Chaturantabut S. Stabilized model reduction for nonlinear dynamical systems through a contractivity-preserving framework	615
Apaza-Perez W.A., Combastel C. and Zolghadri A. On distributed symbolic control of interconnected systems under persistency specifications	629
<b>Kaczorek T. and Sajewski Ł.</b> Pointwise completeness and pointwise degeneracy of fractional standard and descriptor linear continuous-time systems with different fractional orders	641
Grzymkowski Ł., Trofimowicz D. and Stefański T.P. Stability analysis of interconnected discrete-time fractional-order LTI state-space systems	649
Uciński D. Construction of constrained experimental designs on finite spaces for a modified $E_k$ -optimality criterion	659
Zuev A., Zhirabok A. and Filaretov V. Fault identification in underwater vehicle thrusters via sliding mode observers	679
Altuntas V., Gok M. and Kocal O.H. Response of Lyapunov exponents to diffusion state of biological networks	689
<b>Kłopotek R., Kłopotek M. and Wierzchoń S.</b> A feasible <i>k</i> -means kernel trick under non-Euclidean feature space	703
Horzyk A., Bulanda D. and Starzyk J.A. ASA-graphs for efficient data representation and processing	717
Wiśniewska J., Sawerwain M. and Obuchowicz A. Basic quantum circuits for classification and approximation tasks	733
Barkalov A., Titarenko L. and Mielcarek K. Improving characteristics of LUT-based Mealy FSMs	745
Mihelač L. and Povh J. AI based algorithms for the detection of (ir)regularity in musical structure	761