

p-ISSN 1641-876X e-ISSN 2083-8492 QUARTERLY December 2022

# applied mathematics and computer science

Special section

BIG DATA AND ARTIFICIAL INTELLIGENCE FOR COOPERATIVE VEHICLE-INFRASTRUCTURE SYSTEMS

**Guest editors** 

Baozhen YAO Shuaian (Hans) WANG Sobhan (Sean) ASIAN





## Indexation

#### 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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#### Indexing and abstracting

ACM Digital Library, Applied Mechanics Reviews, Clarivate (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: 2.157 (2021) JCR 5-Year Impact Factor: 1.794 (2021) SCImago Journal Rank: 0.552 (2021)

Source Normalized Impact per Paper: 0.981 (2021)

CiteScore: 3.7 (2021)

Polish ministerial points: 100 (2021)



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# International Journal of applied mathematics and computer science

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#### 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
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- · 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 historically with 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.

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#### **PREFACE**

#### Special section on

Big Data and Artificial Intelligence for Cooperative Vehicle-Infrastructure Systems

Cooperative vehicle-infrastructure systems (CVISs) strive to incorporate advanced sensor, edge computing and communication technologies into vehicles and road infrastructures. Recently, technological innovations of intelligent transportation systems have been flourishing CVISs. The generated big data have been applied to almost all aspects of CVISs, which can provide new perspectives and insight for researchers. It is important and promising to explore the application of big data driven and AI based analysis in transportation systems analysis, modeling and understanding.

This special section presents five papers related to recent advances in the analysis, modeling, and application merits of AI transportation systems. The authors focus on new aspects, algorithms and concepts related to the application of cooperative vehicle-infrastructure systems. Their papers include novel techniques, algorithms, and theoretical results oriented towards the modeling and analysis of intelligent transportation systems, including intelligent control, vehicle-to-vehicle communication and system simulation.

The paper entitled A coordinated optimization of rewarded users and employees in relocating station-based shared electric vehicles designs a shared electric vehicle (SEV) relocating optimization model based on a reward mechanism to solve the mismatch between shared SEV supply and demand in space and time. The aim of the model is to achieve a cost-minimized rebalancing of the SEV system. Users are guided to attend the relocating SEV by a reward mechanism, and employees can continuously relocate multiple SEVs before returning to the supply site. The optimization model is solved by a Shuffled Complex Evolution (SCE–UA) based heuristic column generation algorithm. The presented technique is supported by experimental research based on the implementation of the system in a real-life environment.

The paper entitled A container ship traffic model for simulation studies develops a container ship traffic model for port simulation studies to collect accurate information about the ship stream to build test scenarios and benchmark instances. A statistical model of ship traffic is developed on the basis of container ship arrivals in eight world ports. The model provides three parameters of the arriving ships: ship size, arrival time and service time. The stream of ships is divided into classes according to vessel sizes. For each class, service time distributions and mixtures of return time distributions are provided. A model of aperiodic arrivals is also proposed. The achieved results are essential for terminal design analyses and testing performance of optimization algorithms.

The paper entitled A hybrid control strategy for a dynamic scheduling problem in transit networks discusses the dynamic scheduling problem in the transit network to guarantee service reliability of transit networks. A two-layer control method is developed to minimize the total travel time of passengers in the transit network. Based on conventional strategies, the hybrid control strategy considers making full use of idle standby buses at the depot. Deep reinforcement learning (DRL) is adopted to solve the problem of continuous decision-making. The numerical results imply that the hybrid control strategy could reduce the average headway of bus fleet and improve the reliability of bus service.

The paper entitled Analytical performance analysis of the M2M wireless link with an antenna selection system over interference limited dissimilar composite fading environments considers direct mobile-to-mobile (M2M) communications with a dual antenna selection (AS) system at a destination mobile node (DMN) in interference limited, dissimilar composite fading environments. The dissimilar interference limited signals are modeled at the inputs of a dual branch AS system as (i) the ratio of two Nakagami-m (N) random variables (RVs) at the first branch and (ii) the ratio of two Rice RVs at the second branch, in order to account for non line-of-sight (NLOS) and line-of-sight (LOS) communications. The derived statistical results are presented graphically and evaluated for all statistical measures considered.

The paper entitled *Vision-based positioning of electric buses for assisted docking to charging stations* presents a novel approach to vision-based localization for assisted electric buses docking to a charging station. The method employs a monocular camera system for positioning upon carefully selected point features detected on the charging station. While the pose is estimated using a geometric method, the detection of keypoints themselves and the initial recognition of the charging station are accomplished using learned neural network models. Extensive experiments are presented in the paper and the results show that the proposed method offers the best performance with respect to the estimated translation and rotation of the bus with a low-cost hardware setup and minimal passive markers on the charging station.

Concluding, we would like to thank all the authors who submitted their papers to our special section. We highly appreciate the contribution of the reviewers with their constructive comments and suggestions. We also wish to acknowledge the journal's Editor-in-Chief, Professor Józef Korbicz, for his acceptance of this special section, as well as his cooperation, support and assistance throughout the publication process.

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December 2022

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