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# HYBRID METHODS OF MODELING AND OPTIMIZATION IN COMPLEX SYSTEMS

Selected, peer-reviewed papers from  
International Workshop “Hybrid methods of modeling and optimization in complex  
systems” (HMMOCS 2022), 22-24 November 2022, Krasnoyarsk, Russia

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HYBRID METHODS OF MODELING AND OPTIMIZATION IN COMPLEX SYSTEMS



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# Preface

The volume contains the proceedings of the International Workshop “Hybrid methods of modeling and optimization in complex systems” – HMMOCS-2022, held on 22-24 November 2022 in Krasnoyarsk, Russian Federation.

The purpose of the workshop was to share the original results in mathematical modeling for software- and hardware applications in various fields.

The event offered a platform for bringing together postdocs, innovative academics and scientists to exchange their ideas and contribute new innovative approaches to modeling and optimization in complex systems.

The workshop provided the premier interdisciplinary and multidisciplinary forum for researchers, practitioners and educators to present and discuss the most recent innovations, trends, concerns, practical challenges and the solutions in the fields of mathematical modeling, mathematical logic, applications of the data analysis methods, machine learning models, application of fuzzy logic, developing algorithms for economics and industrial applications, virtual robotics, cognitive modeling, nonlinear optimization, data clustering, artificial neural network architecture, adaptive computing technologies, automatic grouping of metadata etc.

Although the schedule of the workshop was very tight, there were very vivid discussions among the participants.

The program of the workshop consisted of keynote and plenary talks, presentations of the participants. The Plenary Talks and Keynote Speeches were held in Krasnoyarsk. The parallel sessions took place online.

The thematic sections of the workshop were devoted to:

- Mathematical models and their applications
- Mathematical modelling techniques
- Optimization techniques, incl. multi-criterion optimization and decision making support
- Hybrid methods of mathematical modelling and optimization in complex systems
- Data mining and knowledge discovery
- Machine learning
- Pattern recognition
- Learning in evolutionary algorithms
- Genetic programming
- Artificial neural networks
- Computational intelligence and its applications
- Bio-inspired and swarm intelligence
- Text/Web/Data mining
- Human-Computer Interaction
- Natural language processing
- Applications in engineering, natural sciences, social sciences, computer science, etc.

The international scope of the workshop was confirmed by the participation of representatives from 7 countries besides Russia (Spain, Serbia, China, Uzbekistan, Belorussia, Greece, Germany). Russian Federation

was presented by the participants from all over the country including Chechen Republic, the Republic of Khakassia, Moscow, Krasnoyarsk, Stavropol, Samara, St. Petersburg, Zheleznogorsk, etc.

Scholars from more than 30 universities and scientific organizations took part in the workshop. During three days of the workshop more than 50 reports were presented at the plenary sessions, parallel sessions by the authors. Each author was given 10-15 minutes to present the report and answer questions. More than 20 reports were presented in the form of video, poster- and e-presentations. The best presentations are available at the website of the workshop (<https://conf.domnit.ru/en/materialy/hmmocs-2022/>).

All papers came through the basic review which included an initial technical criterion check (paper field, structure of submission, adherence to the submission instructions, English language usage and a check for the similarity rate). Any papers out of the scope or containing plagiarism, including self-plagiarism, were rejected. The organization committee used a double anonymous system for peer review; the reviewers' identities remained anonymous. The submitted papers were reviewed by at least two external reviewers. The third reviewer was involved in case the reviewers had had doubts about the content of the papers or the authors had not agreed with the review result. The review process took from 5 to 10 days as a rule. The reviews were conducted to the professional and scientific standards. The Antiplagiat software program was used for plagiarism detection. The decision to accept or reject the paper was based on the suggestions of reviewers. Acceptance/rejecting notifications were sent to the corresponding author(s).

Workshop submission was carried out through the workshop management system developed by the Organizer. It is easy to use, and has features to make it suitable for simultaneous conference or workshop calls. More than 20,500 registration forms have been already processed by the system which showed its stability and flexibility. The management system is integrated with the workshop website of the Organizer which helps the Organizer to cope with the complexity of the submission, reviewing, refereeing and accepting processes. The current version supports management of the access of reviewers and editors to papers; automatic registration and paper submission; list of the current, forthcoming and held conferences and workshops with all necessary information; list of all conference and workshops materials with online presentations and/or video reports of participants, list of published proceedings with direct links to publications and journals; sending emails to programme committee members, reviewers and authors; preparation and publishing of conference and workshop programmes; all authors submitting the papers are assumed to accept the terms of Publication Licence and send to the Organizer signed Copyright Form and Conflict of Interest Disclaimer; all requirements for papers, templates and sample papers are accessible for the authors.

There were 95 applications received, 88 submissions were sent for review, 50 papers were accepted, so the acceptance rate was 52 per cent. A total of 32 reviewers were involved into the process of revision. The external reviewers were invited from the Russian and International Union of Scientific and Engineering Associations, Russian Academy of Sciences, Siberian Federal University (Russia), Reshetnev Siberian State University of Science and Technology (Russia), Voronezh State Technical University (Russia), Bukhara and Namangan Engineering Technological Universities (Uzbekistan), University of Niš (Serbia), University of Cadiz (Spain), National and Kapodistrian University of Athens (Greece).

The Checklist for the reviewers included the following criteria: relevance to the scope of the conference topics, the scientific quality, assessing the errors, organisation of the paper, the title, the references, the level of the English language, the quality of the figures and tables, etc. The reviewers could give the following

recommendation: to publish the paper as it is, to publish it after mandatory/optional minor/major revision, to reject the paper.

Special thanks are given to all the reviewers, the members of the Programme Committee. We would also like to thank Prof. Maxim Rumyantsev, rector of the Siberian Federal University for collaboration and all those who contributed to every process to improve the quality of this issue and to provide reviewing process, efficient reports and discussions during the workshop.

The workshop was funded by the Ministry of Science and Higher Education of the Russian Federation, Grant No. 075-15-2022-1121.

23 December, 2022

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Yury Kochetov, Dr. Sc., Professor  
Sobolev Institute of Mathematics, Novosibirsk, Russia

### **Prediction of Heavy-Tailed Random Functions**

Evgeny Spodarev, Dr. Sc., Professor  
Institute of Stochastics, Ulm University, Ulm, Germany

### **Neural Dynamics Based Learning and Control of Robots**

Long Jin, Dr. Sc., Professor  
School of Information Science and Engineering, Lanzhou University, Lanzhou, China

## Plenary Speakers

### **Towards New Equivalence Modelling for Fuzzy Automata**

Stefan Stanimirovic, Dr. Sc., Professor  
Faculty of Sciences and Mathematics, University of Nis, Nis, Serbia

### **Determination of Homogeneous Batches of Anodes Based on Hybrid Optimization Models**

Lev Kazakovtsev, Dr. Sc., Professor  
Reshetnev Siberian State University of Science and Technology, Krasnoyarsk, Russia

### **OLAP Concept as a Basis for Business for Analysis of Multidimensional Data Structures**

Alena Stupina, Dr. Sc., Professor,  
Siberian Federal University, Krasnoyarsk, Russian Federation

### **Determination of Homogeneous Batches of Anodes Based on Hybrid Optimization Models**

Ivan Rozhnov, PhD, Associate Professor,  
Reshetnev Siberian State University of Science and Technology, Krasnoyarsk, Russia

## Workshops

### **The Eleventh International Workshop on Mathematical Models and their Applications**

Eugene S. Semenin, Dr. Sc., Professor,  
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Reshetnev Siberian State University of Science and Technology, Krasnoyarsk, Russian Federation

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