Preface
III International Workshop “Hybrid methods of modeling and optimization in complex systems” (HMMOCS-III 2024)

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Abstract. The preface provides an overview of the III International Workshop "Hybrid Methods of Modeling and Optimization in Complex Systems" (HMMOCS-III 2024), held from December 2-4, 2024, in Krasnoyarsk, Russian Federation. The workshop brought together international experts to discuss advanced topics in mathematical modeling, optimization, and complex systems. The proceedings contain 50 selected papers reflecting the latest advancements in hybrid methods and interdisciplinary approaches to modeling and optimizing complex systems.

The volume contains the proceedings of the III International Workshop “Hybrid methods of modeling and optimization in complex systems” – HMMOCS-III 2024 held on 2-4 December 2024 in Krasnoyarsk, Russian Federation.

The primary organizers of the workshop were Siberian Federal University and the Krasnoyarsk Science and Technology City Hall, while the other institutions served as partners and co-organizers. These included the University of Niš in Serbia, Birla Institute of Technology and Science (BITS) Pilani in India, the Innovation Scientific Consulting Center in Uzbekistan. This diverse group of international academic and scientific institutions collaborated to bring together expertise and resources for the workshop, fostering global cooperation in the field of study.

The workshop covered mathematical modeling techniques, optimization methods including multi-criterion optimization and decision support, hybrid approaches for complex systems, data mining, knowledge discovery, and machine learning. The scope extended to pattern recognition, evolutionary algorithms, genetic programming, artificial neural

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networks, and computational intelligence. Bio-inspired and swarm intelligence, text and web mining, human-computer interaction, and natural language processing were also discussed.

The HMMOCS-III 2024 workshop featured a comprehensive plenary session held on December 2, 2024, which seamlessly integrated both in-person and online meetings. The session commenced with participant registration, followed by a warm welcome from the organizers. The highlight of the day was the series of plenary reports, showcasing presentations from distinguished international speakers.

Predrag Stanimirović from the University of Niš, Serbia, delivered an insightful talk on continuous time recurrent neural networks. Spyridon Mourtas from the National and Kapodistrian University of Athens, Greece, presented his research on credit approval classification using a bio-inspired WASD neuronet. Artem Stupin, affiliated with both the Birla Institute of Technology and Science in India and Siberian Federal University in Russia, discussed the optimization of traffic light phases at adjacent intersections. Kachhwaha Neetu from the University of Rajasthan, India, explored innovative educational techniques, focusing on the potential of edutainment and gamification. Alexander Blinnikov from Krasnoyarsk State Agrarian University, Russia, presented on the application of a generative adversarial U-Net network with Attention mechanism in hardware-software complexes for digital image post-processing. The session also included presentations from various researchers affiliated with Siberian Federal University and other institutions. These talks covered a wide range of topics, including nearest neighbor search, artificial intelligence in industry, computer vision and machine learning methods, personalization of adaptive learning methodologies, clustering of RNA genes, blockchain technology for data protection, and evaluation of complex systems' effectiveness. The plenary session concluded with closing remarks and a summary of the seminar's outcomes, providing attendees with a comprehensive overview of cutting-edge research in hybrid methods of modeling and optimization in complex systems. Poster presentations and sections were organized for the participants on 3 and 4 December 2024.

The participants of the Workshop presented universities from Serbia, Greece, Bangladesh, India, China, Uzbekistan, Kazakhstan, Kyrgyzstan and such regions of the Russian Federation as Krasnoyarsk, Moscow, St. Petersburg, Kaliningrad, Grozny, Makhachkala, Nalchik, etc.

The thematic sections of the workshop covered a wide range of topics, including mathematical models and their applications, mathematical modeling techniques, optimization techniques (including multi-criterion optimization and decision-making support), hybrid methods of mathematical modeling 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, and various applications in engineering, natural sciences, social sciences, computer science, and other fields.

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 second 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 iThenticate 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).

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).

There were 140 applications received, 130 submissions were sent for review, 50 best papers were accepted. The Volume presents scientific papers in 5 main sections:

- Advances in Hybrid Modeling and Optimization Techniques;
- Applications of AI and Complex Systems in Various Domains;
- Interdisciplinary Mathematical Modeling and Applications;
- Data Mining, Machine Learning and Pattern Recognition;
- Adaptive Intelligence: Exploring Learning in Evolutionary Algorithms and Neural Networks.

The proceedings of the III International Workshop on Hybrid Methods of Modeling and Optimization in Complex Systems (HMMOCS-III 2024) cover a wide range of cutting-edge research topics, organized into several key sections.

The volume opens with advances in hybrid modeling and optimization techniques, showcasing innovative approaches that combine multiple methodologies to tackle complex systems. This section includes papers on novel algorithms, computational methods, and theoretical frameworks for optimizing intricate processes across various domains.

Applications of AI and complex systems in various domains form another significant portion of the proceedings. These papers explore how artificial intelligence and complex systems theory are being applied to real-world problems in fields such as engineering, healthcare, finance, and environmental science.

Interdisciplinary mathematical modeling and applications constitute the section highlighting the cross-pollination of ideas between different scientific disciplines. This part of the volume features studies that leverage mathematical models to solve problems at the intersection of multiple fields, demonstrating the power of interdisciplinary approaches.

The data mining, machine learning, and pattern recognition section containes papers on advanced techniques for extracting knowledge from large datasets, developing sophisticated machine learning models, and identifying patterns in complex data structures. These studies are relevant in the era of big data and artificial intelligence.

Lastly, the section on adaptive intelligence explores learning in evolutionary algorithms and neural networks. This section presents papers on self-improving AI systems, novel neural network architectures, and evolutionary computation techniques that can adapt to changing environments or problem spaces.

Overall, the volume reflects the workshop's focus on hybrid methods and interdisciplinary approaches to modeling and optimizing complex systems, demonstrating the latest advancements in these rapidly developing fields.

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