



Aleksandr I. Panov

Curriculum Vitae

Educational Background

- 2011–2015 **Ph.D. in Theoretical Bases of Computer Science**, *Institute for Systems Analysis*, Moscow, Russia.
Specialized in modeling of goal-oriented behavior of intelligent agents and their coalitions. Thesis title: “Investigation of methods, development of models and algorithms for formation of elements of sign-based worldview of the actor”.
- 2009–2011 **Master of Applied Mathematics and Physics**, *Moscow Institute of Physics and Technology*, Department of Applied Mathematics and Management, Moscow, Russia.
Majors: technologies of active databases, computer graphics, game theory and decision making, effective algorithms, decomposition in optimization. Specialized in logical methods (AQ, JSM) of data mining and multi-agent systems. Thesis title: “Investigation and modeling of group behavior for multifunctional agents”.
- 2005–2009 **Bachelor of Physics**, *Novosibirsk State University*, Department of Physics, Novosibirsk, Russia.
Majors: operational systems, digital integrated circuits, introduction to CAD, microprocessors, information networks and systems, object-oriented analysis and design. Specialized in semantic integration of databases. Thesis title: “Semantic integration of biological databases”.

Teaching Experience

- 2011–Present **Head of AI Master Program**, *Moscow Institute of Physics and Technology*, Phystech School of Applied Mathematics and Informatics, Moscow, Russia.
Seminars on Basis of Operation Systems and Basis of Object-Oriented Programming, Lectures on Introduction in AI and Reinforcement Learning
- 2015–2019 **Associate Professor**, *National Research University Higher School of Economics*, Faculty of Computer Science, Moscow, Russia.
Seminar on Intelligent Data Mining
- 2011–2016 **Assistant Lecturer**, *Peoples' Friendship University of Russia*, Department of Computer Science, Moscow, Russia.
Lectures on Intelligent Dynamic Systems, Theoretical Computer Science and Intelligent Data Analysis

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Research Experience

2021– present **Head of laboratory**, ARTIFICIAL INTELLIGENCE RESEARCH INSTITUTE, Cognitive AI Systems Laboratory, Moscow, Russia.

Leading non-profit organization in the field of Artificial Intelligence – www.airi.net.

- Cognitive robotics:
 - PlanFormer: pretrained multimodal architecture .
 - LLM-based planners for mobile robots and manipulators.
- Reinforcement learning in multi-agent systems:
 - Switching algorithms of planning-based and learning-based multi-agent path finding methods.
 - Monte-Carlo approach in multi-agent systems.
- Neural-symbolic integration:
 - Disentangled representations and object-oriented world models.
 - Vector symbolic architectures in VQA and robot navigation setting.

2018– present **Director**, MOSCOW INSTITUTE OF PHYSICS AND TECHNOLOGY, Center for Cognitive Modeling, Moscow, Russia.

Leading University in Russia in Physics and Computer Science – <http://cogmodel.mipt.ru>.

- Applied research in self-driving cars and mobile robotics:
 - New framework for behavior planning of self-driven cars based on Apollo-auto.
 - Original methods of neural-based object segmentation, detection, tracking for mobile robots.
- Reinforcement learning:
 - Hierarchical reinforcement learning and learning from demonstrations.
 - Learning-based methods for visual navigation in indoor scenes.
- Neuromorphic computing:
 - Architecture of the hierarchical intrinsically motivated agent (HIMA).
 - Improved variants of hierarchical temporal memory.

2010–Present **Head of Laboratory**, FEDERAL RESEARCH CENTER “COMPUTER SCIENCE AND CONTROL” OF RUSSIAN ACADEMY OF SCIENCES, Institute for Artificial Intelligence Research, Moscow, Russia.

Leading academic institute in Computer Science and High-performance computing – www.frccsc.ru.

- Reinforcement learning:
 - Object-centric world models for reinforcement learning.
 - Model-based reinforcement learning with heuristic planning.
- Cognitive modeling:
 - Psychologically inspired models of human behavior based on theory of sign-based world model.
 - Biologically inspired models of sign components: image, significance and personal meaning.
 - Algorithms of behavior planning and goal setting procedures.
- Machine learning and multi-agent systems:
 - The composite logical method to extract cause-effect relationships.
 - Algorithms of planning and role distribution in coalition of cognitive agents.
- Cognitive Robotics:
 - Multi-layer control system for coalition of cognitive robots.

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2015–2018 **Research Fellow**, NATIONAL RESEARCH UNIVERSITY HIGHER SCHOOL OF ECONOMICS, Laboratory of Process-Aware Information Systems (PAIS Lab), Moscow, Russia.

Leading University in Russia in Economics and Computer Science - www.hse.ru.

- Investigation of learning mechanisms based on sign representations in the problem of collective behavior planning.

Research Grants

As a head

2020–2025 **Grant for young head of scientific group**, *Russian Science Foundation (RSF)*. Reinforcement learning using network vector-symbolic representations in the task of smart navigation of cognitive agents.

2018–2020 **Grant for postdocs**, *Russian Science Foundation (RSF)*. Hierarchical reinforcement learning in the task of acquiring conceptual procedural knowledge by cognitive agents.

2016–2019 **Grant for postdocs**, *Russian Foundation for Basic Research (RFBR)*. Investigation of learning mechanisms based on sign representations in the problem of collective behavior planning.

2016–2018 **Grant for postdocs**, *Russian Foundation for Basic Research (RFBR)*. Investigation of learning mechanisms based on sign representations in the problem of collective behavior planning.

2016–2018 **Oriented basic research**, *Russian Foundation for Basic Research (RFBR)*. Development of new methods for knowledge base construction, search and adaptation of cases for scientific-technical solutions and technologies using their text descriptions based on semantic networks.

As a senior researcher

2017–2020 **Grant in priority thematic research areas**, *Russian Foundation for Basic Research (RFBR)*, research adviser: Nataliya Chudova.
Network approach for construction of sign based world model and sign realization of cognitive functions.

2016–2018 **Grant in priority thematic research areas**, *Russian Science Foundation (RSF)*, research adviser: Prof. Gennady S. Osipov.
Creation of theory, methods and models for distributed control of behavior of cognitive robotic systems and their coalitions in nondeterministic environment.

2015–2017 **Individual grant**, *Russian Foundation for Basic Research (RFBR)*, research adviser: Prof. Gennady S. Osipov.
Neurophysiological and psychological foundations of sign models of the world and cognitive functions.

Research Interests

- Reinforcement Learning
- Cognitive Robotics
- LLM-based agents
- Behavior planning
- Multi-agent systems

Committees and Councils

- 2019–Present Member of the Editorial Board of the *Cognitive Systems Research*, www.sciencedirect.com/journal/cognitive-systems-research
- 2022–Present Member of the Association for the Advancement of Artificial Intelligence: AAAI, www.aaai.org
- 2020–Present Member of Institute of Electrical and Electronics Engineers, Russian Section: IEEE, www.ieee.org
- 2016–Present Executive Chair of the Organizing Committee of several international conferences and schools: BICA (school.bicasociety.org), RAAI, RAAI School
- 2016–2019 Member of the Editorial Board of the *Biologically Inspired Cognitive Architectures*: BICA Journal, www.journals.elsevier.com/biologically-inspired-cognitive-architectures
- 2016–2019 Member of The Biologically Inspired Cognitive Architectures Society: BICA Society, bicasociety.org
- 2015–2022 Member of Scientific Board of the Russian Association for Artificial Intelligence: RAAI, www.raai.org

Selected Recent Publications

- [1] Brian Angulo, Aleksandr Panov, and Konstantin Yakovlev. "Policy Optimization to Learn Adaptive Motion Primitives in Path Planning With Dynamic Obstacles". In: *IEEE Robotics and Automation Letters* 8.2 (2023), pp. 824–831.
- [2] Daniil Kirilenko, Anton Andreychuk, Aleksandr Panov, and Konstantin Yakovlev. "TransPath: Learning Heuristics For Grid-Based Pathfinding via Transformers". In: *Proceedings of the AAAI Conference on Artificial Intelligence*. AAAI 2023. Vol. 37. 2023, pp. 12436–12443. arXiv: 2212.11730.
- [3] Julia Kiseleva et al. "Interactive Grounded Language Understanding in a Collaborative Environment: Retrospective on IGLU 2022 Competition". In: *Proceedings of the NeurIPS 2022 Competitions Track, PMLR* 220 (2023), pp. 204–216.
- [4] Alexey Skrynnik, Anton Andreychuk, Konstantin Yakovlev, and Aleksandr Panov. "When to Switch: Planning and Learning For Partially Observable Multi-Agent Pathfinding". In: *IEEE Transactions on Neural Networks and Learning Systems* (2023).
- [5] Aleksei Staroverov, Andrey S Gorodetsky, Andrei S Krishtopik, Dmitry A Yudin, Alexey K Kovalev, and Aleksandr I Panov. "Fine-tuning Multimodal Transformer Models for Generating Actions in Virtual and Real Environments". In: *IEEE Access* 11 (2023), pp. 130548–130559.
- [6] Aleksei Staroverov, Kirill Muravyev, Konstantin Yakovlev, and Aleksandr I Panov. "Skill Fusion in Hybrid Robotic Framework for Visual Object Goal Navigation". In: *Robotics* 12 (2023).
- [7] Muhammad Alhaddad, Konstantin Mironov, Aleksey Staroverov, and Aleksandr Panov. "Neural Potential Field for Obstacle-Aware Local Motion Planning". In: *2024 IEEE International Conference on Robotics and Automation (ICRA)*. ICRA 2024. Yokohama, Japan: IEEE, 2024, pp. 9313–9320.
- [8] Andrey Gorodetskiy, Konstantin Mironov, and Aleksandr Panov. "Model-based Policy Optimization using Symbolic World Model". In: *IROS 2024*. IROS 2024. 2024.

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- [9] Mais Jamal and Aleksandr Panov. "FFStreams: Fast Search with Streams for Autonomous Maneuver Planning". In: *IEEE Robotics and Automation Letters* 9.7 (2024), pp. 6752–6759.
- [10] Daniil Kirilenko, Vitaliy Vorobyov, Alexey Kovalev, and Aleksandr Panov. "Object-Centric Learning with Slot Mixture Module". In: *The Twelfth International Conference on Learning Representations*. ICLR 2024. 2024.
- [11] Alexey Skrynnik, Anton Andreychuk, Maria Nesterova, Konstantin Yakovlev, and Aleksandr Panov. "Learn to Follow: Decentralized Lifelong Multi-Agent Pathfinding via Planning and Learning". In: *Proceedings of the AAAI Conference on Artificial Intelligence*. AAAI 2024. Vol. 38. 2024, pp. 17541–17549.
- [12] Alexey Skrynnik, Anton Andreychuk, Konstantin Yakovlev, and Aleksandr Panov. "Decentralized Monte Carlo Tree Search for Partially Observable Multi-agent Pathfinding". In: *Proceedings of the AAAI Conference on Artificial Intelligence*. AAAI 2024. Vol. 38. 2024, pp. 17531–17540.
- [13] Zoya Volovikova, Alexey Skrynnik, Petr Kuderov, and Aleksandr I Panov. "Instruction Following with Goal-Conditioned Reinforcement Learning in Virtual Environments". In: *ECAI 2024*. ECAI 2024. 2024.
- [14] Tatiana Zemskova, Aleksei Staroverov, Kirill Murav'yev, Dmitry Yudin, and Aleksandr Panov. "Interactive Semantic Map Representation for Skill-Based Visual Object Navigation". In: *IEEE Access* 12 (2024), pp. 44628–44639.

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