

Faculty of **Computer** science



UNIVERSITY

International Laboratory of Algebraic Topology and its Applications



https://cs.hse.ru/en/ata-lab/about

Staff*

- Leading researcher Mikiya Masuda, Ph.D. (Japan)
- Head Anton Ayzenberg, Ph.D. (Cand.sc. in geometry and topology)
- Vice head Vsevolod Chernyshev, Ph.D. (Cand.sc. in geometry and topology)
- 3 principal researchers (Doctors of Sciences)
- 4 researchers (Candidates of Sciences)
- 17 research interns (8 Ph.D. students, 5 master students, 4 bachelor students)
- Manager Anastasia Kamyshanova.

Research map



Our expertise: theoretical math

- General topics in algebraic topology: homotopy theory, cobordism theory.
- Torus actions on manifolds.
- Combinatorics of simplicial complexes and related commutative algebra.
- Homology theory, sheaves over finite partially ordered sets.
- Manifolds of isospectral matrices.
- Discrete geometry: graphs, polytopes, simplicial complexes.
- Random graphs and hypergraphs.
- Integral points in polytopes.
- Differential geometry: dynamical systems on manifolds, Morse theory, Laplacian eigenvalues.
- Low-dimensional manifolds and orbifolds.





Our expertise: algorithms

- Applied linear algebra: PCA, diagonalization algorithms, etc.
- Applied topology: persistent homology, zigzag persistence, relative persistence, Vietoris-Rips filtration, witness filtration, alpha-filtration.
- Low-dimensional geometrical algorithms: Delaunay triangulation, minimal Euclidean spanning tree.
- Nonlinear dimension reduction algorithms: UMAP, Mapper.
- Simplicial data representation and simplification: strong collapses, edge collapses, core extraction.
- Neural networks is a necessary toolbox: CNN's, (variational) autoencoders, etc.

Our projects

- Torus actions of complexity one and topology of isospectral matrix spaces (2018-2020) Russian Science Foundation grant.
- Topology, geometry and brain study (2020) Russian Government grant.
- Topology, geometry and combinatorics in applications (2021) Russian Government grant.
- Topology, geometry and combinatorics of manifolds with group actions (2020-2022) Russian Science Foundation grant.
- Development of methods for the analysis of time systems with discrete events (2020-2022), Russian Foundation for Basic Research grant.
- Industrial project on topological applications (2020-2021), details subject to NDA.

Our events

- Weekly seminar of the laboratory, <u>https://cs.hse.ru/ata-lab/seminars</u>
- Autumn Online School "Applications of Topology and Geometry 2020", <u>https://cs.hse.ru/ata-lab/tga/</u> (~300 registered participants)
- International Online Conference "Topology and Geometry of Group Actions", 2020, <u>https://cs.hse.ru/ata-lab/tgga/</u> (~40 talks)
- [Planned] International Conference "Topology of torus actions and related topics", Oct 24 30, 2021, Sirius Mathematical Center, Sochi, Russia.
- [Planned] Autumn School "Toric topology and combinatorics", Oct 31 Nov 6, 2021, Sirius Mathematical Center, Sochi, Russia.

Contacts

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