

Alexey Frolov

Curriculum Vitae

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DOB: February 19, 1987



Research Interests

Information Theory, Wireless Communications, Multiple-Access Techniques, Machine Learning, Distributed Computing

Academic Degrees

- 2021 **D.Sc. in Mathematics** from Moscow Institute of Physics and Technology (MIPT), Moscow, Russia
Thesis: Design and analysis of codes with locality property | 05.13.17 – Theoretical Foundations of Informatics
- 2012 **Ph.D. in Mathematics** from Institute for Information Transmission Problems (IITP), Russian Academy of Sciences, Moscow, Russia
Thesis: Error-correcting capabilities of non-binary low-density parity-check codes | supervisor: Prof. V. Zyablov, 05.13.17 – Theoretical Foundations of Informatics
- 2010 **M.Sc. in Computer Science** from Bauman Moscow State Technical University (BMSTU), Moscow, Russia

Awards and Achievements

- 2020 **Communication Theory Symposium Best Paper Award** (joint with Dr. A. Munari, DLR) IEEE Global Communications Conference (GLOBECOM)
- 2016 **Russian Government Award in Science and Technology for Young Scientists**
Research and development of protocols for prospective wireless networks
- 2013 **Moscow Government Award for Young Scientists**
Development of multiple access techniques, which increase reliability of multimedia data delivery in real time

Professional Experience

- 2019–present **Associate Professor**, Skoltech, CDISE, Moscow, Russia
- 2018–present **Head of Research Group**, Skoltech, Center of Excellence of the National Technology Initiative “Wireless Technologies and Internet of Things”, Moscow, Russia.
- 2017–2019 **Assistant Professor**, Skoltech, CDISE, Moscow, Russia
- 2016–2017 **Senior Research Scientist**, Skoltech, CDISE, Moscow, Russia
- 2013–2016 **Senior Research Scientist**, IITP RAS, Moscow, Russia
- 2013–2014 **Scientific Consultant**, Huawei Technologies, R&D center, Moscow, Russia
- 2012–2013 **Research Scientist**, IITP RAS, Moscow, Russia
- 2008–2012 **Junior Research Scientist**, IITP RAS, Moscow, Russia

Grants

- 2021–2022 **Russian Science Foundation**, Prolongation, “18-19-00673 – Development of random multiple access methods for massive machine type communications”, PI
- 2018–2020 **Russian Science Foundation**, Competition for individual scientific groups carrying out fundamental and exploratory research, “18-19-00673 – Development of random multiple access methods for massive machine type communications”, PI
- 2020–2021 **Russian Foundation for Basic Research**, Scientific Mentoring, “19-37-51036 – Information-theory based analysis of deep neural networks”, PI
- 2018–2019 **Russian Foundation for Basic Research**, Expansion, “19-17-50094 – An information-theoretic approach for reliable distributed storage systems”, PI
- 2018–2019 **Russian Foundation for Basic Research**, My first grant, “18-37-00459 – Investigation of Coding Techniques for High-Loaded Distributed and Cloud Storage Systems”, PI
- 2017–2019 **Skoltech-MIT Next Generation Program**, “Theoretical fundamentals of random multiple-access channels with applications to massive machine-type communications and digital fingerprinting”, co-PI (joint with G. Kabatiansky and Y. Polyanskiy)

Industrial projects

- 2019–2022 **Huawei**, Skoltech-Huawei Innovation Lab, director
- 2021–2023 **Huawei**, “Massive machine type communications with a massive MIMO receiver”, PI
- 2021–2022 **Huawei**, “Math and AI methods to process mobile user data with full compliance to data privacy and data protection principles”, co-PI (joint with Prof. I. Oseledets)
- 2020–2022 **Huawei**, “Error-reducing codes”, PI
- 2020–2021 **Huawei**, “Wide column erasure codes”, co-PI (joint with Dr. P. Rybin)
- 2019–2021 **Huawei**, “Co-architecture Decoder Design Based on Neural Networks”, PI
- 2019 **nWave (UK)**, “Improvement of coding scheme for IoT smart parking system”, PI
- 2018–2019 **Huawei**, “Deep Neural Network Based Decoder Design for 5G Codes”, PI
- 2017–2018 **Huawei**, “Unified FEC for optical lines”, PI
- 2017 **Strizh**, “Development of short low-complexity error-correcting codes for IoT”, PI

Visiting Researcher

- 2018 MIT, USA
- 2016 Israel Institute of Technology (Technion), Israel
- 2015 University of Maryland, USA
- 2014 École Polytechnique Fédérale de Lausanne (EPFL), Switzerland
- 2012 Ulm University, Germany

Teaching & Mentoring Experience

- 2017-2021 **Instructor**, Information and Coding Theory, Skoltech, 6 credits
- 2018-2021 **Co-instructor** (joint with Y. Yanovich), Introduction to Blockchain, Skoltech, 3 credits
- PhD S. Kruglik (Thesis: Codes for local and confidential data recovery, 2021, co-supervisor)
- PhD students A. Glebov, E. Marshakov, G. Balitsky, Y. Balkybek
- MSc students K Nazirkhanova, A. Dzis, N. Zeulin, R. Shaniiazov, E. Chukavina, A. Yaroshenko, D. Ustinova, S. Kuzmichev, A. Fominykh, V. Markovskii, M. Savinova, A. Smeshko, M. Kopylova, A. Gorokhov, N. Osipov, I. Naidenov

Selected Journal Publications

1. Holzbaur L., Kruglik S., **Frolov A.**, Wachter-Zeh A., Secure Codes with Accessibility for Distributed Storage, IEEE Transactions on Information Forensics & Security. Impact factor: 7.178
2. Kowshik S. S., Andreev K., **Frolov A.** and Polyanskiy Y., Energy efficient coded random access for the wireless uplink, IEEE Transactions on Communications, 68:8, 4694–4708, Impact factor: 5.083
3. Kruglik S., Nazirkhanova K. and **Frolov A.**, New Bounds and Generalizations of Locally Recoverable Codes With Availability, IEEE Transactions on Information Theory, 2019, 65:7, 4156–4166, Impact Factor 2.501
4. **Frolov A.**, Zyablov V., On the multiple threshold decoding of LDPC codes over $GF(q)$, Advances in Mathematics of Communications, 2017, 11:1, 123–137. Impact Factor 0.935
5. Tamo I., Barg A. and **Frolov A.**, Bounds on the Parameters of Locally Recoverable Codes, IEEE Transactions on Information Theory, 2016, 62:6, 3070–3083. Impact Factor 2.501
6. **Frolov A.**, Upper bound on the minimum distance of LDPC codes over $GF(q)$ based on counting the number of syndromes, Problems of Information Transmission, 2016, 52:1, 6–13. Impact Factor 0.371
7. **Frolov A.**, Zyablov V., On the capacity of a multiple-access vector adder channel, Problems of Information Transmission, 2014, 50:2, 133–143. Impact Factor 1.082
8. Osipov D., **Frolov A.**, Zyablov V. Multiple access system for a vector disjunctive channel, Problems of Information Transmission, 2012, 48:3, 243–249. Impact Factor 1.082
9. **Frolov A.** and Zyablov V., Bounds on the minimum code distance for nonbinary codes based on bipartite graphs, Problems of Information Transmission, 2011, 47:4, 327–341. Impact Factor 1.082
10. **Frolov A.** and Zyablov V., Asymptotic estimation of the fraction of errors correctable by q -ary LDPC codes, Problems of Information Transmission, 2010, 46:2, 142–159. Impact Factor 1.082

Selected Conference Publications

1. Andreev K., Rybin P. and **Frolov A.**, Unsourced Random Access Based on List Recoverable Codes Correcting t Errors, In Proc. IEEE Information Theory Workshop (ITW), Kanazawa, Japan, pp. 1–6, October 17–21, 2021
2. Munari A. and **Frolov A.**, Average Age of Information of Irregular Repetition Slotted ALOHA, IEEE Global Communications Conference (GLOBECOM), pp. 1–6, 2020, Taipei, Taiwan (**best paper award**)
3. Holzbaur L., Kruglik S., **Frolov A.**, Wachter-Zeh A., Secrecy and Accessibility in Distributed Storage, IEEE Global Communications Conference (GLOBECOM), pp. 1–6, 2020, Taipei, Taiwan
4. Andreev K., Marshakov E. and **Frolov A.**, A Polar Code Based TIN-SIC Scheme for the Unsourced Random Access in the Quasi-Static Fading MAC, In Proc. IEEE Int. Symp. Inf. Theory (ISIT), Los Angeles, CA, USA, 2020, pp. 3019–3024.
5. Kowshik S. S., Andreev K., **Frolov A.** and Polyanskiy Y., Energy efficient random access for the quasi-static fading MAC, In Proc. IEEE Int. Symp. Inf. Theory (ISIT), Paris, France, 2019, pp. 2768–2772.
6. Kowshik S. S., Andreev K., **Frolov A.** and Polyanskiy Y., Short-Packet Low-Power Coded Access for Massive MAC, In Proc. 53rd Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, USA, 2019, pp. 827–832.
7. Marshakov E., Balitskiy G., Andreev K. and **Frolov A.** A Polar Code Based Unsourced Random Access for the Gaussian MAC, In Proc. IEEE 90th Vehicular Technology Conference (VTC2019-Fall), Honolulu, Hawaii, USA, Sep. 2019.

8. Kruglik S., Nazirkhanova K. and **Frolov A.** On Distance Properties of (r,t,x) -LRC Codes, In Proc. IEEE Int. Symp. Inf. Theory (ISIT), Vail, CO, pp. 1336-1339, 2018.
9. Kruglik S., **Frolov A.**, Bounds and Constructions of Codes with All-Symbol Locality and Availability, In Proc. IEEE Int. Symp. Inf. Theory, Aachen, Germany, June 25–30, 2017, pp. 1023–1027.
10. Kruglik S., Dudina M., Potapova V., **Frolov A.** On One Generalization of LRC Codes with Availability, In Proc. IEEE Information Theory Workshop (ITW), Kaohsiung, Taiwan. pp.1–5, November 6-10, 2017
11. **Frolov A.**, An Upper Bound on the Minimum Distance of LDPC Codes over $GF(q)$, In Proc. IEEE Int. Symp. Inf. Theory, Hong Kong, China, June 14–19 2015, pp. 2885–2888.
12. **Frolov A.** and Zyablov V., On the Multiple Threshold Decoding of LDPC codes over $GF(q)$, In Proc. IEEE Int. Symp. Inf. Theory, Hong Kong, China, June 14–19 2015, pp. 2673–2677.
13. **Frolov A.** and Zyablov V., A new coding method for a multiple-access system with a large number of active users, In Proc. IEEE Information Theory Workshop (ITW), Jerusalem, Israel. pp.1–5, April 26-May 1 2015.
14. **Frolov A.**, Zyablov V., Sidorenko V., Fischer R., On a multiple-access in a vector disjunctive channel, In Proc. IEEE International Symposium on Information Theory, Istanbul, Turkey, July 7–12, 2013. P. 211–215.
15. **Frolov A.**, Zyablov V. Upper and Lower Bounds on the Minimum Distance of Expander Codes, Proc. of IEEE International Symposium on Information Theory (ISIT 2011), Saint-Petersburg, Russia. 2011.–Jul./Aug. P. 1302–1306

Selected Invited Talks

- Feb. 2020 A Polar Code Based TIN-SIC Scheme for the Unsourced Random Access in the Quasi-Static Fading MAC, DLR-MIT-TUM Workshop on Coding and Random Access, Germany
- Feb. 2019 Deep Neural Network Based Decoding of Short 5G LDPC Codes, German Aerospace Center (DLR), Germany
- Feb. 2019 Energy-efficient coded random access with applications to massive machine-type communications, Institute for Communications Engineering, Technical University of Munich (TUM), Germany
- Dec. 2018 New Bounds and Generalizations of Locally Recoverable Codes with Availability, Dagstuhl Seminar “Algebraic Coding Theory for Networks, Storage, and Security”, Germany
- Oct. 2018 Energy-efficient coded random access with applications to massive machine-type communications, Laboratory for Information and Decision Systems Seminar, MIT, USA
- Feb. 2018 Deep Neural Network Based Decoding of Error-Correcting Codes, Laboratory for Information and Decision Systems Seminar, MIT, USA
- March 2016 The Analysis of Hard-Decision Multi-Threshold Decoding of Non-Binary LDPC Codes, Coding Theory Seminar, Israel Institute of Technology (Technion), Israel
- Feb. 2015 On the Multiple Threshold Decoding of q -ary LDPC codes, Communication, Control and Signal Processing Seminar, University of Maryland, USA

Professional Service

Chairman of IEEE Russia Information Theory Society Chapter (2021).

TPC member: IEEE Information Theory Workshop (2020), International Congress on Ultra Modern Telecommunications and Control Systems (2018-2021), Workshop of Coding and Cryptography (2019, 2022).

Reviewer: IEEE Transactions on Information Theory, IEEE Transactions on Communications, IEEE Communications Letters, Problems of Information Transmission, Designs, Codes and Cryptography, Advances in Mathematics of Communications, Discrete Mathematics, IEEE Wireless Communications Letters, IEEE International Symposium on Information Theory (ISIT), IEEE Information Theory Workshop (ITW).

Languages

English **Fluent**

Russian **Native Speaker**