

# 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 Computer Science and Communications** from Moscow Institute of Physics and Technology (MIPT), Moscow, Russia  
Thesis: Design and analysis of codes with locality property
- 2012 **Ph.D. in Computer Science and Communications** 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
- 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**
- 2013 **Moscow Government Award for Young Scientists**

### Professional Experience

- 2024–present **Director**, Skoltech, Project Center for Next Generation Wireless and IoT (PCNGW), Moscow, Russia
- 2022–present **Full Professor**, Skoltech, Project Center for Next Generation Wireless and IoT (PCNGW), Moscow, Russia
- 2018–2024 **Head of Research Group**, Skoltech, Center of Excellence of the National Technology Initiative “Wireless Technologies and Internet of Things”, Moscow, Russia.
- 2019–2022 **Associate Professor**, Skoltech, CDISE, Moscow, Russia
- 2017–2019 **Assistant Professor**, Skoltech, CDISE, Moscow, Russia
- 2016–2017 **Senior Research Scientist**, Skoltech, CDISE, Moscow, Russia
- 2013–2022 **Senior Research Scientist**, IITP RAS, Moscow, Russia
- 2012–2013 **Research Scientist**, IITP RAS, Moscow, Russia
- 2008–2012 **Junior Research Scientist**, IITP RAS, Moscow, Russia

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## Grants

- 2023–2025 **Russian Science Foundation**, Competition for individual scientific groups carrying out fundamental and exploratory research, “23-11-00340 – Development of new coding schemes and decoding algorithms for next-generation communication systems”, PI
- 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)

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## Industrial projects

- 2023–2024 **Huawei**, “LDPC+EC Joint Design Technology”, PI
- 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

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## 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

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## Teaching & Mentoring Experience

- Courses I have developed a part in a joint course “Modern Applications of Information Theory”, 2022–present, Skoltech, 3 credits
- Courses I have developed and teach a course “Information and Coding Theory”, 2017–present, Skoltech, 6 credits

I have developed and teach the part on cryptography in a joint course “Introduction to Blockchain”, 2018–present, Skoltech, 3 credits

MSc Currently I supervise 5 MSc students, I have 25 graduate students

PhD I supervise 9 PhD students: D. Ustinova, A. Fominykh, D. Artemasov, E. Pavlova, I. Butakov, A. Tolmachev, A. Shchebetov, O. Nesteremkov, D. Sefiw

On Sep. 2021 my PhD student (co-supervision with Prof. G. Kabatiansky), Stanislav Kruglik, successfully defended PhD thesis “Codes for local and confidential data recovery” at MIPT

## Selected Journal Publications

1. Artemasov D., Andreev K., Rybin P. and **Frolov A.**, Iterative Syndrome-Based Deep Neural Network Decoding. IEEE Open Journal of the Communications Society, vol. 6, pp. 629–641, 2024.
2. Saiapin A., Balitskiy G., Bershatsky D., Katrutsa A., Frolov E., **Frolov A.**, Oseledets I., Kharin V., Federated privacy-preserving collaborative filtering for on-device next app prediction. User Modeling and User-Adapted Interaction, vol. 34, 1369–1398, 2024.
3. Andreev K., Ustinova D. and **Frolov A.**, Unsourced Random Access with the MIMO Receiver: Projection Decoding Analysis, IEEE Wireless Communications Letters, vol. 13, no. 1, pp. 69–73, Jan. 2024.
4. Glebov A., Rybin P., Andreev K. and **Frolov A.**, Energy Efficiency of Unsourced Random Access over the Binary-Input Gaussian Channel, IEEE Communications Letters, vol. 27, no. 9, pp. 2313–2317, 2023.
5. Andreev K., Rybin P. and **Frolov A.**, Coded Compressed Sensing with List Recoverable Codes for the Unsourced Random Access, IEEE Transactions on Communications, 2022, 70:12, pp. 7886–7898
6. Holzbaur L., Kruglik S., **Frolov A.**, Wachter-Zeh A., Secure Codes with Accessibility for Distributed Storage, IEEE Transactions on Information Forensics & Security, vol. 16, 5326–5337, 2021.
7. 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, 2020.
8. 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.
9. **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.
10. 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.
11. **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.
12. **Frolov A.**, Zyablov V., On the capacity of a multiple-access vector adder channel, Problems of Information Transmission, 2014, 50:2, 133–143.
13. Osipov D., **Frolov A.**, Zyablov V. Multiple access system for a vector disjunctive channel, Problems of Information Transmission, 2012, 48:3, 243–249.
14. **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.
15. **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.

## Selected Conference Publications

1. Butakov I., Sememenko A., Tolmachev A., Gladkov A., Munkhoeva M., and **Frolov A.**, Efficient Distribution Matching of Representations via Noise-Injected Deep InfoMax, The 13th International Conference on Learning Representations (ICLR 2025, A\*)
2. Butakov I., Tolmachev A., Malanchuk S., Neopryatnaya A., and **Frolov A.**, Mutual information estimation via normalizing flows, Neural Information Processing Systems 2024 (NeurIPS 2024, A\*)
3. Butakov I., Tolmachev A., Malanchuk S., Neopryatnaya A., **Frolov A.** and Andreev K., Information Bottleneck Analysis of Deep Neural Networks via Lossy Compression, The 12th International Conference on Learning Representations (ICLR 2024, A\*).
4. Artemasov D., Andreev K., Rybin P. and **Frolov A.**, Soft-Output Deep Neural Network-Based Decoding, 2023 IEEE Globecom Workshops (GC Wkshps), Kuala Lumpur, Malaysia, 2023, pp. 1692-1697.
5. 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
6. 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**)
7. 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
8. 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.
9. 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.
10. 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.
11. 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.
12. 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.
13. 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.
14. 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
15. **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.
16. **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.
17. **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.

18. **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.
19. **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

- March 2024 Energy Efficiency of Unsourced Random Access over the Gaussian and MIMO Channels, Algorithmic Structures for Uncoordinated Communications and Statistical Inference in Exceedingly Large Spaces Banff, Canada
- Oct. 2023 On error-reducing properties of sparse regression codes, Hong Kong university of science and technology (HKUST), Hong Kong, China
- Aug. 2022 Coded Compressed Sensing with List Recoverable Codes for the Unsourced Random Access, International Symposium on Topics in Coding (ISTC 2022), Montreal, Canada
- Apr. 2021 Massive Random Access for the Quasi-Static Fading MAC, IEEE Information Theory Workshop (ITW 2020), Riva del Garda, Italy
- Oct. 2021 Unsourced Random Access for the MIMO Channel, International Balkan Conference on Communications and Networking (BalkanCom 2021), Novi Sad, Serbia
- 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 (2021-2022).

**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).

**Editor:** IEEE Transactions on Communications.

**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).

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## Languages

English **Fluent**

Russian **Native Speaker**