Igor **Sokolov**

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Research Interests

Stochastic and distributed optimization for ML · Communication-efficient methods for Federated Learning (compression, quantization, local updates, error feedback) · Variance reduction · Convex/non-convex and smooth/non-smooth convergence analysis · Orthogonalized gradient preconditioning · Reproducible large-scale numerical experiments.

Education

King Abdullah University of Science and Technology (KAUST) — *Thuwal, Saudi Arabia*

MS and PhD in Applied Mathematics and Computational Science — *08/2020–08/2026 (expected)*

Supervisor: Peter Richtárik · **MS Thesis:** «Non-convex Stochastic Optimization with Biased Gradient Estimators» · **GPA(PhD):** 3.89/4.00 (Transcript).

Moscow Institute of Physics and Technology (MIPT) — *Moscow, Russia*

MS in Applied Mathematics and Physics — *09/2019–08/2021*

Supervisor: Alexander Gasnikov · **Thesis:** «Distributed Nonconvex Stochastic Optimization with Gradient Compression».

BS in Applied Mathematics and Physics — *09/2014–08/2019*

Supervisor: Peter Richtárik · **Thesis:** «Stochastic Coordinate Descent Method with Arbitrary Sampling».

Publications

[5] A Guide Through the Zoo of Biased SGD — *KAUST, Thuwal, Saudi Arabia*

Yury Demidovich, Grigory Malinovsky, **Igor Sokolov**, Peter Richtárik — *05/2023*

NeurIPS 2023 (Poster) · arXiv · Code · **Contribution:** Led experimental design and implementation; prepared reproducible code; helped with literature review and writing.

[4] Don't Compress Gradients in Random Reshuffling: Compress Gradient Differences — *KAUST, Thuwal, Saudi Arabia*

Abdurakhmon Sadiev, Grigory Malinovsky, Eduard Gorbunov, **Igor Sokolov**, Ahmed Khaled, Konstantin Burlachenko, Peter Richtárik — *06/2022*

NeurIPS 2024 (Poster) · FL-ICML 2023 Workshop (Poster) · arXiv · Code · **Contribution:** Led the experimental study; implemented all logistic-regression experiments; contributed to Deep Learning studies.

[3] 3PC: Three Point Compressors for Communication-Efficient Distributed Training and a Better Theory for Lazy Aggregation — *KAUST, Thuwal, Saudi Arabia*

Peter Richtárik, **Igor Sokolov**, Ilyas Fatkhullin, Elnur Gasanov, Zhize Li, Eduard Gorbunov — *02/2022*

ICML 2022 (Poster) · arXiv · Code · **Contribution:** Co-led theory and experiments; derived key theoretical bounds; ran large-scale benchmarks; co-wrote the manuscript.

[2] EF21 with Bells & Whistles: Practical Algorithmic Extensions of Modern Error Feedback — *KAUST, Thuwal, Saudi Arabia*

Ilyas Fatkhullin, **Igor Sokolov**, Eduard Gorbunov, Zhize Li, Peter Richtárik — *10/2021*

JMLR · OPT-NeurIPS 2021 Workshop (Poster) · arXiv · Code · **Contribution:** Developed several algorithmic extensions; ran most experiments; contributed to analysis and writing.

[1] EF21: A New, Simpler, Theoretically Better, and Practically Faster Error Feedback — *KAUST, Thuwal, Saudi Arabia*

Peter Richtárik, **Igor Sokolov**, Ilyas Fatkhullin — *06/2021*

NeurIPS 2021 (Oral + Poster) · arXiv · Code · **Contribution:** Proved the main theorems; ran most experiments; co-wrote the manuscript.

Preprints (arXiv)

[3] Bernoulli-LoRA: A Theoretical Framework for Randomized Low-Rank Adaptation — *KAUST, Thuwal, Saudi Arabia*

Igor Sokolov, Abdurakhmon Sadiev, Yury Demidovich, Fawaz S Al-Qahtani, Peter Richtárik — *08/2025*

arXiv · **Contribution:** Led the project; proved key results; implemented and ran all experiments.

[2] MARINA-P: Superior Performance in Non-smooth Federated Optimization with Adaptive Stepsizes — *KAUST, Thuwal, Saudi Arabia*

Igor Sokolov, Peter Richtárik — *12/2024*

arXiv · **Contribution:** Independent lead: developed the theory, ran experiments, and wrote the manuscript (with periodic guidance).

[1] Cohort Squeeze: Beyond a Single Communication Round per Cohort in Cross-Device Federated Learning — *KAUST, Thuwal, Saudi Arabia*

Kai Yi, Timur Kharisov, **Igor Sokolov**, Peter Richtárik — *06/2024*

FL@FM-NeurIPS 2024 Workshop (Oral) · arXiv · **Contribution:** Ran experiments; conducted literature review; contributed to writing.

Selected Conferences, Summer Schools, Posters & Talks

Invited & Spotlight Talks

Rising Stars in AI Symposium 2024 — *Thuwal, Saudi Arabia*

KAUST — *19–-21/02/2024*

Spotlight talk — *«Federated Optimization with Random Reshuffling & Gradient Compression»*.

SIAM Conference on Optimization (OP23) — *Seattle, USA*

Sheraton Grand Seattle — *31/05–-02/06/2023*

Invited talk — *«EF21: A New, Simpler, Theoretically Better, and Practically Faster Error Feedback»*.

Conference Posters / Presentations

ICML 2023 — Workshop on Federated Learning and Analytics in Practice — *Honolulu, USA*

Honolulu Convention Center — *23–-29/07/2023*

Poster — *«Federated Optimization with Random Reshuffling & Gradient Compression»*.

NeurIPS 2021 (main) — *Online*

Virtual Conference — *06–-14/12/2021*

Poster — *«EF21: A New, Simpler, Theoretically Better, and Practically Faster Error Feedback»*.

NeurIPS 2021 — Workshop on Optimization for Machine Learning — *Online*

Virtual Conference — *06–-14/12/2021*

Poster — *«EF21 with Bells & Whistles: Practical Algorithmic Extensions of Modern Error Feedback»*.

ICML 2021 — Workshop on Federated Learning for User Privacy & Data Confidentiality — *Online*

Virtual Conference — *18–-24/07/2021*

Poster — *«EF21: A New, Simpler, Theoretically Better, and Practically Faster Error Feedback»*.

Summer Schools & Training

On Local Methods for Non-Convex Federated Optimization — *Sochi, Russia*

Sirius University — Summer School on Modern Methods of Information Theory, Optimization and Control — *08/2020*

Team project: On Local Methods for Non-Convex Federated Optimization.

Summer School on Machine Learning in Business Analytics — *Moscow, Russia*

Samsung Research Russia — *07/2019*

Capstone project: forecasting sales impact of marketing strategies across device lines.

Teaching & Co-supervising

KAUST CEMSE Division — *Thuwal, Saudi Arabia*

Teaching Assistant · *Graduate Seminar (CS 398, PhD)* — *09–12/2025*

Checked weekly attendance of students of the lectures, checked weekly reports, conducted Q&A sessions. The course was taught to 66 KAUST student.

Saudi Aramco — *Remote and on-site*

Teaching Assistant · *Data Science MS program for Saudi Aramco employees* — *11/2022, 07–11/2025*

- *Introduction to Machine Learning* — *10–11/2025*

  Remote from KAUST

  Checked student's solutions to quiezzes, exams and assignmints including theoretical and practical assignments. The course was taught to 26 students.
- *Introduction to Optimization* — *07–08/2025*

  Remote from Moscow, Russia

  Checked student's solutions to quiezzes, exams and assignmints including theoretical and practical assignments. The course was taught to 27 students.
- *Introduction to Optimization* — *10–12/2022*

  Dammam, Saudi Arabia

  Created exercises in Jupyter notebooks in Python, held practical sessions, and checked in-class quesses and exams and home assignemnts. The course was taught to 26 students.

KAUST CEMSE Division — *Thuwal, Saudi Arabia*

Teaching Assistant · *Stochastic Gradient Descent Methods (CS 331, PhD)* — *08–12/2022*

Checked biweekly homework assignments of 17 students, and conducted Q&A sessions with students.

KAUST Vision Computing Center — *Thuwal, Saudi Arabia*

Co-supervisor · *Undergraduate Visiting Researcher* — *06–08/2022*

Mentored an undergraduate visiting student, Omar Shaikh Omar, from the University of Washington.

Selected Honors & Awards

06/2025	**CEMSE Dean's List (Top 20% of KAUST students)**, KAUST	*Thuwal, Saudi Arabia*
10/2022	**Top Reviewer Award**, NeurIPS 2022	*New Orleans, USA*
07/2022	**Outstanding Reviewer (Top 10%)** · **Session Chair Nomination**, ICML 2022	*Baltimore, USA*
08/2020	**IDEX Master's Scholarship (declined)**, Université Grenoble Alpes	*Grenoble, France*
08/2018 – 08/2019	**Increased Academic Scholarship for Scientific Achievement**, MIPT	*Moscow, Russia*

Professional Experience

Optimization and Machine Learning Lab, KAUST — *Thuwal, Saudi Arabia*

Graduate Student Researcher · Advisor: Peter Richtárik — *08/2020–Present*

Conduct research on stochastic and distributed optimization for federated learning, co-authoring five publications and three preprints.

Optimization in Machine Learning Lab, Artificial Intelligence Research Institute (AIRI) — *Moscow, Russia*

Research Intern · Advisor: Alexander Tyurin — *06/2025–09/2025*

Conducted research on asynchronous optimization in non-Euclidean spaces.

Optimization and Machine Learning Lab, KAUST — *Thuwal, Saudi Arabia*

Research Intern · Advisor: Peter Richtárik — *01/2019–02/2019*

Completed a theoretical project on the coordinate descent method that culminated in my bachelor's thesis.

Laboratory of Advanced Combinatorics and Network Applications, MIPT — *Moscow, Russia*

Junior Researcher · Advisor: Peter Richtárik — *08/2018–10/2019*

Conducted research on randomized algorithms for distributed optimization problems.

Selected Research & Software Projects

Recent Advances in Policy Gradient Methods — *KAUST, Thuwal, Saudi Arabia*

Course project · Reinforcement Learning (CS394V, PhD) — *11/2022*

Report · Slides · Surveyed state-of-the-art policy-gradient RL.

Recent Advances in Non-convex Private Communication-Efficient Federated Optimization — *KAUST, Thuwal, Saudi Arabia*

Course project · Private Data Analysis (CS325, PhD) — *11/2022*

Report · Slides · Literature review of non-convex DP federated optimization under communication constraints (compression, local steps, error-feedback); compared privacy accounting and convergence rates;

Algorithmic Complexity and Practical Performance of Top-k Compression for Communication-Efficient Distributed Optimization — *KAUST, Thuwal, Saudi Arabia*

Course project · Design and Analysis of Algorithms (CS260, MS) — *10–12/2021*

GitHub · Report · Slides · Proposed and led MS group project; benchmarked Top-k gradient compressors in a federated-learning pipeline.

On Local Methods for Non-Convex Federated Optimization

Sirius University, Sochi, Russia

Summer school project · Modern Methods of Information Theory, Optimization and Control — *08/2020*

GitHub · Slides · Implemented baselines and compared local-update schemes for FL in a summer-school team project.

Background and Foreground Estimation via Robust PCA

MIPT, Moscow, Russia

Course project · Geometric Data Analysis Methods (MS) — *01/2020*

GitHub · Compared robust-PCA approaches for background/foreground separation.

Academic Service

Organizing

Minisymposium Organizer

Seattle, USA

SIAM conference on optimization (OP 23) — *02/06/2023*

Organized and chaired a minisymposium titled *«Communication-Efficient Federated Optimization»*.

Seminar Co-organizer

Thuwal, Saudi Arabia

Optimization & Machine Learning Lab, KAUST — *09/2021–10/2022*

Co-organized weekly lab seminars (speaker invites, scheduling, announcements, moderation).

Peer Review

Conference Reviewer

ICML (2022–2025) · ICLR (2024–2026) · NeurIPS (2022, 2024–2025) — *02/2022–Present*

Reviewed 29 manuscripts across the venues above.

Journal Reviewer

Transactions on Machine Learning Research (TMLR) · Numerische Mathematik — *03/2023–Present*

TMLR (2023–2025) · Numerische Mathematik (2025) · Reviewed 9 manuscripts across journals.

Skills

Programming	Python, C/C++, Bash
Scripting & Markup Languages	SQL, LaTeX, Markdown
Frameworks & Libraries	PyTorch, Matplotlib, NumPy, SciPy
Development Environments	VScode, Jupyter, Slurm
Operating Systems	Windows, Linux, MacOS
Languages	Russian (Native), English (Fluent)

References

Peter Richtárik

KAUST, Thuwal, Saudi Arabia

Professor, Computer Science

peter.richtarik@kaust.edu.sa · **Relationship:** MS & PhD advisor.

Mikhail Moshkov

KAUST, Thuwal, Saudi Arabia

Professor, Applied Mathematics and Computational Science

mikhail.moshkov@kaust.edu.sa · **Relationship:** Course instructor; MS & PhD defense committee member.

Di Wang

KAUST, Thuwal, Saudi Arabia

Assistant Professor, Computer Science

di.wang@kaust.edu.sa · **Relationship:** Course instructor; MS & PhD defense committee member.