Alexey Bochkarev

Researcher in Mathematical Optimization / Operations Research
Postdoc at RPTU Kaiserslautern :: AG Optimierung (Germany)

a@bochkarev.io
www.bochkarev.io
alex-bochkarev
@a_bochka
@abochka

Research interests

Mathematical optimization, theory and applications, especially:

- Combinatorial optimization,
- Network optimization and interdiction,
- Decision diagrams and dynamic programming,
- Applications of reinforcement learning techniques.

Quantum computing, its applications and efficiency for optimization.

Applications, I have a special interest in optimization related to electricity markets: pricing / OPF / economic dispatch / planning, etc.

Education

PhD Industrial Engineering (2018–2021)
Clemson University, US
Operations Research track

Dissertation: "Selected Topics in Network Optimization: Aligning Binary Decision Diagrams for a Facility Location Problem and a Search Method for Dynamic Shortest Path Interdiction."
(https://tigerprints.clemson.edu/all_dissertations/2915)

Research supervisor: Dr. J. Cole Smith.

MSc Appl. Math and Physics (2004–2010)
Moscow Institute of Physics
and Technology, Russia

M.A. Economics (2008–2010)
New Economic School, Russia

Technical skills (more)

Main programming stack:

- Python (gurobi, CBC, numpy/pandas, etc.)
- R (ggplot, dplyr, tidyverse),
- Julia (JuMP/gurobi, LightGraphs),
- C++ (gurobi, armadillo/BLAS, boost).

Basics: PyTorch, Java, Matlab/Octave.

Other technical skills: PBS (comp cluster), GNU/Linux, bash; make, git, LaTeX, Emacs, basic GIS (QGIS), Inkscape, beamer / PPT / reveal.js, Jupyter.

(Human) Languages

English (fluent), Russian (native), German (A1–A2).

Research experience and current projects (more)

- **Dynamic Shortest-Path Interdiction (DSPI):** (ongoing) applying game-playing and reinforcement learning techniques to DSPI problem, in a framework of a Monte-Carlo Search Tree based algorithm. (with Dr. J. Cole Smith.)
- **Quantum Computing for Discrete Optimization:** (ongoing) highlighting three specific technologies (QAOA, Quantum Annealing, and Rydberg-blockade based regime) and applying them to a few discrete optimization problems (TSP, Max Cut, and Max Independent Set). I try to take an OR scientist perspective and discuss the possible workflows, issues, and prospects.
(with Dr. Anita Schoebel et al.)
- **Align-BDD:** seeking to obtain computational benefits and sensitivity information by representing a combinatorial problem as a collection of Binary Decision Diagrams (BDDs). The project involves creating a heuristic to enforce a certain structural property for a pair of BDDs and building a related "computational pipeline" for a specific, hard optimization problem: a variant of the facility location.
(with Dr. J. Cole Smith.)

Current supervisor: Dr. Anita Schoebel

Papers

- A. A. Bochkarev, J.C. Smith, (2023) On Aligning Non-Order-Associated Binary Decision Diagrams, accepted to *INFORMS Journal on Computing*, online: https://doi.org/10.1287/ijoc.2023.1293.

- A. A. Bochkarev, J.C. Smith, A Monte Carlo Tree Search for Dynamic Shortest-Path Interdiction, submitted to *Networks* (under review).
- A. A. Bochkarev, R. Heese, S. Jaeger, P. Schiewe, A. Schoebel, Quantum approaches for discrete optimization: a highlight of three technologies (in preparation).

Presentations / Talks

- A case-based comparison of three key quantum approaches to discrete optimization, *OR 2023* (Annual conference of GOR), Hamburg, Germany.
- A Monte Carlo Tree Search for Dynamic Shortest-Path Interdiction, *International Network Optimization Conference, 2022*, Aachen, Germany (INOC-2022).
- On Aligning Non-Order-Associated Binary Decision Diagrams, *INFORMS Annual Meeting, 2020* (virtual), BDD section.

Grants and awards

- Clemson University Doctoral Disseration Completion grant (support for Fall 2021)
- The Seth Bonder Foundation grant (to participate in INFORMS Annual Meeting 2021)
- International Teaching Fellowship from Clemson University (partial support in 2020, teaching training)

Teaching experience

(more)

- Currently designing two 5 CP (125 hours) courses for distance learning MSc study program: "Mathematical Foundations of Quantum Technologies" and "Quantum Computing I."
- Designed and delivered three 4-days mini-courses/workshops aimed at gifted high-school students and early undergrads for School for Molecular and Theoretical Biology (SMTB) and Puschino Winter School (ZPSh), mostly in English (sometimes in Russian as well):
  - "Practical Introduction to Probability Theory," ZPSh-2021, SMTB-2021
  - "A Glimpse into Algorithms," SMTB-2020; SMTB-2021, SMTB-2022
  - "How to teach machines: simple examples on ML," SMTB-2022
- TA in "Intro probability" undergrad course at Clemson University (IE3600), Summer 2021

Service and volunteering / Community

Besides teaching at summer and winter schools (above), I have been doing some work under the umbrella of Clemson University INFORMS Student Chapter:

- serving on the Executive Board: as a Secretary (2020) and President (2021),
- organized a "Journal club on Network optimization and interdiction" (2021),
- designed and delivered "OR Tech Seminar" – a series of four workshops on "research toolbox" (2021).

Industry experience

Electric energy / The Federal Grid (FGC UES) (2013–2017)
Electricity transmission. Moscow, Russia

Role: Team deputy head → head; modeling and analytics
Focus: Performance benchmarking (branches), operational efficiency improvement. Internal and external regulations / KPI, strategy, analytics / modeling, and presentations.

Roland Berger Strategy Consultants GmbH (2010–2013)
Strategic consulting. Moscow, Russia

Role: Intern → Junior Consultant → Consultant
Focus: Infrastructure and construction. Strategy and performance: market entry, supply/demand modeling, growth strategy, efficiency improvement. Internal knowledge sharing, modeling, presentations.