Shuvomoy Das Gupta

Contact

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Citizenship Canada

Research Interests Optimization, Game Theory, Transportation

Current Position

Columbia University, New York, NY, USA 2024–Present
Postdoctoral Research Scientist, Department of Industrial Engineering and Operations Research
Working on designing optimal algorithms for large-scale game solving.

Industry Experience

Thales Canada Inc., Toronto, Canada 2016–2018
Researcher, Research & Technology Department
Worked on real-time embedded optimization and sensor fusion algorithms in autonomous transportation systems. My work in this domain has been implemented in largest installed base of communication-based train control (CBTC) systems worldwide.

Education

Massachusetts Institute of Technology 2019 – 2024
Ph.D. in Operations Research
GPA: 5.0/5.0
Thesis: Advances in Computer-Assisted Design and Analysis of First-Order Optimization Methods and Related Problems
Advisors: Prof. Robert M. Freund and Prof. Bart P.G. Van Parys

University of Toronto 2016
Master of Applied Science in Electrical and Computer Engineering
GPA: 4.0/4.0
Thesis: Optimization Models for Energy-Efficient Railway Timetables
Advisor: Prof. Lacra Pavel

Awards and Honors

Winner, Informs Computing Society Student Paper Award 2024

Honorable Mention, George Nicholson Student Paper Competition 2024

Honorable Mention, MIT Operations Research Center Best Student Paper Award 2024

Selected Published Papers

[1] Branch-and-Bound Performance Estimation Programming: A Unified Methodology for Constructing Optimal Optimization Methods
with Prof. Bart P.G. Van Parys and Prof. Ernest K. Ryu
Published in *Mathematical Programming, 2024*
PDF: https://arxiv.org/pdf/2203.07305.pdf

[2] Nonlinear Conjugate Gradient Methods: Worst-Case Convergence Rates via Computer-Assisted Analyses
with Prof. Robert M. Freund, Prof. Andy Sun, and Prof. Adrien Taylor
Published in in *Mathematical Programming, 2024*
PDF: `https://arxiv.org/pdf/2301.01530.pdf`

[3] Exterior-Point Optimization for Sparse and Low-Rank Optimization
with Prof. Bartolomeo Stellato and Prof. Bart P.G. Van Parys
Published in *the Journal of Optimization Theory and Applications, 2024*
PDF: `https://arxiv.org/pdf/2011.04552.pdf`

[4] On Seeking Efficient Pareto Optimal Points in Multi-Player Minimum Cost Flow Problems with Application to Transportation Systems
with Prof. Lacra Pavel
Published in *the Journal of Global Optimization, 2019*
PDF: `https://arxiv.org/pdf/1805.11750.pdf`

[5] A Two-Step Linear Programming Model for Energy-Efficient Timetables in Metro Railway Networks
with Prof. Lacra Pavel and J. Kevin Tobin
Published in *Transportation Research Part B: Methodological, 2016*
PDF: `https://arxiv.org/pdf/1506.08243.pdf`

[6] An Optimization Model to Utilize Regenerative Braking Energy in a Railway Network
with Prof. Lacra Pavel and J. Kevin Tobin
Published in *the Proceedings of American Control Conference, 2015*
PDF: `https://tinyurl.com/ACCRegenOpt`

Papers Under Review

[7] Energy-Optimal Timetable Design for Sustainable Metro Railway Networks
with Prof. Bart P.G. Van Parys and J. Kevin Tobin
R&R in *Transportation Research Part B: Methodological*
PDF: `https://arxiv.org/pdf/2309.05489.pdf`

[8] Computer-Assisted Design of Accelerated Composite Optimization Methods: OptISTA
with Uijeong Jang and Prof. Ernest K. Ryu
Major revision in *Mathematical Programming*
PDF: `https://arxiv.org/pdf/2305.15704.pdf`

Teaching

6.7220: Nonlinear Optimization Spring 2023
Teaching Assistant. This is MIT's main doctoral course in optimization.
Rating: 6.9/7.0

15.S60: Computing in Optimization and Statistics Winter 2022, Winter 2023
Instructor. I taught the ORC's required three-hour module on advanced methods in computational optimization.
Rating: 6.9/7

15.S08: Optimization of Energy Systems Spring 2022

Teaching Assistant. This is a graduate course in power systems modeling and optimization.
RATING: 6.0/7.0

TALKS

Design and Analysis of First-Order Methods via Nonconvex QCQP Frameworks
One of just four invited "long talks" at the 1st Workshop on Performance Estimation, UCLouvain, Belgium 2023

BnB-PEP: A Unified Methodology for Constructing Optimal Optimization Methods
INFORMS Annual Meeting, Phoenix, AZ 2023
SIAM Conference on Optimization (OP23), Seattle, Washington 2023
UTORG Seminar, University of Toronto, Toronto, Canada 2023
International Conference on Continuous Optimization, Bethlehem, PA 2022
MIT Data Science Lab Seminar 2022

Energy-Optimal Timetable Design for Sustainable Metro Railway Networks
INFORMS Annual Meeting, Phoenix, AZ 2023
33rd Annual POMS Conference, Orlando, FL 2023
2023 MIT Energy Initiative Annual Research Conference 2023

Exterior-Point Optimization for Sparse and Low-Rank Optimization
INFORMS Annual Meeting (virtual) 2020

On Convergence of Heuristics Based on Douglas-Rachford Splitting and ADMM to Minimize Convex Functions over Nonconvex Sets
56th Allerton Conference on Communication, Control, and Computing, Monticello, IL 2018

Multi-Player Minimum Cost Flow Problems with Nonconvex Costs and Integer Flows
55th IEEE Conference on Decision and Control, Las Vegas, NV 2018

SERVICE

Reviewer for *Mathematical Programming, Transportation Research Part B: Methodological, IEEE Transactions on Control of Network Systems, American Control Conference, IEEE Transactions on Intelligent Transportation Systems, IEEE Transactions on Automatic Control*

Session Chair, INFORMS Annual Meeting 2023

Session Chair, INFORMS Annual Meeting 2022

SOFTWARE

[1] BnB-PEP
Computes optimal first-order algorithms for different convex and nonconvex setups
LINK: `https://github.com/Shuvomoy/BnB-PEP-code`

[2] NCG-PEP
Computes worst-case convergence rates of nonlinear conjugate gradient methods
LINK: `https://github.com/Shuvomoy/NCG-PEP-code`

[3] NExOS
Implements the Nonconvex Exterior-point Optimization Solver (NExOS) algorithm for solving low-rank and sparse optimization problems
LINK: `https://github.com/Shuvomoy/NExOS.jl`

LANGUAGES

Fluent in
English, Bengali, Hindi, Urdu
Proficent in
`Julia, C, C++, MATLAB, Mathematica`

OTHER

I enjoy playing cricket, reading novels, cooking, and blogging at `https://shuvomoy.github.io/blogs/`.

MEDIA COVERAGE

"Risky Giant Steps Can Solve Optimization Problems Faster" August, 2023 by Allison Parshall in *Quanta Magazine*
I was interviewed and quoted in the article along with my paper [1] being cited as the main inspiration for the discovery of long step gradient descent by Prof. Ben Grimmer. Also publicized in the *Nautilus Quarterly Magazine* and in the Chinese magazine *Heart of the Machine*.
URL: `https://www.quantamagazine.org/risky-giant-steps-can-solve-optimization-problems-faster-20230811/`