Shuvomoy Das Gupta

Contact

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Citizenship Canada

Education

Massachusetts Institute of Technology 2019 - 2024 (expected)
Ph.D. in Operations Research
GPA: 5.0/5.0
Thesis: A Unified Methodology for Constructing Optimal Optimization Algorithms
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

Research Interests

My primary research interest is developing methodologies that construct the *provably fastest* algorithms for optimization problems arising in machine learning, business analytics, and data science. My methodologies have led to the discovery of optimal algorithms in several practically relevant setups. I am also interested in application-driven areas involving energy, sustainability, and transportation systems. Through industry collaboration, my research on energy-optimal timetable design for sustainable metro railway networks has been implemented in the largest installed base of communication-based train control systems worldwide.

Work Experience

Thales Canada Inc., Toronto, Canada 2016-2018
Researcher, Research & Technology Department
Worked on large-scale, real-time, and embedded optimization in autonomous transportation systems.

Selected Published Papers

[1] Branch-and-Bound Performance Estimation Programming: A Unified Methodology for Constructing Optimal Optimization Methods (*job market paper*)
with Prof. Bart P.G. Van Parys and Prof. Ernest K. Ryu
Published in *Mathematical Programming, 2023*
PDF: https://arxiv.org/pdf/2203.07305.pdf

[2] 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

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

[4] 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

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

[6] Energy-Optimal Timetable Design for Sustainable Metro Railway Networks
with Prof. Bart P.G. Van Parys and J. Kevin Tobin
Under review in *Manufacturing & Service Operations Management*
PDF: `https://arxiv.org/pdf/2309.05489.pdf`

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

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

Teaching

Danforth Math and Reading Center, Toronto, Canada 2012-2014
Science Teacher at an after school program. Taught and tutored immigrant high school students mathematics and physics.

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/`

References

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