Rohit Kannan, Ph.D.

Mathematical Optimizer

Curriculum Vitae

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Google Scholar

EDUCATION

Ph.D.	Chemical Engineering	Massachusetts Institute of Technology	2018
M.S.	Chemical Engineering Practice	Massachusetts Institute of Technology	2014
B.Tech.	Chemical Engineering	Indian Institute of Technology Madras	2012

PROFESSIONAL APPOINTMENTS

Postdoctoral Fellow, Center for Nonlinear Studies, Los Alamos National Laboratory	since 2021
Postdoctoral Associate, Wisconsin Institute for Discovery, University of Wisconsin-Madison	2018-2020
Engineering Consultant, Alcon, Fort Worth, TX	2013
Engineering Consultant, Corning Inc., Corning, NY	2013
Research Intern, Laboratory of Computational Systems Biotechnology, EPFL, Switzerland	2011
Research Intern, Technology Transfer Laboratory, Orchid Chemicals and Pharmaceuticals, India	2010

SELECTED HONORS AND AWARDS

Center for Nonlinear Studies Postdoctoral Fellowship, Los Alamos National Laboratory	2021-2022
Best Paper Award, 2015 AIChE Annual Meeting	2015
George M. Keller Graduate Fellowship, MIT	2012-2013
Oil and Natural Gas Corporation Scholarship, Government of India	2012
Reliance Heat Transfer Award for academic excellence, IIT Madras	2012
Institute Merit Award for academic excellence, IIT Madras	2010 & 2011
Prof. M. Ramanujam Memorial Award, IIT Madras	2011
EPFL, DAAD WISE, and MITACS Globalink Summer Research Fellowships (chose EPFL)	2011
Top 10 Ranks in the Regional Mathematics Olympiad, India	2004, 2006 & 2008
Selected for the Indian National Informatics and Chemistry Olympiads (top 1%)	2008

FUNDING HISTORY

Principal Investigator, "*Using Graph Convolutional Neural Networks to Accelerate Solutions to Hard Nonconvex Optimization Problems,*" Applied Machine Learning Summer Research Fellowship Program, Information Science and Technology Institute, Los Alamos National Laboratory. Co-PIs: Harsha Nagarajan and Deepjyoti Deka ($25,000). — 2023

Co-Investigator, "*Learning to Accelerate Global Solutions for Non-Convex Optimization,*" Laboratory Directed Research & Development, Los Alamos National Laboratory. PIs: Harsha Nagarajan and Deepjyoti Deka ($1,013,000). — 2022-2025

Co-Investigator, "*Stochastic Optimization Models for Enhancing the Resilience of the Power Grid,*" Center for Nonlinear Studies Summer Student Program, Los Alamos National Laboratory. PIs: Harsha Nagarajan and Deepjyoti Deka ($10,000). — 2022

PUBLICATIONS

Peer-Reviewed Journal Papers

11. R. Kannan and J. R. Luedtke (2021), "A Stochastic Approximation Method for Approximating the Efficient Frontier of Chance-Constrained Nonlinear Programs," *Mathematical Programming Computation*, 13(4), pp. 705-751.

10. R. Kannan, J. R. Luedtke, and L. A. Roald (2020), "Stochastic DC Optimal Power Flow with Reserve Saturation," *Electric Power Systems Research* (special issue for XXI *Power Systems Computation Conference*), 189, 106566, pp. 1-9. Featured on the UW-Madison College of Engineering Website.

9. R. Kannan and P. I. Barton (2018), "Convergence-Order Analysis of Branch-and-Bound Algorithms for Constrained Problems," *Journal of Global Optimization*, 71(4), pp. 753-813.

8. R. Kannan and P. I. Barton (2017), "The Cluster Problem in Constrained Global Optimization," *Journal of Global Optimization*, 69(3), pp. 629-676.

7. R. Kannan and A. K. Tangirala (2014), "Correntropy-Based Partial Directed Coherence for Testing Multivariate Granger Causality in Nonlinear Processes," *Physical Review E*, 89(6), 062144, pp. 1-15.

Submitted Journal Papers

6. E. M. Turan, J. Jäschke, and R. Kannan, "Optimality-Based Discretization Methods for the Global Optimization of Nonconvex Semi-Infinite Programs," arXiv preprint arXiv:2303.00219, pp. 1-22. Status: Submitted.

5. R. Kannan, H. Nagarajan, and D. Deka (2022), "Learning to Accelerate the Global Optimization of Quadratically-Constrained Quadratic Programs," arXiv preprint arXiv:2301.00306, pp. 1-27. Status: Submitted.

4. A. Subramanian, R. Kannan, F. Holtorf, T. A. Adams II, T. Gundersen, and P. I. Barton (2022), "Optimization Under Uncertainty of a Hybrid Waste Tire and Natural Gas Feedstock Flexible Polygeneration System Using a Decomposition Algorithm," LAPSE preprint LAPSE:2021.0798, pp. 1-75. Status: Submitted.

3. R. Kannan, G. Bayraksan, and J. R. Luedtke (2020), "Residuals-Based Distributionally Robust Optimization with Covariate Information," arXiv preprint arXiv:2012.01088, pp. 1-44. Status: Under Third Review.

2. R. Kannan, G. Bayraksan, and J. R. Luedtke (2020), "Data-Driven Sample Average Approximation with Covariate Information," arXiv preprint arXiv:2207.13554, pp. 1-57. Status: Under Second Revision.

Technical Reports

1. R. Kannan, G. Bayraksan, and J. R. Luedtke (2021), "Heteroscedasticity-Aware Residuals-Based Contextual Stochastic Optimization," arXiv preprint arXiv:2101.03139, pp. 1-15.

Work-In-Progress Journal Papers

5. M. Goutham, R. Kannan, D. Pasqualini, D. Deka, H. Nagarajan, and R. Bent, "Optimal Power Flow for Resilient Electric Grids under Uncertain Hurricane Forecasts: A Multistage Stochastic Programming Approach."

4. R. Kannan, H. Nagarajan, and D. Deka, "Stochastic Unit Commitment with Reserve Saturation."

3. R. Kannan, N. Ho-Nguyen, and J. R. Luedtke, "Data-Driven Multistage Stochastic Optimization on Time Series."

2. R. Kannan and P. I. Barton, "GOSSIP: Decomposition Software for the Global Optimization of Nonconvex Two-Stage Stochastic Mixed-Integer Nonlinear Programs."

1. R. Kannan and P. I. Barton, "Integrating Benders Decomposition and Lagrangian Relaxation for Solving Two-Stage Stochastic Mixed-Integer Nonlinear Programs."

Peer-Reviewed Conference Proceedings

2. E. M. Turan, R. Kannan, and J. Jäschke (2022), "Design of PID Controllers Using Semi-Infinite Programming," Proceedings of the 14th *International Symposium on Process Systems Engineering*, pp. 439-444.

1. R. Kannan and P. I. Barton (2016), "The Cluster Problem in Constrained Global Optimization," Proceedings of the 13th *Global Optimization Workshop* (GOW'16), pp. 9-12.

Theses

2. Ph.D.: "Algorithms, Analysis, and Software for the Global Optimization of Two-Stage Stochastic Programs," *Massachusetts Institute of Technology*, 2018.

1. B.Tech.: "Partial Directed Coherence for Nonlinear Granger Causality: A Generalized Correlation Function-Based Approach," *Indian Institute of Technology Madras*, 2012.

TEACHING AND OUTREACH

➤ Math Lecturer, IIT Joint Entrance Exam (IIT JEE), Massachusetts Institute of Technology   2016

   – Recorded online video lectures for the entrance exam to the IITs as part of an MIT team.

   – **Featured on MIT OpenCourseWare** and supported by the MIT Office of Digital Learning.

➤ Teaching Assistant, Department of Chemical Engineering, Massachusetts Institute of Technology   2015

  – Teaching assistant for the graduate-level "Chemical Reactor Engineering" course ($\approx$ 50 students).
  – Designed homework exercises in MATLAB and Q-Chem that utilized computational techniques. Also co-moderated online discussion forums.

➤ Math Olympiad Trainer, Science and Math Academy for Real Talents, Chennai, India   2008-2011

  – Coached $\approx$ 30 middle-school and high-school students each year for the Math Olympiad.
  – One trainee was among the 40 students selected to represent India at the 2010 *International Math Olympiad Training Camp*.

➤ Volunteer, National Services Scheme, Indian Institute of Technology Madras   2008-2009

  – Volunteered for the "Science Activities" team of the National Services Scheme at IIT Madras.
  – Designed and demonstrated science experiments to students in underprivileged schools.

SERVICE

Student Mentorship

➤ Mithun Goutham, "Stochastic Optimization Models for Enhancing the Resilience of the Power Grid," Summer Student at the Center for Nonlinear Studies, *Los Alamos National Laboratory*, 2022.

➤ Avinash Subramanian, "Optimization under Uncertainty of Hybrid Feedstock Polygeneration Systems," Ph.D. Student, Department of Energy & Process Engineering, *Norwegian University of Science and Technology* (NTNU), 2021.

Committees and Editorial Service

➤ Invited External Examiner for the following students:

  – Mari E. Rugland, "An object-oriented framework for the optimization of flexible renewable energy systems," Master's thesis, Department of Chemical Engineering, *Norwegian University of Science and Technology* (NTNU), 2021. Supervisors: Johannes Jäschke, Truls Gundersen, and Avinash Subramanian.
  – Petter E. Nordby, "Optimization of flexible renewable energy systems under uncertainty," Master's thesis, Department of Energy & Process Engineering, *Norwegian University of Science and Technology* (NTNU), 2021. Supervisors: Truls Gundersen, Johannes Jäschke, and Avinash Subramanian.

➤ Invited Peer-Reviewer for the following journals and conferences (Web of Science Reviewer Profile):

- *Operations Research*
- *Mathematical Programming*
- *SIAM Journal on Optimization*
- *Journal of Global Optimization*
- *Set-Valued and Variational Analysis*
- *Computers and Chemical Engineering*
- *Electric Power Systems Research*
- *American Control Conference*
- *Journal of Optimization Theory and Applications*
- *Computational Optimization and Applications*
- *INFORMS Journal on Computing*
- *Optimization Methods and Software*
- *INFORMS Journal on Optimization*
- *Industrial and Engineering Chemistry Research*
- *IEEE Transactions on Control Systems Technology*

Professional and Institutional Service

➤ Invited Session Chair at the following conferences:

  – "Learning-Assisted Dynamic Decision-Making Under Uncertainty," 2022 *INFORMS Annual Meeting*.
  – "Global Optimization of Stochastic and Semi-Infinite Programs," 2022 *INFORMS Annual Meeting*.
  – "Computational Stochastic Programming," 2018 *INFORMS Annual Meeting*.

➤ Organizer of monthly teleconference meetings on "Optimization Under Uncertainty" ($\approx$ 15 participants) as part of the DOE MACSER Project (2018 to 2020).

PROFESSIONAL MEMBERSHIPS

Institute for Operations Research and the Management Sciences (INFORMS)   since 2014
American Institute of Chemical Engineers (AIChE)   since 2014
Mathematical Optimization Society (MOS)   2016-2017

RESEARCH IN THE INDUSTRY

➤ Engineering Consultant, Alcon, Fort Worth, TX   2013

  – Led an MIT team to design a measure of residual stress in molded intraocular lens wafers.
  – Increased bioavailability of an opthalmic drug through experiments and pharmacokinetic modeling.

➤ Engineering Consultant, Corning Inc., Corning, NY & Wilmington, NC   2013

  – Led an MIT team to model the effects of oxygen on the cure rate of UV-curable acrylate polymers.
  – Accelerated cell media development by identifying key components using statistical analysis.

➤ Research Intern, Orchid Chemicals and Pharmaceuticals, India   2010

  – Designed and implemented solutions to scale up the production of a research drug.
  – Investigated methods for increasing the size of drug crystals to reduce filtration time.

TECHNICAL SKILLS

- C++ & C
- Julia
- MATLAB
- Fortran
- Shell Scripting
- Python
- R
- GAMS
- Git
- Cluster Computing

PRESENTATIONS

Plenary

2. R. Kannan and J. R. Luedtke, "A Stochastic Approximation Method for Approximating the Efficient Frontier of Chance-Constrained Nonlinear Programs," CAST Division Plenary, *AIChE Annual Meeting*, Nov. 2021.

1. R. Kannan and P. I. Barton, "GOSSIP: Decomposition Software for the Global Optimization of Nonconvex Two-Stage Stochastic Mixed-Integer Nonlinear Programs," CAST Division Plenary, *AIChE Annual Meeting*, Nov. 2016.

Invited

24. R. Kannan, N. Ho-Nguyen, and J. R. Luedtke, "Data-Driven Multistage Stochastic Optimization on Time Series," *XVI International Conference Stochastic Programming*, July 2023 (Forthcoming).

23. R. Kannan, D. Deka, and H. Nagarajan, "Learning to Accelerate the Global Optimization of Quadratically-Constrained Quadratic Programs," *SIAM Conference on Optimization (OP23)*, May 2023 (Forthcoming). Session: New Algorithmic Techniques for Global Optimization.

22. R. Kannan, "Learning-Assisted Data-Driven Optimization," Grado Department of Industrial and Systems Engineering, *Virginia Tech*, Feb. 2023.

21. R. Kannan, N. Ho-Nguyen, and J. R. Luedtke, "Integrating Time Series Predictions Within Multistage Stochastic Optimization," *INFORMS Annual Meeting*, Oct. 2022. Session: Learning-Assisted Dynamic Decision-Making Under Uncertainty.

20. R. Kannan, N. Ho-Nguyen, and J. R. Luedtke, "Data-Driven Multistage Stochastic Optimization on Time Series," *Seventh International Conference on Continuous Optimization (ICCOPT)*, July 2022. Session: Multistage Stochastic/Robust Optimization.

19. R. Kannan, "Learning-Assisted Data-Driven Optimization Under Uncertainty," School of Mathematics, *University of Edinburgh*, April 2022.

18. R. Kannan, "Learning-Assisted Data-Driven Optimization Under Uncertainty," Department of Mechanical and Manufacturing Engineering, *University of Calgary*, Feb. 2022.

17. R. Kannan, "Learning-Assisted Data-Driven Optimization Under Uncertainty," School of Industrial Engineering and Management, *Oklahoma State University*, Feb. 2022.

16. R. Kannan, G. Bayraksan, and J. R. Luedtke, "Residuals-Based Distributionally Robust Optimization with Covariate Information," *INFORMS Annual Meeting*, Oct. 2021. Session: Learning and Decision-Making with Contextual Information.

15. R. Kannan, J. R. Luedtke, and L. A. Roald, "Stochastic DC Optimal Power Flow With Reserve Saturation," *Los Alamos—Arizona Days*, May 2021. Session: Engineered Systems.

14. R. Kannan, "A Modular Framework for Integrating Machine Learning within Stochastic Optimization," Department of Mathematical Sciences, *Florida Institute of Technology*, March 2021.

13. R. Kannan, "A Modular Framework for Integrating Machine Learning within Stochastic Optimization," Department of Chemical and Biomolecular Engineering, *Clarkson University*, March 2021.

12. R. Kannan, "A Modular Framework for Integrating Machine Learning within Stochastic Optimization," Systems and Industrial Engineering Department, *University of Arizona*, Feb. 2021.

11. R. Kannan, G. Bayraksan, and J. R. Luedtke, "Data-Driven Sample Average Approximation with Covariate Information," *INFORMS Annual Meeting*, Nov. 2020. Session: Data, Statistics and Learning in Energy Systems Optimization.

10. R. Kannan, J. R. Luedtke, and L. A. Roald, "Stochastic DC Optimal Power Flow with Reserve Saturation," *INFORMS Annual Meeting*, Nov. 2020. Session: Optimization in Energy Systems Under Uncertainty.

9. R. Kannan, "Data-Driven Stochastic Optimization with Covariate Information," Mathematics & Computer Science Division, *Argonne National Laboratory*, Sep. 2020.

8. R. Kannan, "Predict, then Smart Optimize with Stochastic Programming," Center for Nonlinear Studies, *Los Alamos National Laboratory*, July 2020.

7. R. Kannan, G. Bayraksan, and J. R. Luedtke, "Predict, then Smart Optimize with Stochastic Programming," *IPAM Workshop on Intersections between Control, Learning and Optimization*, Feb. 2020.

6. R. Kannan and P. I. Barton, "GOSSIP: Decomposition Software for the Global Optimization of Nonconvex Two-Stage Stochastic Mixed-Integer Nonlinear Programs," *INFORMS Annual Meeting*, Nov. 2018. Session: Computational Stochastic Programming.

5. R. Kannan, "Algorithms, Analysis, and Software for the Global Optimization of Chemical Process Systems Under Uncertainty," *ExxonMobil Research and Engineering*, Clinton, NJ, Dec. 2017.

4. R. Kannan, "Algorithms, Analysis, and Software for the Global Optimization of Chemical Process Systems Under Uncertainty," *Lawrence Berkeley National Laboratory*, Nov. 2017.

3. R. Kannan, "Algorithms, Analysis, and Software for the Global Optimization of Chemical Process Systems Under Uncertainty," Wisconsin Institute for Discovery, *University of Wisconsin-Madison*, Oct. 2017.

2. R. Kannan, "Optimization of Chemical Process Systems Under Uncertainty," *Rockwell Automation R&D*, Austin, TX, March 2017.

1. R. Kannan and P. I. Barton, "Convergence-Order Analysis of Lower Bounding Schemes for Constrained Global Optimization Problems," *Fifth International Conference on Continuous Optimization (ICCOPT)*, Aug. 2016. Session: Advances in Deterministic Global Optimization.

Contributed

10. R. Kannan, D. Deka, and H. Nagarajan, "Learning to Accelerate the Global Solution of Quadratically-Constrained Quadratic Programs," *AIChE Annual Meeting*, Nov. 2022. Session: Advances in Global Optimization.

9. R. Kannan, E. M. Turan, and J. Jäschke, "Tighter Lower Bounds for Semi-Infinite Programming Using Parametric Sensitivity Theory," *AIChE Annual Meeting*, Nov. 2022. Session: Design and Operations Under Uncertainty.

8. R. Kannan, N. Ho-Nguyen, and J. R. Luedtke, "Data-Driven Multistage Stochastic Optimization on Time Series," *AIChE Annual Meeting*, Nov. 2021. Session: Advances in Machine Learning & Intelligent Systems.

7. R. Kannan, G. Bayraksan, and J. R. Luedtke, "Data-Driven Sample Average Approximation with Covariate Information," *AIChE Annual Meeting*, Nov. 2021. Session: Design and Operations Under Uncertainty.

6. R. Kannan, G. Bayraksan, and J. R. Luedtke, "Residuals-Based Distributionally Robust Optimization with Covariate Information," *Robust Optimization Webinar*, April 2021.

5. R. Kannan, and P. I. Barton, "The Cluster Problem in Constrained Global Optimization," *AIChE Annual Meeting*, Nov. 2016. Session: Advances in Optimization.

4. R. Kannan, and P. I. Barton, "The Cluster Problem in Constrained Global Optimization," *Thirteenth Global Optimization Workshop*, Aug. 2016.

3. R. Kannan, and P. I. Barton, "Convergence-Order Analysis of Branch-and-Bound Algorithms for Constrained Problems," *AIChE Annual Meeting*, Nov. 2015. Session: Advances in Optimization.

2. R. Kannan, and P. I. Barton, "A Software Framework for the Global Optimization of Nonconvex Two-Stage Stochastic Programs," *AIChE Annual Meeting*, Nov. 2015. Session: Software Tools & Implementations for PSE.

1. R. Kannan, and P. I. Barton, "A Decomposition Strategy for a Class of of Nonconvex Two-Stage Stochastic Programs," *AIChE Annual Meeting*, Nov. 2014. Session: Design and Operations Under Uncertainty.

Poster

7. R. Kannan, G. Bayraksan, and J. R. Luedtke, "Integrated Learning and Optimization," Third Annual Wisconsin Institute for Discovery Symposium, *University of Wisconsin-Madison*, Aug. 2020.

6. R. Kannan, G. Bayraksan, and J. R. Luedtke, "Predict, then Smart Optimize with Stochastic Programming," *IPAM Workshop on Intersections between Control, Learning and Optimization*, Feb. 2020.

5. R. Kannan and J. R. Luedtke, "A Stochastic Approximation Method for Chance-Constrained Nonlinear Programs," *AIChE Annual Meeting*, Nov. 2019. Session: Systems and Process Operations.

4. R. Kannan, "Optimization and Control of Chemical Process Systems Under Uncertainty," *AIChE Annual Meeting*, Nov. 2019.

3. R. Kannan and J. R. Luedtke, "Stochastic Approximation for Chance-Constrained NLPs," Computing in Engineering Forum, *University of Wisconsin-Madison*, Sept. 2019.

2. R. Kannan and J. R. Luedtke, "Stochastic Approximation for Chance-Constrained NLPs," *ICERM Workshop on Optimization of Systems Impacted by Rare, High-Impact Random Events*, June 2019.

1. R. Kannan and J. R. Luedtke, "Optimizing Uncertain Systems with Reliability Requirements," Second Annual Wisconsin Institute for Discovery Symposium, *University of Wisconsin-Madison*, June 2019.