Rohit Kannan, Ph.D.

Mathematical Optimizer

Curriculum Vitae

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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

Assistant Professor, Grado Department of Industrial and Systems Engineering, Virginia Tech	since 2023
Postdoctoral Associate, Applied Mathematics and Plasma Physics, Los Alamos National Laboratory	2021-2023
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

VT Presidential Principles of Community Group Award (as part of the ISE DEI Committee)	2024
Received several "Thank-a-Teacher notes" from students	2023 & 2024
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

RESEARCH INTERESTS

Methodologies:	Optimization under uncertainty (stochastic and robust optimization), Global optimization, Learning-enhanced optimization, Computational optimization algorithms.
Applications:	Energy systems, Process systems engineering.

PUBLICATIONS

Underlined Authors are Graduate Students I've Supervised or Mentored

Peer-Reviewed Journal Papers

11. **R. Kannan**, G. Bayraksan, and J. R. Luedtke (2024), "Residuals-Based Distributionally Robust Optimization with Covariate Information," *Mathematical Programming* (Series A), 207(1–2), pp. 369-425.

10. A. Subramanian, **R. Kannan**, F. Holtorf, T. A. Adams II, T. Gundersen, and P. I. Barton (2023), "Optimization Under Uncertainty of a Hybrid Waste Tire and Natural Gas Feedstock Flexible Polygeneration System Using a Decomposition Algorithm," *Energy*, 284, 129222, pp. 1-11.

9. **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.

8. **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*.

7. **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.

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

5. **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

4. E. M. Turan, J. Jäschke, and **R. Kannan** (2023), "Bounding-Focused Discretization Methods for the Global Optimization of Nonconvex Semi-Infinite Programs," arXiv:2303.00219. Status: Under Review in *Computational Optimization and Applications*.

3. **R. Kannan**, H. Nagarajan, and D. Deka (2023), "Strong Partitioning and a Machine Learning Approximation for Accelerating the Global Optimization of Nonconvex QCQPs," arXiv:2301.00306. Status: Under Review in *INFORMS Journal on Computing*.

2. **R. Kannan**, G. Bayraksan, and J. R. Luedtke (2020), "Data-Driven Sample Average Approximation with Covariate Information," arXiv:2207.13554. Status: Under Review in *Operations Research*.

Technical Reports

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

Work-In-Progress Journal Papers

5. E. George, **R. Kannan**, H. Nagarajan, and D. Deka, "Learning to Accelerate the Global Optimization of QCQPs: An End-to-End Graph-based Stochastic Partitioning Approach."

4. M. Goutham, **R. Kannan**, D. Deka, H. Nagarajan, and R. Bent (2023), "Operational Resilience Enhancement of Electric Grids using Uncertain Hurricane Forecasts."

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 Papers

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

➤ Instructor, Department of Industrial and Systems Engineering, Virginia Tech   2023-present

Term	Course	Enrollment	SPOT (Mean, Median)	# Thank You Notes
F24	ISE 3434: Deterministic Operations Research II	13	__	__
S24	ISE 5406: Nonlinear Optimization	13	4.6, 5	4
F23	ISE 6514: Advanced Math Programming	11	5.9, 6	2

SPOT evaluations are for the question "Overall, the instructor's teaching was effective."

"Thank-a-Teacher notes" were submitted by students through the Center for Excellence in Teaching and Learning.

Course Syllabi

– ISE 3434 (Undergraduate): complexity theory, integer programming, nonlinear programming, stochastic programming, machine learning, and modeling languages and optimization software.

– ISE 5406 (Graduate): convex analysis and optimization, generalizations of convexity, first and second-order optimality conditions, algorithms for unconstrained and constrained nonlinear optimization.

– ISE 6514 (Graduate): convex analysis, optimality conditions, duality, linear programming, decomposition methods, conic programming (SOCPs, SDPs), solution approaches, applications in OR, energy, ML.

➤ 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, and co-moderated online discussion forums.

SERVICE

Student Supervision

Ph.D. Students

➤ Dhruva Sundararajan, 2024-present.

➤ Hung Tran, 2024-present.

M.S. Students

➤ Hiral Makwana (co-advised with Dr. Eduardo Molina in Sustainable Biomaterials), 2024-present.

B.S. Students

➤ Soham Mehra, Spring 2024.

➤ Senior Design Advisor for the following student groups:
   – Amtrak Equipment Inventory Analysis, 2023-2024.

Student Mentorship

Ph.D. Students

➤ Erin George (UCLA), "Graph Convolutional Neural Networks to Accelerate Solutions to Nonconvex Optimization," Applied Machine Learning Summer Research Fellow, *Los Alamos National Laboratory*, 2023. Role: Primary Mentor. Co-Mentors: Dr. Harsha Nagarajan and Dr. Deepjyoti Deka.

➤ Mithun Goutham (OSU), "Stochastic Optimization Models for Enhancing the Resilience of the Power Grid," Summer Student at the Center for Nonlinear Studies, *Los Alamos National Laboratory*, 2022. Role: Primary Mentor. Co-Mentors: Dr. Harsha Nagarajan and Dr. Deepjyoti Deka.

➤ Avinash Subramanian (NTNU), "Optimization under Uncertainty of Hybrid Feedstock Polygeneration Systems," Ph.D. Student, Department of Energy & Process Engineering, *Norwegian University of Science and Technology*, 2021. Role: Mentor. Ph.D. Advisors: Dr. Truls Gundersen and Dr. Johannes Jäschke.

Committees and Editorial Service

➤ Thesis Committee Member for the following Ph.D. students:

– Hyunwoo Lee, 2023-present.
Advisors: Dr. Esra Büyüktahtakın Toy and Dr. Robert Hildebrand.

– Daniel Alfredo Neira-González, 2023-present.
Advisors: Dr. Subhash Sarin and Dr. Manish Bansal.

➤ Invited External Examiner for the following students:

– Mari E. Rugland, "An object-oriented framework for the optimization of flexible renewable energy systems," M.Sc. thesis, Department of Chemical Engineering, *Norwegian University of Science and Technology* (NTNU), 2021. Advisors: Dr. Johannes Jäschke, Dr. 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. Advisors: Dr. Truls Gundersen, Dr. Johannes Jäschke, and Avinash Subramanian.

➤ Invited Peer-Reviewer for the following funding programs:

– Panelist for the U.S. National Science Foundation, 2024.

➤ 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*
- *Mathematics of Operations Research*
- *Set-Valued and Variational Analysis*
- *IISE Transactions*
- *Annals of Operations Research*
- *Electric Power Systems Research*
- *Computers and Chemical Engineering*
- *Journal of Optimization Theory and Applications*
- *Computational Optimization and Applications*
- *INFORMS Journal on Computing*
- *Optimization Methods and Software*
- *Optimization Letters*
- *INFORMS Journal on Optimization*
- *Industrial and Engineering Chemistry Research*
- *IEEE Transactions on Control Systems Technology*
- *IEEE Transactions on Automation Science and Engineering*
- *American Control Conference*

Professional and Institutional Service

➤ Elected Vice-Chair of Global Optimization, INFORMS Optimization Society, 2025-2026.

➤ Served in the following committees at Virginia Tech:

– Diversity, Equity & Inclusion Committee, ISE Department, 2023-2025.
– Graduate Admissions Committee, ISE Department, 2023-2025.

➤ Session Chair at the following conferences:

– "Learning and Optimization Techniques for Uncertain Systems," 2024 *INFORMS Annual Meeting*.
– "Advances in Deterministic Global Optimization," 2024 *INFORMS Optimization Society Conference*.
– "Machine Learning for Discrete and Global Optimization I & II," 2023 *INFORMS Annual Meeting*.
– "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" (≈ 15 participants) as part of the DOE MACSER Project (2018 to 2020).

Educational Outreach

➤ Guest Lecturer, ISE 5024 (Graduate Seminar Series), Virginia Tech   2023, 2024

➤ Math Lecturer for the IIT Joint Entrance Exam (IIT JEE)   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.

➤ 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, IIT 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.

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)   since 2016

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

(Excluding presentations where I was a co-author but not the presenter.)

Plenary

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

1. "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

39. "Data-Driven Multistage Stochastic Optimization on Time Series," *INFORMS Annual Meeting*, Oct. 2024.

38. "Learning to Accelerate the Global Optimization of Quadratically-Constrained Quadratic Programs," *25th International Symposium on Mathematical Programming*, July 2024.

37. "Bounding-Focused Discretization Methods for the Global Optimization of Nonconvex Semi-Infinite Programs," *INFORMS Optimization Society Conference*, March 2024.

36. "LE^{2}GO: Learning An End-to-End Partitioning Policy for the Global Optimization Of QCQPs," *INFORMS Annual Meeting*, Oct. 2023.

35. "Data-Driven Multistage Stochastic Optimization on Time Series," *16th International Conference Stochastic Programming (ICSP)*, July 2023.

34. "Learning to Accelerate the Global Optimization of Quadratically-Constrained Quadratic Programs," *SIAM Conference on Optimization*, May 2023.

33. "Learning-Assisted Data-Driven Optimization," Department of Chemical and Biological Engineering, *South Dakota School of Mines and Technology*, March 2023.

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

31. "Integrating Time Series Predictions Within Multistage Stochastic Optimization," *INFORMS Annual Meeting*, Oct. 2022.

30. "Data-Driven Multistage Stochastic Optimization on Time Series," *7th International Conference on Continuous Optimization (ICCOPT)*, July 2022.

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

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

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

26. "Residuals-Based Distributionally Robust Optimization with Covariate Information," *INFORMS Annual Meeting*, Oct. 2021.

25. "Stochastic DC Optimal Power Flow With Reserve Saturation," *Los Alamos—Arizona Days*, May 2021.

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

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

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

21. "Data-Driven Sample Average Approximation with Covariate Information," *INFORMS Annual Meeting*, Nov. 2020.

20. "Stochastic DC Optimal Power Flow with Reserve Saturation," *INFORMS Annual Meeting*, Nov. 2020.

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

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

17. "Predict, then Smart Optimize with Stochastic Programming," *IPAM Workshop on Intersections between Control, Learning and Optimization*, Feb. 2020.

16. "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.

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

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

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

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

11. "Convergence-Order Analysis of Lower Bounding Schemes for Constrained Global Optimization Problems," *5th International Conference on Continuous Optimization (ICCOPT)*, Aug. 2016.

Contributed

10. "Learning to Accelerate the Global Solution of Quadratically-Constrained Quadratic Programs," *AIChE Annual Meeting*, Nov. 2022.

9. "Tighter Lower Bounds for Semi-Infinite Programming Using Parametric Sensitivity Theory," *AIChE Annual Meeting*, Nov. 2022.

8. "Data-Driven Multistage Stochastic Optimization on Time Series," *AIChE Annual Meeting*, Nov. 2021.

7. "Data-Driven Sample Average Approximation with Covariate Information," *AIChE Annual Meeting*, Nov. 2021.

6. "Residuals-Based Distributionally Robust Optimization with Covariate Information," *Robust Optimization Webinar*, April 2021.

5. "The Cluster Problem in Constrained Global Optimization," *AIChE Annual Meeting*, Nov. 2016.

4. "The Cluster Problem in Constrained Global Optimization," *13th Global Optimization Workshop*, Aug. 2016.

3. "Convergence-Order Analysis of Branch-and-Bound Algorithms for Constrained Problems," *AIChE Annual Meeting*, Nov. 2015.

2. "A Software Framework for the Global Optimization of Nonconvex Two-Stage Stochastic Programs," *AIChE Annual Meeting*, Nov. 2015.

1. "A Decomposition Strategy for a Class of of Nonconvex Two-Stage Stochastic Programs," *AIChE Annual Meeting*, Nov. 2014.

Poster

7. "Integrated Learning and Optimization," 3rd Annual Wisconsin Institute for Discovery Symposium, *University of Wisconsin-Madison*, Aug. 2020.

6. "Predict, then Smart Optimize with Stochastic Programming," *IPAM Workshop on Intersections between Control, Learning and Optimization*, Feb. 2020.

5. "A Stochastic Approximation Method for Chance-Constrained Nonlinear Programs," *AIChE Annual Meeting*, Nov. 2019.

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

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

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

1. "Optimizing Uncertain Systems with Reliability Requirements," 2nd Annual Wisconsin Institute for Discovery Symposium, *University of Wisconsin-Madison*, June 2019.