Rohit Kannan

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Research Interests

Methodologies: Optimization under uncertainty, integrated learning & optimization, large-scale optimization, and deterministic global optimization
Applications: Power, energy and chemical process systems

Professional Appointments

University of Wisconsin-Madison — Madison, WI

Postdoctoral Associate at the Wisconsin Institute for Discovery — **2018 - present**

- Focus: Data-driven optimization under uncertainty with application to power systems
- PI: Prof. James R. Luedtke (Industrial & Systems Engineering)

Education

Massachusetts Institute of Technology — Cambridge, MA

Ph.D. in Chemical Engineering — **2018**

- Thesis: Algorithms, analysis and software for the global optimization of two-stage stochastic programs. Advisor: Prof. Paul I. Barton
- Committee: Prof. Richard D. Braatz, Prof. Youssef M. Marzouk, Prof. Paul I. Barton

Master of Science in Chemical Engineering Practice — **2014**

Indian Institute of Technology Madras — Chennai, India

Bachelors in Chemical Engineering (with highest honors) — **2012**

Select Honors and Awards

Best Paper in the Advances in Optimization I session, AIChE Annual Meeting	2015
George M. Keller Graduate Fellowship, MIT	2012-2013
Reliance Heat Transfer Pvt. Ltd. Award for academic excellence, IIT Madras	2012
Oil and Natural Gas Corporation Scholarship, India	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 Fellowships (chose EPFL)	2011
First prize in the Math Modeling and Puzzle Championship events, Shaastra, IIT Madras	2011
Top 10 Ranks in the Regional Mathematics Olympiad, India	2004, 2006 & 2008
Qualified for the Indian National Informatics and Chemistry Olympiads (top 1%)	2008
Fellowship to attend Math + CS program at CMI, India (declined in favor of IIT Madras)	2008

Journal Papers

Published or Accepted Papers

5. R. Kannan and J. R. Luedtke. A stochastic approximation method for approximating the efficient frontier of chance-constrained nonlinear programs. Forthcoming in *Mathematical Programming Computation*. arXiv preprint arXiv:1812.07066, pp. 1-50.
4. R. Kannan, J. R. Luedtke, and L. A. Roald (2020). Stochastic DC optimal power flow with reserve saturation. *Electric Power Systems Research* (proceedings of the XXI *Power Systems Computation Conference*), pp. 1-9.
3. 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.
2. R. Kannan and P. I. Barton (2017). The cluster problem in constrained global optimization. *Journal of Global Optimization*, 69(3), pp. 629-676.
1. 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 Papers

2. R. Kannan, G. Bayraksan, and J. R. Luedtke. Residuals-based distributionally robust optimization with covariate information. In submission to *Mathematical Programming*, pp. 1-38.
1. R. Kannan, G. Bayraksan, and J. R. Luedtke. Data-driven sample average approximation with covariate information. Under Review in *Operations Research*, pp. 1-34.

Working Papers

3. R. Kannan, N. Ho-Nguyen, and J. R. Luedtke. Multi-stage stochastic optimization given time series data.
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. A modified Lagrangian relaxation algorithm for two-stage stochastic mixed-integer nonlinear programs.

Refereed Proceedings

1. R. Kannan and P. I. Barton (2016). The cluster problem in constrained global optimization. Proceedings of the XIII *Global Optimization Workshop* (GOW'16), pp. 9-12.

Research in the news

- UW-Madison College of Engineering. Power tools: New math model optimizes energy
  This article discusses how my paper *Stochastic DC optimal power flow with reserve saturation* enables efficient use of intermittent renewable energy resources through a new optimal power flow model.

Academic Research Highlights

University of Wisconsin-Madison Madison, WI
Postdoctoral Associate at the Wisconsin Institute for Discovery **2018 - present**

- Designed a practical stochastic approximation method for chance-constrained nonlinear programs
- Modeled saturation of generator reserves in DCOPF with uncertain renewables output. Designed a tailored decomposition method for the resulting nonsmooth nonconvex two-stage stochastic program
- Explored new formulations for integrating machine learning models within stochastic optimization. Investigated asymptotic and finite sample properties of their solutions. Introduced distributionally robust and multi-stage generalizations of these formulations, and studied their theoretical properties

Massachusetts Institute of Technology Cambridge, MA
Graduate Research Assistant **2013 - 2018**

- Designed decomposition algorithms and a software for the global optimization of two-stage stochastic MINLPs. Software is currently being used at MIT for the design of flexible polygeneration systems
- Investigated convergence rate of B&B algorithms and the cluster problem in constrained optimization

Indian Institute of Technology Madras Chennai, India
Undergraduate Research Assistant **2012**

- Explored use of a kernel-based Granger causality measure for nonlinear multivariate processes

École Polytechnique Fédérale de Lausanne (EPFL) Lausanne, Switzerland
Summer Intern in the Hatzimanikatis Lab (LCSB) **2011**

- Analyzed bifurcations in the number of stable steady states in E.coli's glycolysis pathway

Oral and Poster Presentations

- Data-Driven Sample Average Approximation With Covariate Information
  - INFORMS 2020 Annual Meeting. **Invited** Session: Data, Statistics and Learning in Energy System Optimization.
  - Argonne National Laboratory, September 2020.

  - Wisconsin Institute for Discovery 2020 Annual Symposium, UW-Madison (Poster).
  - Los Alamos National Laboratory, July 2020.
  - IPAM 2020 Workshop on Intersections between Control, Learning and Optimization (**Invited**).
- Stochastic DC Optimal Power Flow With Reserve Saturation
  - INFORMS 2020 Annual Meeting. **Invited** Session: Optimization in Energy Systems Under Uncertainty.
- Stochastic Approximation for Chance-Constrained Nonlinear Programs.
  - AIChE 2019 Annual Meeting. Interactive Session: Systems and Process Operations (Poster).
  - 2019 Computing in Engineering Forum, UW-Madison (Poster).
  - ICERM 2019 Workshop on Optimization of Systems Impacted by Rare, High-Impact Random Events (Poster).
  - Wisconsin Institute for Discovery 2019 Annual Symposium, UW-Madison (Poster).
- Optimization of Chemical Process Systems Under Uncertainty
  - ExxonMobil Research and Engineering, Clinton NJ, December 2017.
  - Lawrence Berkeley National Lab, Berkeley, CA, November 2017.
  - Rockwell Automation R&D, Austin TX, March 2017.
- GOSSIP: decomposition software for the Global Optimization of nonconvex two-Stage Stochastic mixed-Integer nonlinear Programs
  - INFORMS 2018 Annual Meeting. **Invited** Session: Computational Stochastic Programming.
  - AIChE 2016 Annual Meeting. CAST Division **Plenary**.
  - AIChE 2015 Annual Meeting. Session: Software Tools and Implementations for PSE.
- The Cluster Problem in Constrained Global Optimization
  - AIChE 2016 Annual Meeting. Session: Advances in Optimization I.
  - Global Optimization Workshop, 2016.
- Convergence-Order Analysis of Branch-and-Bound Algorithms for Constrained Problems
  - ICCOPT 2016. **Invited** Session: Advances in Deterministic Global Optimization I.
  - AIChE 2015 Annual Meeting. Session: Advances in Optimization I.
- A Decomposition Algorithm for Two-Stage Stochastic Mixed-Integer Nonconvex Programs
  - AIChE 2014 Annual Meeting. Session: Design and Operations Under Uncertainty II.
  - INFORMS 2014 Annual Meeting. **Invited** Session: Chance, Inference and Robustness.

Teaching Experience

Massachusetts Institute of Technology Cambridge, MA

Teaching Assistant **2015**

- Teaching assistant for the graduate-level *Chemical Reactor Engineering* course (50 students)
- Shared responsibility for office hours, online discussion forums, exams, homework assignments (including development of MATLAB and Q-Chem-based exercises), and grades

Math Lecturer for the IIT Joint Entrance Exam (IIT JEE) **2016**

- Recorded free video lectures for the entrance exam to the IITs as part of a team of MIT students
- Supported by the MIT Office of Digital Learning & **featured on MIT OpenCourseWare**

Indian Institute of Technology Madras Chennai, India

Math Olympiad Trainer at SMART **2008 - 2011**

- Coached around 30 middle-school and high-school students each year for the Math Olympiad
- One trainee was among the 40 students nationwide selected to attend the 2010 *International Math Olympiad Training Camp*

Research in Industry

Alcon, a Novartis Division Fort Worth, TX
Engineering Consultant **2013**

- Led a team of three MIT students in designing a measure of residual stress in molded intraocular lens wafers using statistical techniques in MATLAB to optimize Alcon's injection molding process
- Evaluated the efficacy of amorphous dispersions towards increasing the bioavailability of an opthalmic drug through experiments and thermodynamic and pharmacokinetic modeling in MATLAB

Corning Incorporated Corning, NY & Wilmington, NC
Engineering Consultant **2013**

- Led a team of three MIT students in determining the effects of oxygen on the cure rate of UV-curable acrylate polymers through experiments and first-principles modeling
- Conducted statistical analysis in MATLAB to accelerate cell culture media development by identifying key components that could enable meaningful scale-up and improve protein production efficiency

Orchid Chemicals and Pharmaceuticals Ltd. R&D Centre Chennai, India
Summer Intern in the Technology Transfer Lab **2010**

- Designed computational solutions in MATLAB to several scale-up problems. Tested the solutions by scaling up drug production from the laboratory to the pilot plant
- Implemented techniques for increasing drug size during crystallization to reduce filtration time.

Service

Session Chair (Invited), Computational Stochastic Programming, INFORMS 2018.

Invited Reviewer for: Mathematical Programming, Journal of Global Optimization, Journal of Optimization Theory and Applications, Optimization Methods & Software, Computational Optimization and Applications, Set-Valued and Variational Analysis, Industrial & Engineering Chemistry Research, American Control Conference, Power Systems Computation Conference.

Organizer of monthly teleconference meetings on optimization under uncertainty (about 15 participants) as part of the MACSER project (since Nov. 2018).

Organized the "Math Modeling" (Oct. 2010) and "Online Math Contest" (Oct. 2009) events in Shaastra, the annual technical festival of IIT Madras.

Volunteered for the Science Activities team of the National Services Scheme at IIT Madras (Sept. 2008 to May 2009). Designed and demonstrated science experiments in underprivileged schools.

Computer Skills

C++, C, Python, Julia, MATLAB, GAMS, R, FORTRAN, Unix shell scripts, Git, LaTeX.

Memberships

- American Institute of Chemical Engineers (AIChE), 2014-2017 & 2019-2020
- Institute for Operations Research and the Management Sciences (INFORMS), 2014-2015 & 2018-present
- Mathematical Optimization Society (MOS), 2016-2017

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