Rohit Kannan

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Research Interests

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

Professional Appointments

University of Wisconsin-Madison — Madison, WI

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

- Focus: Algorithms for data-driven stochastic optimization with application to power systems
- P.I.: Prof. James R. Luedtke (Industrial & Systems Engineering)

Education

Massachusetts Institute of Technology — Cambridge, MA

Ph.D. in Chemical Engineering — **Dec. 2017**

- 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 — **June 2014**

Indian Institute of Technology Madras — Chennai, India

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

Select Honors and Awards

Best Paper in the "Advances in Optimization I" session, AIChE Annual Meeting	2015
George M. Keller Graduate Fellowship, Dept. of Chemical Engineering, 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, IIT Madras	2010 & 2011
Prof. M. Ramanujam Memorial Award, Dept. of Chemical Engineering, 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

Refereed Journal Publications

J1. 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.

J2. R. Kannan and P. I. Barton (2017). The cluster problem in constrained global optimization. Journal of Global Optimization, 69(3), pp. 629-676.

J3. 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.

Refereed Proceedings

C1. R. Kannan, J. R. Luedtke, and L. A. Roald (2020). Stochastic DC optimal power flow with reserve saturation. Proceedings of the XXI Power Systems Computation Conference, pp. 1-10. Published in Electric Power Systems Research.

C2. 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.

Accepted Papers

A1. R. Kannan and J. R. Luedtke. A stochastic approximation method for approximating the efficient frontier of chance-constrained nonlinear programs. Mathematical Programming Computation. arXiv preprint arXiv:1812.07066, pp. 1-37.

Submitted Papers

S1. R. Kannan, G. Bayraksan, and J. R. Luedtke. Data-driven sample average approximation with covariate information. Submitted to Operations Research, pp. 1-34.

Working Papers

W1. R. Kannan, G. Bayraksan, and J. R. Luedtke. Residuals-based distributionally robust optimization with covariate information.

W2. R. Kannan, N. Ho-Nguyen, and J. R. Luedtke. Data-driven multi-stage stochastic convex optimization given a single trajectory of a vector autoregressive process.

W3. R. Kannan and P. I. Barton. GOSSIP: decomposition software for the Global Optimization of nonconvex two-Stage Stochastic mixed-Integer nonlinear Programs (based on Chapter 4 of my Ph.D. thesis).

W4. R. Kannan and P. I. Barton. A modified Lagrangian relaxation algorithm for two-stage stochastic mixed-integer nonlinear programs (based on Chapter 3 of my Ph.D. thesis).

Oral and Poster Presentations

- Predict, then smart optimize with stochastic programming
  - Argonne National Laboratory, September 2020.
  - WID 2020 Annual Symposium, UW-Madison (Poster).
  - Los Alamos National Laboratory, July 2020.
  - IPAM 2020 Workshop "Intersections between Control, Learning and Optimization" (**Invited**).
- Stochastic approximation for chance-constrained NLPs.
  - AIChE 2019 Annual Meeting. Interactive Session: Systems and Process Operations (Poster).
  - 2019 Computing in Engineering Forum, UW-Madison (Poster).
  - ICERM 2019 Workshop "Optimization of Systems Impacted by Rare, High-Impact Random Events" (Poster).
  - WID 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 lower bounding schemes for constrained global optimization 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
  - ISMP 2015. **Invited** Session: Advances in Global Optimisation.
  - AIChE 2014 Annual Meeting. Session: Design and Operations Under Uncertainty II.
  - INFORMS 2014 Annual Meeting. **Invited** Session: Chance, Inference and Robustness.

Research in the news

UW-Madison Engineering: Power tools: New math model optimizes energy

Academic Research Highlights

University of Wisconsin-Madison Madison, WI

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

- Designed a practical stochastic approximation method for chance-constrained nonlinear programs
- Modeled saturation of generator reserves in DC optimal power flow with uncertain loads and renewable generation capacity. Designed a stochastic approximation-based decomposition method for solving the resulting nonsmooth nonconvex two-stage stochastic program
- Designed new data-driven formulations for stochastic programs with side information. Investigated consistency and rates of convergence of approximations. Derived theoretical guarantees for multi-stage stochastic programs and distributionally robust formulations

Massachusetts Institute of Technology Cambridge, MA

Graduate Research Assistant **Sept. 2012 - Dec. 2017**

- Designed decomposition algorithms and a software with more than 50,000 lines of C++ code for solving two-stage stochastic mixed-integer nonlinear programs (MINLPs)
- Software is currently being used at MIT, and its test library has been used at CMU
- Investigated convergence rate of B&B algorithms and the cluster problem in constrained optimization

Indian Institute of Technology Madras Chennai, India

Undergraduate Research Assistant **Jan. 2011 - May 2012**

- Designed a kernel-based nonlinear Granger causality measure that extends partial directed coherence
- Developed a MATLAB tool for causality detection

École Polytechnique Fédérale de Lausanne (EPFL) Lausanne, Switzerland

Summer Intern in the Hatzimanikatis Lab (LCSB) **May - July 2011**

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

Teaching Experience

Massachusetts Institute of Technology Cambridge, MA

Math Lecturer for the IIT Joint Entrance Exam (IIT JEE) **May 2016 - Dec. 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**

Teaching Assistant **Jan. 2015 - May 2015**

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

Indian Institute of Technology Madras Chennai, India

Math Olympiad Trainer at SMART **Aug. 2008 - Apr. 2011**

- Coached around 30 middle 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 **Oct. 2013 - Dec. 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 **Aug. 2013 - Oct. 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 **May 2010 - July 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.

Computer Skills

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

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.

Memberships

AIChE (2014-2017,2019-2020), INFORMS (2014-2015,2018-present), MOS (2016-2017).

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