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Professional Experience and Education

Associate Professor (and earlier Assistant Professor), Department of Applied Mathematics, Illinois Institute of Technology, Chicago, Fall 2006 - present.

Co-Director, Computational Decision Science and Operations Research (CDSOR) Program, Illinois Institute of Technology, 2015 - present.

Leadership team, Supporting Pathways for Advancing Readiness in Computing (SPARC) scholarship for talented low-income STEM students, 2025 - present.

Ph.D. Mathematics, University of Illinois at Urbana-Champaign, 2006.

M.Sc. Mathematics, Indian Institute of Technology, Bombay, 1999.

Recognition and Support

NSF grant 2527602, S-STEM: Supporting Pathways for Advancing Readiness in Computing: AI, Mathematics, Cybersecurity, and Statistics, **co-PI**, $2M, 2026-31, awarded Aug 2025.

Board of Trustees Award for Excellence in Teaching 2019, University-wide award (one per year), Illinois Tech.

Excellence in Teaching Award 2017, College of Science, Illinois Tech. (one award per year)

Distinguished Teaching Fellow, College of Science, Illinois Tech, 2016-2019.

NSF grant 1559606, Extremal Combinatorics at Illinois III Conference, **PI**, $32400, 2016-17.

NSA grant H98230-16-1-0056, Extremal Combinatorics at Illinois III Conf., **PI**, $24900, 2016-17.

Invited Visiting Faculty, Gwangju Institute of Science and Tech, South Korea, Nov 2013.

Invited Visiting Faculty, Center for Discrete Math, Zhejiang Normal Univ, China, Oct 2013.

ERIF funding award for an interdisciplinary project in Transportation Networks with collaborators in Computer Science, and Transportation Engineering, Illinois Tech, 2009-2010.

AMS Project NExT Fellow, Mathematical Association of America, 2007-2008, selected as one of the six fellows of the American Mathematical Society for this professional development program of the MAA on instruction, advising, research, and academic citizenship.

Research and related Activities

Research Interests

Discrete Mathematics, especially Graph Theory, Network Optimization, and related models, algorithms, and interdisciplinary applications in transportation networks, health networks, and computer science. Also, ethical aspects of mathematical and optimization models, and particularly in equitable allocation of resources. Recent topics include: Enumerative and extremal problems in chromatic graph theory, including algebraic and probabilistic methods and perspectives; Models and algorithms for equitable allocation of resources and for interdependent networks.

Publications

- Over **50 papers** published in leading international journals in combinatorics, discrete math, optimization, and algorithms, including Advances in Applied Mathematics, Algorithmica, Combinatorica, Combinatorics, Probability and Computing, European J. of Combinatorics, European J. of Operational Research, J. of Combinatorics, J. of Graph Theory, Mathematical Programming, Random Stuctures & Algorithms, and SIAM Journal on Discrete Mathematics.
- **Junior co-authors**: 8 papers with at least one undergraduate student, 18 papers with at least one graduate student, and 8 papers with at least one postdoctoral scholar.
- **Major contributions** are in Graph packing: best results towards long-standing Bollobás-Eldridge conjecture and extensions of classic Sauer-Spencer theorem; Graph coloring: development of enumerative functions for list coloring, signed coloring, and DP-coloring, and answering conjectures on their asymptotic comparison with the chromatic polynomial; development of new notions of colorings, of color-criticality and their connections to enumerative and extremal problems; Approximation algorithms in graph optimization; Models and Algorithms for equitable resource allocation and network design, especially in transportation and healthcare networks.
- **Select Publications**
  - *Advances in Interdisciplinary Applied Discrete Mathematics*, (co-editor with H.M. Mulder), Interdisciplinary Mathematical Sciences, Volume 11, World Scientific Publishing, 2010, 275pp.
  - *New Global Optima Results for the Kauffman NK Model: Handling Dependency*, (with S.H. Jacobson), Mathematical Programming, 108 (2006), 475-494.
  - *Extremal Graphs for a Graph Packing Theorem of Sauer and Spencer*, (with A. Kostochka), Combinatorics, Probability and Computing, 16 (2007), 409-417.
  - *On a Graph Packing Conjecture of Bollobás, Eldridge, and Catlin*, (with A. Kostochka, G. Yu), Combinatorica, 28 (2008), 469-485.
  - *Long Local Searches for Large Bipartite Subgraphs*, (with D.B. West), SIAM Journal on Discrete Mathematics, 22 (2008), 1138-1144.
  - *Distinguishing Chromatic Number of Cartesian Products of Graphs*, (with J. Choi and S. Hartke), SIAM Journal on Discrete Mathematics, 24 (2010), 82-100.
  - *Maximum Series-Parallel Subgraph: Approximation Algorithms*, (with G. Calinescu, C.G. Fernandes, A. Zelikovsky), Algorithmica, 63 (2012), 137-157.
  - *New Methodology for Transportation Investment Decisions with Consideration of Project Interdependencies*, (with Z. Li, S. Kapoor, E. Veliou, B. Zhou, C. Lee), Transportation Research Record: J. of the Transportation Research Board of the National Academies, 2285 (2012), 36-46.
  - *On Alon-Tarsi Number and Chromatic-choosability of Cartesian Products of Graphs*, (with J. Mudrock), The Elect. Journal of Combinatorics, 26 (2019), article P1.3.
  - *Criticality, The List Color Function, and List Coloring the Cartesian Product of Graphs*, (with J. Mudrock), J. of Combinatorics, 12 (2021), 479-514.
  - *Network Design of Public Transit with Social Access Objectives*, (with A. Rumpf), EAAMO '21: ACM Conference on Equity and Access in Algorithms, Mechanisms, and Optimization 2021, Article 16.
  - *A Linear Input Dependence Model for Interdependent Networks*, (with A. Rumpf), European Journal of Operational Research, 302 (2022), 781-797.
  - *A Generalization of the Graph Packing Theorems of Sauer-Spencer and Brandt*, (with B. Reiniger), Combinatorica, 42 (2022), 1347-1356.
  - *On the List Color Function Threshold*, (with A. Kumar, J. Mudrock, P. Rewers, P. Shin, K. To), J. of Graph Theory, 105 (2024), 386-397.
  - *Flexible List Colorings: Maximizing the Number of Requests Satisfied*, (with R. Mathew, J. Mudrock, M. Pelsmajer), J. of Graph Theory, 106 (2024), 887-906.
  - *An Algebraic Approach for Counting DP-3-colorings of Sparse Graphs*, (with S. Dahlberg and J. Mu-

drock), European Journal of Combinatorics, 118 (2024), article 103890.

- *DP-Coloring of Graphs from Random Covers*, (with A. Bernshteyn, D. Dominik, J.Mudrock), Random Structures & Algorithms, 66 (2025), article e70000.
- *On a Spectral Turán Problem for a Fixed Tree*, (with D. Desai and B. Kudarzi), Linear Algebra and Applications, accepted for publication.
- *On strongly and robustly critical graphs*, (with A. Bernshteyn, J. Mudrock, G. Sharma), J. of Graph Theory, accepted for publication.

Invited Conference and Seminar Talks

- Over 29 invited talks in **conferences** in USA, Canada, and South Korea, including 6 international conferences, 16 AMS and SIAM meetings, and 6 one-hour plenary talks.
- Over 45 invited **colloquium and seminar** talks in universities in the USA, Canada, China, India, and South Korea.

Academic Service to the Profession

- Organized 4 **international conferences and workshops** with 50 to 140 participants each from around the world and funding by NSF, NSA, IMA, etc.; and 7 **minisymposia and special sessions** with 18 to 22 participants each from the USA and Canada.
- Organizing a **Discrete Math seminar** at Illinois Tech with 10+ talks each semester, on Zoom since 2020, with speakers and attendees from USA, Canada, Europe, and Asia.
- **Building connections between communities** in algebraic graph theory and extremal graph theory through organization of these seminars and conferences across these communities with researchers at all stages of their careers.
- **Referee** for over 21 international journals in Mathematics, Applied Math, Computer Science, Operations Research, and Statistics.
- **Review panel** member for AAAS, ORAU, National Science Center of Poland, French National Research Agency (ANR).

Student Advising and Mentorship

- Advisor to 8 graduated **PhD students**, and 2 current PhD students. Two of my students have won the Menger Student Award for Graduate Scholarship at Illinois Tech, and one earned an Honorable mention for NSF Graduate Fellowship.
- Invited as an **expert external examiner** for 9 PhD theses at universities in the USA, India, Singapore. And, member of 15 other PhD committees from Applied Math, CS, Chemical Engg, and ECE, in Illinois Tech.
- Research advisor to 6 graduated **M.S. students**, and 1 current M.S. student. Member of 8 other M.S. thesis committees at IIT.
- Conducted research with over 32 **undergraduate students** from Illinois Tech and other institutions, and 3 **high school students**. Several of these students have gone on to PhD programs. Four of these students have been honored for excellence in research by the Illinois Section of Mathematics Association of America, and by the College of Computing (and earlier College of Science) at Illinois Tech.
- 8 B.S. and M.S. students from Illinois Tech who have done research or extensive coursework in discrete math with me, and otherwise been **mentored by me**, have gone on to do a PhD in Discrete Math from other universities including UCLA, UIUC, Cornell, etc.

- Illinois Tech **team advisor** for the Mathematical Contest in Modeling (MCM), the premier math modeling competition with over 10000 teams from around the world, from 2015 onwards. Two of these teams (2016 and 2019) have been awarded as Meritorious Winners for placing in the 99.5 percentile.
- Advisor for semester-long team projects each spring semester (2014 onwards) based on open-ended real-world modeling problems, using data, math, computing, and implementation with writing communication, to give comprehensive **experiential learning** to all applied math majors (and others from CS, DS, Engg, etc) at Illinois Tech.

Curriculum Development and Teaching Experience

- Developed a comprehensive **scholarship program** SPARC for low-income STEM students in the College of Computing jointly with CS and Information Technology & Management (2024-2025). Secured $2M in funding from NSF S-STEM program (2025-2031), and building a complete ecosystem of support through recruitment, admissions, financial aid, administration, advising, mentorship and evaluation, to ensure student success (2025-2031).
- Created a new **inter-disciplinary M.S. program in Operations Research** (CDSOR) with CS, developed (with S. Kapoor, CS) in 2014-15, approved in 2015. This program has attracted both domestic and international students with work experience, particularly from European partner universities.
- Modernized and completely restructured the existing **M.S. program in Applied Math**, in 2018-19 (as chair of the committee), approved in 2019. The new program has remarkable flexibility for students to pursue a curriculum that can range from a traditional M.Sc. with thesis to a modern M.Sc. with a choice of specialization in a wide variety of contemporary applied fields.
- Created 4 new courses from scratch, and completely revised and updated 6 other courses. These **undergraduate and graduate courses** range over topics like linear algebra, real analysis, math modeling, optimization, combinatorics, and graph theory.
- **Pedagogical innovation** such as: flipped version of Real Analysis (Math 400); experiential learning through projects on modeling with math and data, optimization, networks and graph theory, combinatorics, and more (Math 100, Math 380, Math 535, Math 537, Math 554, etc.).
- Taught 15 different **courses** over the whole range of the curriculum from first year undergrads to advanced PhD students.
- Given the **Board of Trustees Award for Excellence in Teaching** 2019, University-wide award (one per year).
- Given the **Excellence in Teaching Award** 2017 for College of Science (one per year).
- Honored as **Distinguished Teaching Fellow**, College of Science, (one of total 5 awardees).

Service and Leadership in the Home Institution

- **Leadership team**, Supporting Pathways for Advancing Readiness in Computing (SPARC) scholarship, 2025 - present.

  Co-created this STEM program with M. Bilgic, CS; I. Cialenco, Applied Math, G. Gopal, ITM, supported by $2M NSF S-STEM grant. Actively engaged with administrative offices across the university, including Admissions, Financial Aid, Marketing, Student Success, Health Services, Dean and Provost offices, to built a complete administrative structure encompassing recruitment, admissions, financial aid, advising, mentorship, and evaluation, to ensure student success from academics to future careers.
- **Co-Director & Co-Advisor**, M.Sc. CDSOR, 2015 - present.

Co-created this new interdisciplinary graduate program with S. Kapoor of CS; activities include: advising students on Math coursework and requirements, as well as on career planning; co-authoring annual official assessment report; marketing efforts for the program and contacting potential industrial partners for internships, etc.

- **Co-Advisor**, SIAM Student Chapter, Illinois Tech, 2012 - present.
  SIAM chapter is active in organizing activities, including talks, panel discussions on career advice, an annual student conference with participants from all over the midwest, and social events, including a series of talks introducing all mathematics research groups, and a new series of talks on 'my favorite theorem' to popularize mathematics, with funding from SIAM and the student government.
- Active member of a wide variety of **university, college and department level committees**, especially related to mental health of students, strategic planning at university and departmental level, support of undergraduate research, graduate studies and PhD admissions, improvement in pedagogy and coursework, and recognition of innovative work by faculty and students.
- Regular organization of **panel discussions with alumni and faculty** aimed at students preparing for research, internships, and graduate school.
- Organization and support of **Math and Poster competitions** in the university.
- **Department Representative** for recruiting events for undergraduate and graduate programs on- and off-campus as well as in conferences.