Curriculum Vitae

Daniel Bienstock

Liu Family Chair in Operations Research
Dept. of IEOR, Columbia University
Joint affiliation: Applied Math, Electrical Engineering
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Research interests

My research focuses on fundamental methodological and computational aspects of optimization, with emphasis in large-scale, nonconvex and discrete optimization problems. An additional research thrust has focused on optimization problems related to analysis and operations of power transmission networks, including efficient operations, economics and risk analysis. Another recent research thrust concerns the use of mixed-integer programming techniques toward solving mixed-integer or purely continuous quadratically constrained quadratic programs and polynomial optimization problems. Here my particular focus concerns lifted representation of nonconvex problems as higher-dimensional convex problems. Finally, I am also interested in all aspects of high-performance computation as applied to problems arising in science and engineering, and generally problems with large societal impact.

Awards and Honors

I will give a plenary talk at the 2027 International Symposium on Mathematical Programming (Amsterdam).
My former PhD student Gonzalo Muñoz was awarded the 2023 Informs Optimization Society (IOS) Young Researchers Prize, and the 2016 IOS Student paper prize.
Keynote address, 2023 INFORMS National Meeting.
Khachiyan Prize (2022).
Liu Family Chair (2018).
Fellow, Institute for Operations Research and Management Science (2013).
Semi-plenary Speaker, 2006 Mathematical Programming Sympsioum (Rio).
Plenary Speaker, 2005 SIAM Optimization Conference (Stockholm).
IBM Faculty Partnership Award (2005).
Presidential Young Investigator Award (1990 - 1995).
Zannetos Thesis Prize, M.I.T., 1985.

Recent research grants

- ARPA-E "Plus-Up, PERFORM", (joint with Y. Dvorkin and A. Newman), my part approx. $250,000 (2025).
- ARPA-E "GO competition, challenge 3 prize + NCE", (joint with Richard Waltz), my part approx. $260,000 (2025).
- Office of Naval Research, "Contested Logistics," (joint with Alexandra Newman) my part approximately $ 400,000 (2024).
- Air Force Office of Research, "Novel Polyhedral Approaches to Integer and Quadratically Constrained Quadratic Programming," (joint with Y. Faenza), my part approximately $310,000 (2023).
- ARPA-E "PERFORM NCE", PI. Joint with A Capponi, G. Iyengar (Columbia), Yury Dvorkin (NYU) and Michael Chertkov (U. of Arizona). My part approximately $90,000 (2023).

- ARPA-E "GO competition, challenge 3", (joint with Richard Waltz), my part approx. $200,000 (2022).
- ARPA-E "PERFORM", PI. Joint with A Capponi, G. Iyengar (Columbia), Yury Dvorkin (NYU) and Michael Chertkov (U. of Arizona). Approximately $2 million. (2020-2023).
- ARPA-E "GO competition, challenge 2", (joint with Richard Waltz), my part approx. $200,000 (2020). **Placed second.** Won $530,000.
- ARPA-E (joint with R. Waltz and J. Nocedal), "GO competition, challenge 1", my part approx. $250,000 (November 2018 - November 2019).

Service and Editorships

MOS-SIAM Book Series Board.

Chair, Informs Optimization Society Refereed Venue (2024). Steering committee (2026).

I initiated the MIP series of conferences on mixed-integer programming in 2003. The computational competition in MIP is often run using my servers.

Program Committee, *SIAM ACDA23*.

Program Committee Chair, *IPCO 2020*.

Chair, *INFORMS Optimization Society*, 2019, 2020.

Editor-in-chief, *Mathematical Programming Computation* (1/2015 - 12/2018).

Program Committee, *International Symposium on Mathematical Programming 2018*.

Committee member, IPCO, SODA, SEA, ISCO, other conferences (multiple instances).

Nicholson Award Committee (2007 - 2010, 2015 -).

Informs Fellows Selection Committee (2015 - 2017).

Commitee member, Informs Computing Society Prize (2012-2015).

IPCO Steering Committee (2002 - 2010). Chairman (9/2007 - 2010) .

Chairman, IPCO X Organizing Committee (June 2004).

Committee Member, Beale-Orchard-Hays Prize (ISMP 2003).

Associate Editor of *Math. Programming C* (2008- 2014), *Annals of O.R.* (2011-), *Math. Programming* (1995-1999), *SIAM J. Disc. Math.* (1992 -), *Oper. Res.* (2002 - 2006), *Mgt. Science* (2002 - 2006), *Disc. Optimization* (2004 - 2012).

Employment

7/89 - present. Dept. of Industrial Engineering and Operations Research, Columbia University. Associate Professor, 1990. Tenured, 1991. Full Professor, 1995. Joint appointment in Applied Physics and Applied Mathematics, May 2008. Joint appointment in Electrical Engineering, May 2018.

8/85 - 4/86. Graduate School of Industrial Administration, Carnegie Mellon University.

4/86 - 8/89. Combinatorics and Optimization Research, Bellcore.

Education

5/82. B.A., Mathematics, Brandeis University (Summa Cum Laude).

6/85. Ph.D., Operations Research, M.I.T.

Professional Societies

Informs, Mathematical Programming Society, SIAM, IEEE.

Invited and Refereed Presentations (1989-present)

1989

Oberwolfach meeting on Combinatorial Optimization – "Generalized max-flow min-cut problems in the plane".
Cornell (School of O.R.) – "Obstructions to small face covers".
Rutgers (RUTCOR) – "Obstructions to small face covers".
ORSA/TIMS meeting (New York) – "Critical edge problems".
Courant Institute – "Provably hard crossing number problems".
DIMACS meeting on Network Survivability (Rutgers) – "Graph searching, path-width and tree-width".

1990

Integer Programming and Combinatorial Optimization Conference (Waterloo) – "Provably hard crossing number problems".
Sixth Ann. Symp. on Comp. Geometry (Berkeley) – "Provably hard crossing number problems".
Cornell (School of O.R.) – "Blocking small cuts in a network".
N.Y.U. (School of Business) – "Blocking small cuts in a network".
ORSA/TIMS meeting (Philadelphia) – "New results on crossing numbers".
M.I.T. (O.R. Center) – "Searching a network for a virus".
Georgia Tech. (Indust. and Syst. Eng.) – "Blocking small cuts in a network".

1991

U. of Montreal (Comp. Science) – "Searching a network for a virus".
Carleton University (Math.) – "New results on crossing numbers".
SUNY Stony Brook (Appl. Math.) – " Lot-sizing in trees, and network design".
IBM (Yorktown Hts.) – " Computational experience with an algorithm for local access network design".

1992

Cornell (School of O.R.) – "Computational experience with some difficult integer programs".
IBM (Yorktown Hts.) – "Computational experience with OSL on a difficult routing problem in lightwave networks".
Bellcore – " Computational experience with an algorithm for local access network problems".

1993

CORE (U. C. de Louvain, Belgium) – "Computational experience with a strong formulation for a difficult network design problem".
Telecommunications Systems Conference (Vanderbilt) – "Computational experience with an algorithm for a difficult problem in lightwave networks".
DIMACS Conference on Approximation Algorithms – "Several difficult combinatorial optimization problems in telecommunications".
DIMACS Conference on Hard Combinatorial Optimization Problems – "Computational experience with a cutting-plane algorithm for a difficult multicommodity flow problem".

1994

SUNY Stony Brook (Appl. Math.) – " Computational experience with a branch-and-bound quadratic programming algorithm".
ORSA meeting (Boston) – " Capacitated Network Design: Polyhedral Structure and Computation".
ORSA meeting (Boston) – " Solving real-life ATM network design problems".
Math. Programming Symposium – " Capacitated Network Design: Polyhedral Structure and Computation".
Math. Programming Symposium – " Solving real-life ATM network design problems".
Rice University – " Capacitated Network Design: Polyhedral Structure and Computation".
New York Academy of Sciences – "Mixed-integer, multicommodity flow problems".

1995
SUNY Stony Brook (Harriman School) – "Mixed-integer, multicommodity flow problems".
IPCO '95 (Copenhagen) – " Computational experience with a branch-and-bound quadratic programming algorithm".
Northwestern University – " Computational experience with a branch-and-bound quadratic programming algorithm".
ORSA meeting (N. Orleans) – " Computational experience with a branch-and-bound quadratic programming algorithm," "Algorithms for network design problems".
U. of Waterloo – "Algorithms for network design problems".

1996
Artemis meeting (Aussois, France) – "Combinatorial algorithms for network design problems".
Network day (DIMACS) - "Combinatorial algorithms for network design problems".
ORSA meeting (Atlanta) - "Combinatorial algorithms for network design problems".
Northwestern University - "Combinatorial algorithms for network design problems".

1997
IBM (Yorktown Hts) - "Computational experiments with a network design algorithm using ϵ-approximate linear programs."
ISMP '97 (Lausanne, Switzerland) -"Computational experiments with a network design algorithm using ϵ-approximate linear programs."
ISMP '97 (Lausanne, Switzerland) -"Network design with flow-survivability constraints."
ISMP '97 (Lausanne, Switzerland) -"Computational experience with an ATM network layout procedure."
Berlin -"Computational experiments with a network design algorithm using ϵ-approximate linear programs."
Lucent -"Computational experiments with a network design algorithm using ϵ-approximate linear programs."

1998
Cornell -"Computational experiments with a network design algorithm using ϵ-approximate linear programs."
INFORMS-"Polyhedral structure of survivable network design problems."
DIMACS-"Solving LP relaxations of large-scale network design problems"

1999
Oberwolfach - "Solving LP-relaxations of large-scale network design problems."
DIMACS Workshop on Logistics -"Solution of an airline maintenance scheduling problem."
IBM -"Solution of an airline maintenance scheduling problem."
IBM (Gomory meeting) -"Epsilon-approximate LP solutions: new bounds and computation"

2000
Symposium on Discrete Algorithms (SODA) -"Epsilon-approximate LP solutions: new bounds and computation".
Boca Telecomm. Conference -"Approximately solving linear programs: a tutorial".
Optimization Days (Stockholm) -"Approximately solving linear programs: a tutorial".
Telecommunications Coference (Salerno, Italy) -"Solving practical network design problems: theory and practice".
CORE Lecture Series (CORE, Belgium) -"Approximately solving large-scale linear programs" (five three hour lectures).

2001
MIT -"Approximation Algorithms for Linear Programming: From Theory to Growing Practice".
CMU -"Approximation Algorithms for Linear Programming: From Theory to Growing Practice".
UNC -"Approximation Algorithms for Linear Programming: From Theory to Growing Practice".
Donet Summer School/IPCO - 4-hour tutorial on approximation algorithms for large-scale linear programming.
Ga. Tech. -"Approximation Algorithms for Linear Programming: From Theory to Growing Practice".

2002

INFORMS Telecomm. Conference - Tutorial on approximate routing algorithms.
Royal Technical Institute, Stockholm - Faculty opponent for Mikael Prytz's thesis defense.
APMOD'02 (Italy) - "Combined pricing and network design."
Integer Programming Conference in honor of Egon Balas - "Subset algebra lifting algorithms for 0-1 Integer Programming."
Bell Laboratories - "Subset algebra lifting algorithms."
IMA Tutorial on Supply-Chain Optimization - "Large-scale Linear Programming."
IMA Workshop on Integer Programming - "Subset algebra lifting algorithms."
Lehigh University - "Subset algebra lifting algorithms."

2003

ZIB (Berlin Algorithms Day) - "Subset algebra lifting algorithms.".
GSIA, Carnegie Mellon - "Subset algebra lifting algorithms."
MIT - "High-Performance Network Design."
Rutgers - "Subset algebra lifting algorithms."
DIMACS Workshop on Geometric Optimization - "New Trends in Linear and Integer Programming."
ISMP 2003 (Copenhagen) - "Subset algebra lifting algorithms."
INFORMS Atlanta - "Combined network design and pricing"
U. of Buffalo - "Combined network design and pricing"
IBM (Yorktown Hts.) - "Concurrent flows in $O(1/\epsilon)$ iterations."
IBM (Yorktown Hts.) - "Subset algebra lifting algorithms."

2004

Lehigh University - "Subset algebra lifting algorithms."
Oberwolfach (Math. in the Supply Chain) - "Modeling the Lucent supply chain."
STOC 2004 (Chicago) - "Concurrent flows in $O(1/\epsilon)$ iterations."
France Télécom (Paris) - "Large-scale routing algorithms – the state of the art"
France Télécom (Paris) - "Lift-and-project algorithms for integer programming".
University of Chemnitz - "Tree-width and the Sherali-Adams operator."

2005

IBM (Yorktown Hts.) - "Large scale routing algorithms."
Plenary talk, SIAM Conference on Optimization (Stockholm) - "Discrete Optimization and Network Design".
Cornell - "New algorithms for the maximum throughput problem".
IMA - "Optimization and Robust Power Grids".
National Science Foundation - "Optimization and Robust Power Grids".
INFORMS (San Francisco) - "Computing robust basestock levels."

2006

Georgia Tech - "Computing robust basestock levels."
Oberwolfach - "New algorithms for the maximum throughput problem".
NSF Workshop on Adaptive Dynamic Programming (Mexico) - "Optimization and Robust Power Grids".
INFORMS Practice conference - "Robust optimization in supply-chain".
Semi-plenary speaker, 2006 Mathematical Programming Symposium (Rio).
MIT - "Experiments in Robust Portfolio Optimization".
INFORMS Boston Chapter - "Optimization and Robust Power Grids".
U. of Wisconsin - "Experiments in Robust Portfolio Optimization".
Duke University - "Experiments in Robust Portfolio Optimization".

2007

Tech. University Berlin - "Experiments in Robust Portfolio Optimization".
Carisma meeting (London) - "Experiments in Robust Portfolio Optimization".
MIP Meeting (Montreal) - "Experiments in Robust Portfolio Optimization".
Informs 2007 - "The attack problem in power grids".

Informs 2007 - “Experiments in Robust Portfolio Optimization’.
McGill University – “The attack problem in power grids”.
Lehigh University - “The attack problem in power grids”.
Lehigh University - “Experiments in Robust Portfolio Optimization’.

2008

Informs Optimization Conference – “The attack problem in power grids”.
Carisma meeting (London) - “Experiments in Optimal Trade Execution”.
U. of Rome - “New results on knapsack problems.”.
Informs 2008 - “New results on knapsack problems.”.
Informs 2008 - “Finding weaknesses in power grids.”.

2009

U. of Wisconsin - “The N-k problem in power grids.”
U. of Washington - “New results on knapsack problems.”.
Ohio State University - “The N-k problem in power grids.”
Plenary speaker, International Network Optimization Conference (Pisa, Italy, April 2009).
Invited speaker, Laurence Wolsey birthday celebration (CORE, Belgium, May 2009).
MIP ’09 - “Eigenvalue techniques in nonconvex optimization.”
Los Alamos Nat’l Lab - “Continuing work on power grid problems.”
Alcatel-Lucent - “Continuing work on power grid problems.”
Cornell - “Eigenvalue techniques in nonconvex optimization.”
Georgia Tech - “Eigenvalue techniques in nonconvex optimization.”
CMU - “Eigenvalue techniques in nonconvex optimization.”
Texas A & M - “Continuing work on power grid problems.”

2010

U. of Florida - “Continuing work on power grid problems.”
Berkeley DOE meeting (plenary) – “Continuing work on power grid problems.”
EWMINLP10 (Marseille) - “Eigenvalue techniques in nonconvex optimization.”
CORE (Belgium) - “A new LP algorithm for precedence constrained production scheduling.”
IPCO (Lausanne) - “Eigenvalue techniques in nonconvex optimization.”
IPCO (Lausanne) - “A new LP algorithm for precedence constrained production scheduling.”
Snowbird DOE-SIAM meeging - “Optimal control of cascading power grid failures.”
Informs 2010 - “Eigenvalue techniques in nonconvex optimization.”
Informs 2010 - “A new LP algorithm for precedence constrained production scheduling.”

2011

Brookhaven Nat’l Lab - “Computational Math of the Power Grid.
Telcordia - “Computational Math of the Power Grid.
SIAM Conference on Optimization (Darmstadt) - “The N-K problem with AC power flows.”
FERC (Washington, DC) - “Online Control of Cascading Power Failures.”
IEEE Power Engineering Society Nat’l Meeting - “Online Control of Cascading Power Failures.”
SIAM Conference on Computational Science and Engineering (Reno) - “Online Control of Cascading Power Failures.”
DOE P.I. Meeting - “Online Control of Cascading Power Failures.”
Informs Nat’l Meeting - “Convex Optimization over Non-Convex Domains.”
Informs Nat’l Meeting - “Mitigating the Impact of a Pandemic Through Robust Optimization.”
Joint CDC-IEEE meeting - “Online Control of Cascading Power Failures.”

2012

Aussois - “Convex Optimization over Non-Convex Domains.” (A. Michalka).
Santa Fe conference on complex systems - “Online Control of Cascading Power Failures.”
Federal Energy Regulatory Commission - “Chance-constrained optimal power flow.”
STOC Workshop on Computational Sustainability - “Computational Challenges in Power Grid Modeling:

Strong Algorithms for Power Flows and Understanding Cascades."
ISMP Berlin - "Convex Optimization over Non-Convex Domains."
ISMP Berlin - "Chance-constrained optimal power flow."

Informs Nat'l Meeting - "Strong formulationes over Non-Convex Domains."
Informs Nat'l Meeting - "Chance-constrained DC-OPF"

2013

USC - "Mitigating the Impact of a Pandemic Through Robust Optimization."
National Research Council Workshop on the Resiliency of the Electric Power Delivery System in Response to Terrorism and National Disasters – "Simulation and Control of Cascades."
SIAM Conference on Computational Science and Engineering - "Analysis of geographically correlated power grid cascades."
DIMACS Workshop on Energy Infrastructure - "Chance-constrained optimal power flow."
Federal Energy Regulatory Commission - "Synchronization aware OPF."
2013 IREP Symp. - "Synchronization-Aware and Algorithm-Efficient Chance Constrained OPF."
Allerton Conference - "Stochastic control of power line temperature."
MIT - "Convex Optimization over Non-Convex Domains."
Informs Nat'l Meeting - "Cutting planes for Convex Optimization over Non-Convex Domains."
U. Michigan - "Chance-constrained optimization problems in the power grid."
CDC - "Stochastic control of power line temperature."

2014

SODA - "Polynomial solvability of variants of the trust-region subproblem."
INFOCOM - "Power Grid Vulnerability to Geographically Correlated Failures - Analysis and Control Implications"
MINLP - "Recent results on solving QCQPs, and related problems."
FERC - "Multi-time-step Chance Constrained Generation Re-dispatch."
MIP - "Solving QCQPs."
IEEE PES - "Efficient Direct Test for Dynamics Following a Cleared Fault."
MOPTA - "Solving QCQPs."
INFORMS - "Solving QCQPs", "A new relaxation for AC-OPF."
Rutgers - "Modeling the power grid".
PGMO'14 (École Polytechnique) - "Solving QCQPs."
Waterloo - "A new LP formulation for polynomial optimization."

2015

LANL Winter School - "Optimization Fundamentals of OPF Problems."
LANL Winter School - "A new LP formulation for polynomial optimization."
Princeton - "A new LP formulation for polynomial optimization."
FERC - "Identifying and controllying risky contingencies of transmission systems"
ISMP - "LP formulations for mixed-integer polynomial optimization problems"
GraphEx - "Sample average approximation and cascading failures of power grids"
PES - "On linear relaxations of OPF problems"
Ga. Tech - "LP formulations for mixed-integer polynomial optimization problems"
JHU - "LP formulations for mixed-integer polynomial optimization problems"
CMO-BIRS (Oaxaca) - Opening talk: "Exploiting structured sparsity in mixed-integer polynomial optimization"
Montreal - "Exploiting structured sparsity in mixed-integer polynomial optimization"

2016

Aussois - "Exploiting structured sparsity in mixed-integer polynomial optimization"
Ga. Tech - "Operations research problems in power engineering"
Berkeley - "Operations research problems in power engineering"
U. of Illinois - "Recent results on polynomial optimization problems"

CWI, Amsterdam - "Operations research problems in power engineering"
FERC – "Robust optimization of batteries"
IMA – "Overview of Polynomial Optimization Problems"
U. of Michigan – "Robust optimization of batteries"

2017

LANL Winter School – "Robust optimization of batteries"
Clemson University – "Robust optimization of batteries"
ACM Sigmetrics workshop – "Computing undetectable attacks on power grids"
SIAM Optimization Conference – "S-free Sets for Polynomial Optimization and Oracle-Based Cuts"
SIAM Optimization Conference – Tutorial (joint with P. Van Hentenryck) "New Developments on Optimal Power Flow Problems"
Reconnect Workshop on Reliability of the Power Grid – three talks on structure and resiliency of the power grid.
Porquerolles workshop (France) – Plenary talk: "S-free Sets for Polynomial Optimization and Oracle-Based Cuts"
ODS 2017 (Sorrento, Italy) – Plenary talk: "Robust network control and disjunctive programming"
USC – "Robust network control through disjunctive programming"
Ga. Tech – "Controlling variability in power systems"

2018

Aussois – "S-free Sets for Polynomial Optimization and Oracle-Based Cuts" (talk by G. Muñoz)
SIAM WNS 18 – "Stochastic defense against ideal grid attacks" (talk by M. Escobar)
PSCC 18 – "Variance-aware optimal power flow"
Tel Aviv workshop on optimization and discrete geometry – 'Easier derivation of bounded pitch inequalities for set covering problems"
ISMP 18 – "Using Integer Programming to Train Neural Networks"
CMU (Tepper) – "Two applications of disjunctive programming"
MOPTA 18 plenary – "Variability in power systems: stochastic defense against ideal grid attacks"
U. Chicago Booth – "Big data problems in power grids."
Duke CS – "Principled deep neural network training through linear programming"
Triangle lecture in combinatorics – "Approximate Nonconvex Optimization and Treewidth"

2019

IPCO 2019 – "Outer-Product-Free Sets for Polynomial Optimization".
Powertech '19 – "Learning from power system data stream: phasor-detective approach"
Oberwolfach – "Solving nonconvex optimization problems."
INFORMS '19 – "Principled deep neural network training through linear programming", "Stochastic defense against complex grid attacks."
Balas memorial – "Solving nonconvex optimization problems."

2020

CTW 2020 (Ischia) – Plenary, "Numerically hard algebraic optimization problems."
New York Scientific Data Summit – "Risk in Power Systems."
Cornell – "Complexity and Exactness in Polynomial Optimization."
INFORMS – multiple talks.
U. of Arizona – "Complexity and Exactness in Polynomial Optimization."

2021

U. of Erlangen – "Complexity and Exactness in Polynomial Optimization."
MIP 21 – "Complexity and Exactness in Polynomial Optimization."
SIAM Conference on Optimization 2021 – "Complexity and Exactness in Polynomial Optimization."
Bell Labs – "Data and Power Grids."
Google – "Data and Power Grids."

2022
UT Austin – "Solving security-constrained ACOPF problems."
Keynote Speaker, ACM Critical Infrastructure Network Security workshop, U. of Illinois at Urbana-Champaign.
Bonn Workshop on Combinatorial Optimization (in honor of Bill Cook).
IEEE PES GM – PERFORM panelist.
FERC – "Solving ACOPF."
INFORMS – multiple talks.
Rocky Mountain Informs Chapter – "Practical Solution Approaches to Optimization and Engineering: Case Studies in Mine Planning and Electrical Power."

2023
ICERM (Brown U.) – "Solving ACOPF."
Gurobi, LLC. – "Solving ACOPF."
Georgia Tech – "Solving ACOPF."
General Electric (Niskayuna, NY) – "Next-generation energy markets."
Air Force grantees workshop – "Solving ACOPF."
Informs – multiple talks.
PSERC Workshop, Atlanta – "ACOPF in the GO competition."
Rice University – "Accurate and Warm-Startable Linear Cutting-Plane Relaxations for ACOPF."

2024
University of Tennessee, Knoxville – "Accurate and Warm-Startable Linear Cutting-Plane Relaxations for ACOPF."
IOS – "Accurate and Warm-Startable Linear Cutting-Plane Relaxations for ACOPF.."
IOS – "Risk-Aware Security-Constrained Unit Commitment."
University of Bergamo – "Accurate and Warm-Startable Linear Cutting-Plane Relaxations for ACOPF."
CDC 2024 (Milano) – "Accurate and Warm-Startable Linear Cutting-Plane Relaxations for ACOPF.."
INFORMS – multiple talks.

2025
ICS 2025 – "Risk-Aware Security-Constrained Unit Commitment."
Lehigh – "Solving ACOPF problems.
Hotelling Lectures, UNC – "Solving ACOPF problems.
Global Optimization workshop, Stockholm – "Solving ACOPF problems.
PSERC workshop – "Risk-aware power flows."

2026
Rutgers – "Solving ACOPF problems."
Cornell – "Derisking solutions to optimization problems."
Georgia Tech – "Derisking solutions to optimization problems."

Doctoral Students
Tongtong Chen.
Blake Sisson (APAM).
Matías Villagra, PhD Spring 2026.
Justin Kilb, Alexander Derenchuk, Remi Ankinwono (Colorado School of Mines – co-advised with Alexandra Newman).
Phil Dinenis (APAM, co-advised with Kyle Mandli, Ph.D. June 2023).
Mauro Escobar (Ph.D. July 2019).
Apurv Shukla (joint with G. Iyengar, Ph.D. April 2022).
Gonzalo Muñoz (Ph.D. July 2017).
Sean Harnett (APAM, Ph.D. March 2016).
Alexander Michalka (Ph.D. August 2013).
Cecilia Zenteno (Ph.D. July 2012).
Aron Ahmadia (APAM, co-advised with David Keyes, Ph.D. March 2010).

Abhinav Verma (Ph.D. December 2009).
Nuri Özbay.(Ph.D. May 2006).
Anton Riabov (Ph.D., May 2004)
Mark Zuckerberg (Ph.D., February 2004).
O. Raskina (Ph.D., December 2002).
Thomas Odenthal (Ph.D. May 1999).
Gabriella Muratore (Ph.D. April. 1999).
Yunhee Jang (Ph.D. June 1996).
Oktay Günlük (Ph.D. June 1994).
Nicole Diaz (Ph.D. May 1992).

Courses Taught (1989-present)

IEOR 3608 (Intro. to Mathematical Programming, 7 terms)
IEOR 6605 (Network Flows, 12 terms)
IEOR 6604 (Optimization II, 5 terms)
IEOR 4004 (Introduction to deterministic models, 7 terms)
IEOR 4100 (Computer Graphics for IEOR Applications, 5 terms)
IEOR 4500 (Applications Programming for Financial Engineering, 23 terms)
IEOR 4600 (Applied Integer Programming, 8 terms)
IEOR 6603 (Combinatorial Optimization, 9 terms)
IEOR 6608 (Integer Programming, 6 terms)
IEOR 4007 (Optimization in Financial Engineering, 1 term)
IEOR 4525 (ML for OR and FE, 1 term)
IEOR 4739 (Computational methods for Financial Engineering, 3 terms)
CSOR 4231 (Analysis of Algorithms I, 2 terms)
IEOR 8100 (Topics in Discrete Optimization, 1 term)
IEOR 8100 (Computational Math of the Power Grid, 1 term)

Publications

Books

Electrical Transmission System Cascades and Vulnerability: An Operations Research Viewpoint, ISBN 978-1-611974-15-7. SIAM-MOS Series on Optimization (2015).
Potential Function Methods for Approximately Solving Linear Programming Problems, Theory and Practice, ISBN 1-4020-7173-6. Kluwer Academic Publishers, Boston (2002).

Special Volumes

Analytic Research Foundations for the Next-Generation Electric Grid (coauthor), *The National Academies Press* (2016).

Journal and Conference Publications

1. Solving Convex QPs with Structured Sparsity undier Indicator Conditions, with T. Chen, submitted (2026); arxiv:2411.11722.
2. Probabilistic Modeling versus Robust Optimization: A tutorial based on a humanitarian logistics use case, with J. Kilb and A. Newman, submitted (2026).

3. Accurate Linear Cutting-Plane Relaxations for ACOPF, with M. Villagra (2024), *Mathematical Programming C* (2025), 1 – 55.

4. Accurate and Warm-Startable Linear Cutting-Plane Relaxations for ACOPF, with M. Villagra, *Proc. 2024 IEEE 63rd Conference on Decision and Control (CDC)* (2024), 5024 – 5031.

5. Risk-Aware Security-Constrained Unit Commitment: Taming the Curse of Real-Time Volatility and Consumer Exposure, with Y. Dvorkin, C. Guo, R. Mieth and J. Wang, *IEEE Transactions on Energy Markets, Policy and Regulation* (2024) 536 – 551.

6. Virtual Trading in a Multi-Settlement Electricity Market, with A. Capponi, G. Iyengar and B. Yang. SSRN 461966.

7. Optimizing Ventilation in Medium-and-Short Term Mine Planning, with J. Ayaburi, A. Swift, A. Brickey and A. Newman, *Optimization and Engineering* (2024) 1–26.

8. Cardinality Minimization, Constraints, and Regularization: A Survey, with AM Tillmann, A. Lodi and A. Schwartz, *SIAM Review* **66** (2024) 403 - 477.

9. Surface Coal Mine Production Scheduling under Time-of-Use Power Rates, with A. McBrayer, A. Brickey and A. Newman, *Current Sustainable/Renewable Energy Reports* **10** (2023), 82–101.

10. Physics-Informed Machine Learning for Electricity Markets: A NYISO Case Study, with M. Chertkov, Y. Dvorkin, R. Ferrando, Z. Liang, R. Mieth and L. Pagnier, *IEEE Trans. on Energy Markets, Policy and Regulation* **2** (2023), 40 – 51.

11. On a Computationally Ill-Behaved Bilevel Problem with a Continuous and Nonconvex Lower Level, with Y. Beck, M. Schmidt and J. Thürauf, *J. of Optimization Theory and Applications* **198** (2023), 428–447.

12. Principled Deep Neural Network Training through Linear Programming, with G. Muñoz and S. Pokutta, *Discrete Optimization* **49** (2023), 100795.

13. Robust Streaming PCA, with M. Jeong, A. Shukla and S-Y. Yun, *Proc. NeurIPS 2022*.

14. Complexity, Exactness and Rationality in Polynomial Optimization, with A. del Pia and R. Hildebrand. Full version. *Mathematical Programming* (2022).

15. Mathematical programming formulations for the alternating current optimal power flow problem, with M. Escobar, C. Gentile and L. Liberti, *Annals of Operations Research* (online, 2022).

16. Complexity, Exactness and Rationality in Polynomial Optimization, with A. del Pia and R. Hildebrand, *Proc. IPCO 2021*, 58 – 72.

17. Pitch, extension complexity, and covering problems, with Y. Faenza and X. Zhang, *Operations Research Letters* **49** (2021), 357 – 364.

18. Optimization of coastal protections in the presence of climate change, with Y. Miura, P. Dinenis, K. Mandli and G. Deodatis, *Frontiers in Climate* (2021).

19. A methodological framework for determining an optimal coastal protection strategy against storm surges and sea level rise, with Y. Miura, H. Qureshi, C. Ryoo, P. Dinenis, J. Li, K. Mandli, G. Deodatis, H. Lazrus and R. Morss, *Natural Hazards* **107** (2021), 1821 – 1843.

20. Mathematical programming formulations for the alternating current optimal power flow problem, with M. Escobar, C. Gentile and L. Liberti, *4OR* **3** (2020), 249 – 292.

21. Outer-product-free sets for polynomial optimization and oracle-based cuts, with C. Chen and G. Muñoz, *Mathematical Programming* (online, 2020), 1 – 44.

22. On inequalities with bounded coefficients and pitch for the min knapsack polytope, with Yuri Faenza, Igor Malinović, Monaldo Mastrolilli, Ola Svensson and Mark Zuckerberg, *Discrete Optimization* (online, 2020), 1 – 19.

23. Strong NP-hardness of AC power flows feasibility, with A. Verma. *Operations Research Letters* **47** (2019), 494 – 501.

24. Stochastic defense against complex grid attacks, with M. Escobar. *IEEE Trans. Control Network Systems* **7** (2020) 842 – 854 (early access, 2019).

25. Variance-Aware Optimal Power Flow, with A. Shukla, *IEEE Trans. Control Network Systems* **6** (2019) 1185–1196. Also see *Proc. PSCC 2018*.

26. Chance-Constrained Unit Commitment With N-1 Security and Wind Uncertainty (with K Sundar, H Nagarajan, L Roald, S Misra, R Bent), *IEEE Trans. Control Network Systems* **6** (2019), 1062 – 1074.

27. Learning from power system data stream: phasor-detective approach, with M. Escobar and M. Chertkov, *IEEE Powertech '19* (2019) 1–6.

28. Outer-Product-Free Sets for Polynomial Optimization and Oracle-Based Cuts, with C. Chen and G. Muñoz, in *Integer Programming and Combinatorial Optimization* 2019 (Lodi and Nagarajan, eds.), pp. 72 – 87. (Also see: Mathematical Programming 183, 105-148 (2020))**Winner, 2017 MIP Workshop poster award.**

29. Non-Stationary Streaming PCA, with A. Shukla and S. Yun, *Proc NIPS Time Series Workshop* (2017), submitted.

30. Simpler derivation of bounded pitch inequalities for set covering and knapsack sets, with M. Zuckerberg, arXiv 1806.07435.

31. LP formulations for polynomial optimization problems (with G. Muñoz), arXiv 1501.00288, *SIAM J. Optimization* **28** (2018), 1121–1150. **Winner, 2016 Informs Optimization Society Student Paper Prize; Winner, 2015 MIP Workshop poster award**.

32. Robust linear control of storage in transmission systems, and extensions to robust network control problems, with G. Muñoz, S. Yang and C. Matke. Proc. CDC '17. Also see arXiv:1610.09432.

33. Unit commitment with N-1 security and wind uncertainty, (with K. Sundar, H. Nagarajan, M. Lubin, L. Roald, S. Misra and R. Bent). *PSCC '16*, 1–7.

34. Analyzing Vulnerability of Power Systems with Continuous Optimization Formulations (with S. Harnett, T. Kim and S. Wright). *IEEE Trans. Network Science and Eng.* **3** (2016), 132 – 146.

35. A note on polynomial solvability of the CDT problem (2013). arXiv:1406.6429. Appeared online in: *SIAM J. Optimization* **26** (2016) 486–496.

36. Stochastic models and control for electrical power line temperature (with J. Blanchet and J. Li), *Energy Systems* **7** (2016) 173 – 192. An earlier version of this work appeared in *Proc. 51st Annual Allerton Conference on Communication, Control and Computing* (2013), 1344-1348.

37. Temperature-based instanton analysis: Identifying vulnerability in transmission networks, with J. Kersulis, I. Hiskens, M. Chertkov and S. Backhaus, *2015 PowerTech*, 1-6.

38. On linear relaxations of OPF problems (with G. Muñoz), arXiv:1411.1120. *Proc. PES-GM '15.*

39. Chance-constrained DC-OPF (with M. Chertkov and S. Harnett), *SIAM Review* **56** (2014), 461 – 495.

40. Approximation Algorithms for the Incremental Knapsack Problem via Disjunctive Programming (with C. Ye and J. Sethuraman), aXiv:1311.4563.

41. Polynomial solvability of variants of the trust-region subproblem (with A. Michalka), *Proc.* 25^{th} *ACM-SIAM Symp. on Discrete Algorithms (SODA 2014)*, 380 – 390.

42. Strong formulations for convex functions over nonconvex sets (with A. Michalka), *SIAM J. Optimization* **24** (2014), 643-677.

43. Synchronization-Aware and Algorithm-Efficient Chance Constrained Optimal Power Flow (with R. Bent and M. Chertkov), Proc. 2013 IREP Symp. on Bulk Power System Dynamics and Control (Rethymnon, Greece).

44. Power line control under uncertainty of ambient temperature (with J. Blanchet and J. Li), CDC '13.

45. Robust modeling of probabilistic uncertainty in smart grids: Data ambiguous chance constrained optimum power flow, with M. Chertkov and S. Harnett, *Proc 2013 CDC*, 4335-4340.

46. Models for managing the impact of an epidemic (with A.C. Zenteno), arXiv:1507.08648.

47. Sensitivity Analysis of Power Grid Vulnerability to Large-Scale Cascading Failures (with A. Bernstein, D. Hay, M. Uzunoglu and G. Zussman), *ACM Performance Evaluation Review, Special issue of papers from ACM Greenmetrics12*, Vol. 40, No. 3 (Dec. 2012), pp. 33 –37. Also see: Power Grid Vulnerability to Geographically Correlated Failures - Analysis and Control Implications, *INFOCOM '14*.

48. Optimal control of cascading power grid failures, Proc. 2011 IEEE PES Meeting, Proc. 2011 joint CDC-IEEE meeting.

49. Solving LP Relaxations of Large-Scale Precedence Constrained Problems (with M. Zuckerberg), *Proc. IPCO 2010*, 1–14.

50. Eigenvalue techniques for proving bounds for convex objective, nonconvex programs. IPCO 2010, EWMINLP10.

51. Tightening simple mixed-integer sets with guaranteed bounds (with B. McClosky), *Math. Programming* **133** (2012) 337-363.

52. The $N-k$ Problem in Power Grids: New Models, Formulations and Numerical Experiments (with A. Verma) *SIAM J. Optimization* **20** (2010) 1052-6234.

53. Approximate formulations for 0-1 knapsack sets, *Operations Research Letters* **36** (2008), 317–320.

54. Computing robust basestock levels (with N. Özbay), *Discrete Optimization* **5** (2008), 389–414.

55. Histogram models for robust portfolio optimization, *J. Computational Finance* **11** (2007), 1–64.

56. Using mixed-integer programming to solve power grid blackout problems (with S. Mattia), *Discrete Optimization* **4** (2007), 115–141.

57. Scalable Optimization for Multi-Period Optical Network Capacity Planning with Elastic Demand, with O. Raskina, I. Saniee and Q. Wang. *Operations Research* **54** (2006), 261-276.

58. Approximate fixed-rank closures of covering problems (with M. Zuckerberg), *Math. Programming* **105** (2006), 9 – 27.

59. Faster approximation algorithms for covering and packing problems (with G. Iyengar), *SIAM J. Computing* **35** (2006) 825-854.

60. Solving fractional packing problems in O*(1/epsilon) iterations (with G. Iyengar), CORC report TR-2003-03. *Proc. 26th Ann. Symp. Theory of Computing* (Chicago, 2004) 146-155.

61. Tree-width and the Sherali-Adams operator (with N. Özbay), CORC report TR-2003-09. *Discrete Optimization* **1** (2004) 13-22.

62. Subset Algebra Lift Operators for 0-1 Integer Programming (with M. Zuckerberg), *SIAM J. Optimization* **15** (2004) 63-95.

63. Approximation Algorithms for Linear Programming: Theory and Practice, *CORE Lecture Series Monograph* ISSN-0771 3894, Core, UCL, Belgium (2001).

64. Asymptotic analysis of the flow deviation method for the maximum concurrent flow problem (with O. Raskina), *Math. Programming* **91** (2002), 379–492. (CORC Report 2000-02, download from http://www.corc.ieor.columbia/reports/techreports.html).

65. Approximately solving large-scale linear programs. I: Strengthening lower bounds and accelerating convergence, in preparation. CORC Report 1999-1. (An extended abstract for this work was published in the SODA '00 proceedings).

66. ATM network design: Traffic models and optimization-based heuristics (with I. Saniee), *Telecomm. Systems* **16** (2001), 399–421.

67. Strong inequalities for capacitated survivable network design problems (with G. Muratore), *Math. Programming* **89** (2000), 127-148.

68. Minimum-cost capacity installation for multicommodity flows (with O. Günlük, S. Chopra and C.Y. Tsai) (1996), *Math. Programming* **81** (1998), 177-199.

69. Capacity expansion in networks – new inequalities and computation (with O. Günlük), *ORSA J. Comp.* **8** (1996), 243-260.

70. Computational study of a family of mixed-integer quadratic programming problems, *Math. Programming* **74** (1996), 121-140.

71. A degree sequence problem related to network design (with O. Günlük), *Networks* **24** (1994), 195-205.

72. Probabilistic analysis of tour partitioning heuristics for the capacitated vehicle routing problem with unsplit demands (with J. Bramel and D. Simchi-Levi) *Math. Oper. Res.* **18** (1993), 786-802.

73. Computational experience with a difficult multicommodity flow problem (with O. Günlük), *Math. Programming* **68** (1995), 213-237.

74. Computational experience with an effective heuristic for some capacity expansion problems in local access networks, *Telecomm. Sys.* **1** (1993), 379-400.

75. Algorithmic implications of the Graph Minors project (with M. Langston), in *Handbook of Operations Research* (Ball, Magnanti, Monma, Nemhauser, eds.), North-Holland (1995).

76. Blocking small cuts in a network (with N. Diaz), *SIAM J. Computing* **22** (1993), 482-499.

77. A lot-sizing problem on trees, related to network design, *Math. Oper. Res.* **18** (1993), 402-422.

78. A note on the prize-collecting traveling salesman problem (with M. Goemans, D. Simchi-Levi and D. Williamson), *Math. Programming* **59** (1993), 413-420.

79. New results on rectilinear corssing numbers and plane embeddings (with N. Dean), *J. Graph Theory* **16** (1992), 389-398.

80. Bounds on rectilinear crossing numbers (with N. Dean), *J. Graph Theory* **17** (1993), 333-348.

81. A note on finding saddle points (with F.R.K. Chung, M. Fredman, A. Schäfer, P. Shor and S. Suri), *Amer. Math. Monthly* **98** (1991), 418-419.

82. On obstructions to small face covers in planar graphs (with N. Dean), *J. Comb. Theory B* **55** (1992), 163-189.

83. Further polynomially solvable special cases of the Steiner tree problem in planar networks (with M. Bern), *Annals of Operations Research* **33** (1991), 405-418.

84. Graph searching, path-width and tree-width (a survey), in *Reliability of Computer and Communication Networks* (Roberts, Hwang, Monma, eds.) DIMACS (1991), 33-49.

85. Some provably hard crossing number problems, *Disc. Comput. Geom.* **6** (1991), 443-459.

86. On the complexity of testing for odd holes and induced odd paths, *Discrete Math.* **90** (1991), 85-92. (Corrigendum: *D.M.* **102** (1992) 109).

87. Excluding a forest quickly (with N. Robertson, R. Thomas and P.D. Seymour), *J. Comb. Theory (B)* **52** (1991), 274-283.

88. Some generalized max-flow min-cut problems in the plane, *Math. Oper. Res.* **16** (1991), 310-333.

89. Monotonicity in graph searching (with P.D. Seymour), *J. of Algorithms* **12** (1991), 239-245.

90. An extremal problem on sparse 0-1 matrices (with E. Györi), *SIAM J. Disc. Math.* **4** (1991), 17-27.

91. Linear time test for small face covers in any fixed surface, *SIAM J. Comput.* **19** (1990), 907-911.

92. On a network design problem that is intractable on trees (with O. Marcotte), *Math. Oper. Res.* **15** (1990), 530-544.

93. On the structure of minimum-weight k-connected networks (with E.F. Brickell and C.L. Monma), *SIAM J. Disc. Math* **3** (1990), 320-329.

94. On embedding graphs in trees, *J. Comb. Theory B* **49** (1990), 103-136.

95. On the complexity of minimizing various distance measures in a planar graph (with C.L. Monma), *Algorithmica* **5** (1990), 93-109.

96. Optimal enclosing of vertices in a planar graph (with C.L. Monma), *Networks* **19** (1989), 79-94.

97. Average distance in graphs with removed elements (with E. Györi), *J. Graph Theory* **12** (1988), 375-390.

98. Some lattice-theoretic tools for network reliability analysis, *Math. Oper. Res.* **13** (1988), 467-478.

99. Optimizing resource acquisitions by stochastic programming (with J.F. Shapiro), *Mgt. Sci.* **34** (1988), 215-229.

100. On the complexity of covering vertices by faces in a planar graph (with C.L. Monma), *SIAM J. Comput.* **17** (1988), 53-76.

101. Reliability analysis of generalizations of Halin graphs, in *Applications of Discrete Mathematics* (R. Ringeisen and F. Roberts, eds.) SIAM (1988), 87-106.

102. Broadcasting with random faults, *Disc. Appl. Math* **20** (1988), 1-7.

103. Asymptotic analysis of some network reliability problems, *SIAM J. Disc. Math* **1** (1988), 14-21.

104. An algorithm for reliability analysis of planar graphs, *Networks* **16** (1986) 411-422.

105. A Collocational Model of Information Transfer (with R. Smith and E. Housman), *Information Interaction: Proceedings of the Annual Meeting of the American Society of Information Science* **19** (1982), 281-84.