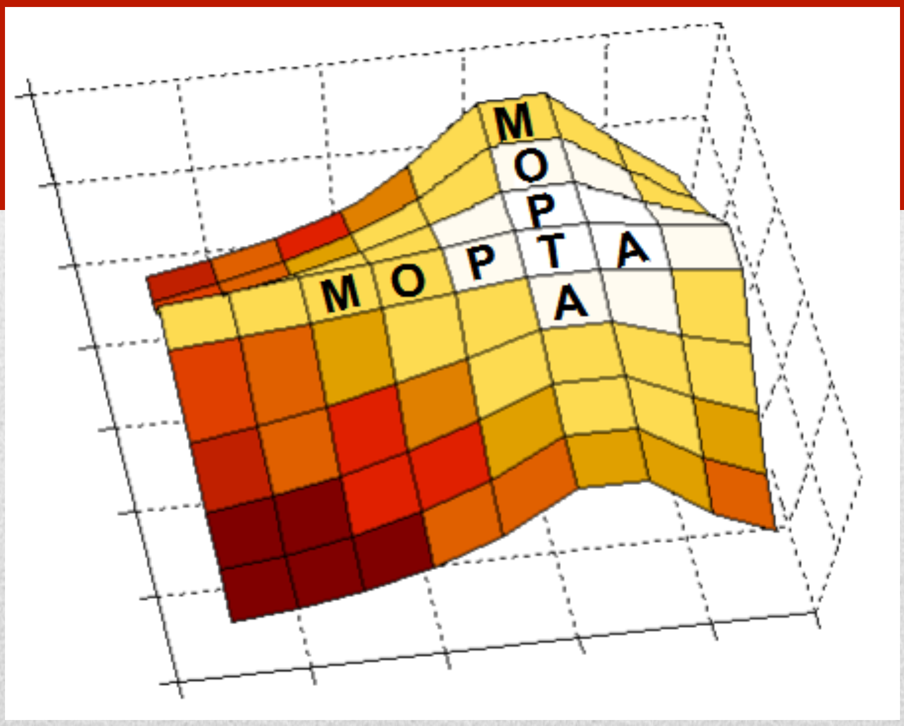
MOPTA 2013

Modeling and Optimization: Theory and Applications



August 14-16, 2013

Lehigh University, Bethlehem, PA, USA

Welcome to the 2013 MOPTA Conference!

Mission Statement

The Modeling and Optimization: Theory and Applications (MOPTA) conference is an annual event aiming to bring together a diverse group of people from both discrete and continuous optimization, working on both theoretical and applied aspects. The format consists of invited talks from distinguished speakers and selected contributed talks, spread over three days.

The goal is to present a diverse set of exciting new developments from different optimization areas while at the same time providing a setting that will allow increased interaction among the participants. We aim to bring together researchers from both the theoretical and applied communities who do not usually have the chance to interact in the framework of a medium-scale event. MOPTA 2013 is hosted by the Department of Industrial and Systems Engineering at Lehigh University.

Organization Committee

Frank E. Curtis - Chair
frank.e.curtis@lehigh.edu

Tamás Terlaky
terlaky@lehigh.edu

Ted Ralphs
ted@lehigh.edu

Katya Scheinberg
katyas@lehigh.edu

Lawrence V. Snyder
larry.snyder@lehigh.edu

Robert H. Storer
Rhs2@lehigh.edu

Aurélie Thiele
Aurelie.thiele@lehigh.edu

Luis Zuluaga
luis.zuluaga@lehigh.edu

Staff
Kathy Rambo

We thank our sponsors!

Program

Wednesday, August 14 – Rauch Business Center

7:30-8:10 - Registration and continental breakfast - Perella Auditorium Lobby
8:10-8:20 - Welcome: Tamás Terlaky, Department Chair, Lehigh ISE - Perella Auditorium (RBC 184)
8:20-8:30 - Opening remarks: Patrick Farrell, Provost, Lehigh University - Perella Auditorium (RBC 184)
8:30-9:30 - Plenary talk - Perella Auditorium (RBC 184)

Zhi-Quan (Tom) Luo, On the Linear Convergence of the Alternating Direction Method of Multipliers
Chair: Tamás Terlaky

9:30-9:45 - Coffee break - Perella Auditorium Lobby
9:45-11:15 - Parallel technical sessions

Mathematical Models in Health Insurance **Room: RBC 184** **Chair: Aurelie Thiele**	**Computational Techniques for Smart Grids** **Room: RBC 271** **Chair: Larry Snyder**	**Optimization Algorithms** **Room: RBC 91** **Chair: Xi Bai**
Robust Partial Capitation Aurelie Thiele	Security-Constrained Optimal Power Flow with Sparsity Control and Efficient Parallel Algorithms Andy Sun	An Inexact Block-Decomposition CG Hybrid Method for Dense and Large-Scale Conic Programming Camilo Ortiz
Robust Risk Adjustment in Health Insurance Tengjiao Xiao	Convex Quadratic Approximations of AC Power Flows Hassan L. Hijazi	A Tight Iteration-Complexity Bound for IPM via Redundant Klee-Minty Cubes Murat Mut
Robust Value-Based Insurance Design Shuyi Wang	Relaxations of Approximate Linear Programs for the Real Option Management of Commodity Storage Selvaprabu Nadarajah	Risk Parity in Portfolio Selection: Models and Algorithms Xi Bai

11:15-11:30 - Coffee break - Perella Auditorium Lobby
11:30-12:30 - Plenary talk - Perella Auditorium (RBC 184)

Brian Denton, Optimization of Planning and Scheduling of Health Care Delivery Systems
Chair: Aurélie Thiele

12:30-1:30 - Lunch - (RBC 292)
1:30-3:00 - Parallel technical sessions

Energy Management Systems **Room: RBC 184** **Chair: Miguel Anjos**	**Nonsmooth and Derivative-Free Optimization** **Room: RBC 271** **Chair: Frank E. Curtis**	**Optimization Under Uncertainty** **Room: RBC 91** **Chair: Luis Zuluaga**
MPC-Based Appliance Scheduling for Residential Building Energy Management Controller Chen Chen	Full Stability in Nonlinear Optimization with Applications to Semidefinite Programming Nghia Tran	Extensions of Scarf's Max-Min Order Formula Luis F. Zuluaga
A Centralized Energy Management System for Isolated Microgrids Daniel Olivares	Handling Equality Constraints in Expensive Black-Box Optimization Using Radial Basis Function Surrogates Rommel Regis	Linear Solution Scheme for the Candinality Constarined Portfolio Allocation Models Onur Babat
Optimization of Wind, Diesel and Battery Systems for Remote Areas Miguel Anjos	A BFGS-Based SQP Method for Constrained Nonsmooth, Nonconvex Optimization Tim Mitchell	Computing Semiparametric Bounds on the Expected Payments of Insurance Instruments via Column Generation Robert Howley

3:00-3:15 - Coffee break - Perella Auditorium Lobby
3:15-4:45 - Parallel technical sessions

Large-Scale Optimization with Applications to Machine Learning **Room: RBC 184** **Chair: Katya Scheinberg**	**Disruption Management** **Room: RBC 271** **Chair: Lin He**	**Models for Electricity Market Mechanism Design** **Room: RBC 91** **Chair: Alberto Lamadrid**
Sparse Inverse Covariance Matrix Estimation Using Quadratic Approximation Cho-Jui Hsieh	Inventory Management for a Distribution System Subject to Supply Disruptions Lin He	Environmental SuperOPF Electricity Market Planning Tool Biao Mao
A Deterministic Rescaled Perceptron Algorithm Negar Soheili Azad	Optimal Dynamic Stochastic Scheduling with Partial Losses of Work Xiaoqiang Cai	A Nested Look-Ahead Model for Unit Commitment with Joint Ramping Capability Requirements Boris Defourny
Complexity of Inexact Proximal Newton Method Xiaocheng Tang	A Modeling and Simulation Approach to Emergency Management Brian J. Hunt	An Experimental Study of Complex-Offer Auctions: Payment Cost Minimization versus Offer Cost Minimization Rimvydas Baltaduonis

4:45-5:00 - Coffee break - Perella Auditorium Lobby
5:00-6:00 - Plenary talk - Perella Auditorium (RBC 184)

Jorge Nocedal, Some Matrix Optimization Problems Arising in Machine Learning
Chair: Katya Scheinberg

6:30-9:30 - Graduate student social - Graduate Student Center (Packer House)

Program

Thursday, August 15 – Rauch Business Center

8:30-9:00 - Continental breakfast - Perella Auditorium Lobby

9:00-10:45 - AIMMS/MOPTA Optimization Modeling Competition: Final presentations - Perella Auditorium (RBC 184)

Chair: Peter Nieuwesteeg (winner will be announced at conference banquet)
Team “OptNAR”, Universidad Politécnica de Madrid (TU-Madrid) and INTEC Raul Pulido Martinez, Natalia Ibañez Herrero (TU-Madrid), Adrian Marcelo Aguirre (INTEC); advised by Miguel Ortega Mier (TU-Madrid)
Team “ORopt”, Technische Universität Berlin and ZIB Alexander Tesch (TU-Berlin); advised by Ralf Borndörfer (ZIB)
Team “Universiteit Twente”, Universiteit Twente Corine Laan, Clara Stegehuis; advised by Bodo Manthey
Team “ORTEC”, ORTEC, University of Amsterdam Harmen Boersma, Tristan Hands, Jan-Willem Arentshorst; advised by Frans van Helden

10:45-11:00 - Coffee break - Perella Auditorium Lobby

11:00-12:00 - Plenary talk - Perella Auditorium (RBC 184)

Ignacio Grossmann, Relaxations for Convex Nonlinear Generalized Disjunctive Programs and their Application to Nonconvex Problems Chair: Ted Ralphs

12:00-1:00 - Lunch - (RBC 292)

1:00-2:30 - Parallel technical sessions

Approximation Algorithms Room: RBC 184 Chair: Amir Ali Ahmadi	**Models for Uncertainty and Demand Response in Smart Grids Room: RBC 271 Chair: Larry Snyder**	**Applications of MINLP Room: RBC 91 Chair: Hande Y. Benson**
Rounding by Sampling Arash Asadpour	Optimizing Locations for Wave Energy Farms Under Uncertainty Larry Snyder	Interior-Point Methods within a MINLP Framework Hande Y. Benson
Approximation Algorithms for Graph Partitioning Problems using SDP Hierarchies Ali Kemal Sinop	Generation and Storage Dispatch in Electricity Networks with Generator Disruptions M.Mohsen Moarefdoost	Mixed Integer Nonlinear Programming for Multi Vehicle Motion Planning: Ground and Underwater Vehicles Pramod Abichandani
Approximation of the Joint Spectral Radius via Dynamic and Semidefinite Programming Amir Ali Ahmadi	Modeling Demand Response for FERC Order 745 Yanchao Liu	Multiperiod Portfolio Optimization with Cone Constraints and Discrete Decisions Umit Saglam

2:30-2:45 - Coffee break - Perella Auditorium Lobby

2:45-4:15 - Parallel technical sessions

Mixed Integer Optimization and Applications Room: RBC 184 Chair: Ted Ralphs	**PDE-Constrained Optimization Room: RBC 271 Chair: Jason Hicken**	**Facility Layout Problems Room: RBC 91 Chair: Abdul-Rahim Ahmad**
Evasive Flow Capture: Optimal Location of Weigh-in-Motion Systems, Tollbooths, and Safety Checkpoints Nikola Markovic	A Matrix-Free Augmented Lagrangian Algorithm for Large-Scale Structural Design Andrew Lambe	A Novel Adaptive Boundary Search Algorithm for Solving Facility Layout Problems Abdul-Rahim Ahmad
Column Generation and Accelerating Schemes for Mixed-Mode Aircraft Sequencing Problems Farbod Farhadi	Inexact and Truncated Parareal-in-time Krylov Subspace Methods for Parabolic Optimal Control Problems Daniel B. Szyld	Cyclic Facility Layout Problem: A Hybrid Exact/Heuristic Optimization Approach Abdullah Konak
Three Dimensional Knapsack Problem with Vertical Stability and Pre-Placed Boxes Hanan Mostaghimi Ghomi and Walid Abdul-Kader	A Flexible Iterative Trust-Region Algorithm for Nonstationary Preconditioners Jason Hicken	Solving the Unequal Area Facility Layout Problem: An Effective Hybrid Optimization Strategy Coupled with the Location/Shape Representation Sadan Kulturel-Konak

4:15-4:30 - Coffee break - Perella Auditorium Lobby

4:30-5:30 - Plenary talk - Perella Auditorium (RBC 184)

Omar Ghattas, The Stochastic Newton Method: Combining Large-Scale Optimization and Markov Chain Monte Carlo Methods for the Solution of PDE-Constrained Bayesian Inverse Problems Chair: Frank E. Curtis

6:00-7:00 - Cocktail reception - Asa Packer Dining Room (University Center)

7:00-9:30 - Conference banquet and competition results - Asa Packer Dining Room (University Center)

Program

Friday, August 16 – Rauch Business Center

8:30-9:15 - Continental breakfast - Perella Auditorium Lobby

8:45-10:45 - Parallel technical sessions

Optimization and Differential Equations **Room: RBC 184** **Chair: Yunfei Song**	**Healthcare Applications** **Room: RBC 271** **Chair: Jackie Griffin**	**Advances in Portfolio Management and Pricing** **Room: RBC 91** **Chair: Elcin Cetinkaya**
On the Complexity of Steepest Descent for Minimizing Convex Quadratics Clovis Gonzaga	TBD Walter Massey	Full Characterization of Disjunctive-Conic-Cuts for Mixed Integer Second Order Cone Optimization Julio Góez
Preconditioners for PDE Constrained Optimization Ekkehard W. Sachs	Simulation Model for the Analyses and Cost Estimates of Combination HIV-Prevention Strategies for the Elimination of HIV Chaitra Gopalappa	Implementing Real-Time Pricing in Wholesale Electricity Markets Jingjie Xiao
A Primal-Dual Active-Set Algorithm for Large-Scale Convex Quadratic Optimization Zheng Han	Patient-Bed Assignments in Hospital Systems Jackie Griffin	Portfolio Risk Management with Moment Matching Approach Elcin Cetinkaya
Convex Sets as Invariant Sets for Linear Systems Yunfei Song	Efficient Learning of Donor Retention Strategies for the American Red Cross Bin Han	Robust Manager Allocation for Investment Management Yang Dong

10:45-11:00 - Coffee break - Perella Auditorium Lobby

11:00-12:00 - Plenary talk - Perella Auditorium (RBC 184)

Henry Wolkowicz, Taking Advantage of Degeneracy in Cone Optimization with Applications to Sensor Network Localization and Molecular Conformation
Chair: Luis Zuluaga

12:00-1:00 - Lunch - (RBC 292)

1:00-2:30 - Parallel technical sessions

Networks **Room: RBC 184** **Chair: Eric Landquist**	**Demand Systems** **Room: RBC 271** **Chair: Miguel Anjos**	**Recent Advances in Sparse Linear Programming** **Room: RBC 91** **Chair: Robert Vanderbei**
Multi-Agent Information Routing Under Dynamic and Uncertain Conditions Dimitrios Papadimitriou	Scheduling of Multiproduct Pipelines for Transporting Liquid Fuels Arun Sridharan	Estimating Sparse Precision Matrix by the Parametric Simplex Method Haotian Pang
Dynamic-Programming-Based Link Assignment for Data Collection in Wireless Sensor Networks Yanhong Yang and Huan Yang	Consumer Demand Systems Based on Discrete-Continuous Models Walter Gomez	Fast-Fourier Optimization Robert Vanderbei
A Simple and Efficient Strategy for Solving Large Generalized Cable-Trench Problems Eric Landquist and Francis Vasko	Piecewise-Constant Regression with Implicit Filtering Sanjay Yadav	Online PRSM Xingyuan Fang

2:30-2:45 - Coffee break - Perella Auditorium Lobby

2:45-4:15 - Parallel technical sessions

Optimizing Supply-Demand Match in Power Systems **Room: RBC 184** **Chair: Alberto Lamadrid**	**Semidefinite Optimization** **Room: RBC 271** **Chair: Hongbo Dong**	**Optimization, Information, and Complexity** **Room: RBC 91** **Chair: Eugene Perevalov**
Adaptive Load Management: Scheduling and Coordination of Demand Resources in Power Systems Jhi-Young Joo	The Trust Region Subproblem with Non-Intersecting Linear Constraints Boshi Yang	On the Connection Between the Reliability of Systems and the Notion of Invariance Entropy Getachew K. Befekadu
Co-Optimization of Grid-to-Vehicle Charging and Ancillary Services Jonathan Donadee	Finding Hidden Cliques and Dense Subgraphs via Convex Optimization Brendan Ames	Multiresolution Gaussian Process Model for the Analysis of Large Spatial Data Sets Soutir Bandyopadhyay
The Effects of Bulk Electricity Storage on the PJM Market Roger Lueken	Conic Relaxations for Convex Quadratic Optimization with Indicator Variables Hongbo Dong	On Optimal Information Extraction from Large-Scale Datasets Eugene Perevalov

Program Highlights

Wednesday, August 14

8:30am-9:30am – Zhi-Quan (Tom) Luo, plenary talk (see page 9)

11:30am-12:30pm – Brian Denton, plenary talk (see page 6)

5:00pm-6:00pm – Jorge Nocedal, plenary talk (see page 10)

6:30pm-9:30pm – Graduate student social

Thursday, August 15

9:00am-10:45am – AIMMS/MOPTA Optimization Modeling Competition: Final presentations (see page 12)

11:00am-12:00pm – Ignacio Grossmann, plenary talk (see page 8)

4:30pm-5:30pm – Omar Ghattas, plenary talk (see page 7)

6:00pm-7:00pm – Cocktail reception

7:00pm-9:30pm – Conference banquet and competition results

Friday, August 16

11:00am-12:00pm – Henry Wolkowicz, Plenary talk (see page 11)

Speaker Biography

Brian Denton

Associate Professor
Industrial and Operations Engineering
University of Michigan
btdenton@umich.edu

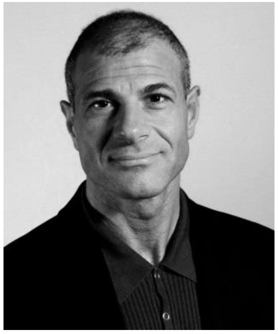
Dr. Brian Denton is an Associate Professor in the Department of Industrial and Operations Engineering at University of Michigan, in Ann Arbor, MI. Previously he has been an Associate Professor in the Department of Industrial & Systems Engineering at NC State University, a Senior Associate Consultant at Mayo Clinic in the College of Medicine, and a Senior Engineer at IBM. He is a Fellow at the Cecil Sheps Center for Health Services Research at University of North Carolina. His primary research interests are in optimization under uncertainty and applications to health care delivery and medical decision making. He completed his Ph.D. in Management Science at McMaster University, his M.Sc. in Physics at York University, and his B.Sc. in Chemistry and Physics at McMaster University in Hamilton, Ontario, Canada.

Title: Optimization of Planning and Scheduling of Health Care Delivery Systems

Date: Wednesday, August 14, 11:30am-12:30pm

Abstract: Optimization of planning and scheduling decisions under uncertainty is important in many service industries to increase the utilization of resources, match workload to available capacity, and smooth the flow of customers through the system. It is particularly important for healthcare delivery where applications include scheduling of patients to outpatient clinics, design of operating room schedules, and allocation of resources within healthcare facilities. In this talk I will discuss stochastic optimization models for scheduling services in outpatient procedure centers and hospitals. I will discuss three related problems. The first involves setting individual procedure start times for a single operating room (OR) given uncertainty in the duration of procedures. The objective of this problem is to minimize a weighted sum of three competing criteria: patient and OR team waiting time, OR idle time, and overtime. The second problem involves the allocation of surgeries across multiple ORs with the goal of balancing the fixed cost of opening ORs with the expected cost of total overtime. The third problem involves setting optimal arrival times for patients to an outpatient procedure center comprising multiple activities including: intake processes, surgery, and recovery. For each problem I will describe the model, stochastic optimization methods that can be applied, and numerical results based on real data to illustrate the potential impact of the model. I will also discuss open questions and future research opportunities related to optimization of health care delivery systems.

Speaker Biography



Omar Ghattas

John A. and Katherine G. Jackson Chair in Computational Geosciences
Professor, Department of Geological Sciences, Jackson School of Geosciences
Professor, Department of Mechanical Engineering
University of Texas at Austin
omar@ices.utexas.edu

Dr. Omar Ghattas is the John A. and Katherine G. Jackson Chair in Computational Geosciences, Professor of Geological Sciences and Mechanical Engineering, and Director of the Center for Computational Geosciences in the Institute for Computational Engineering and Sciences (ICES) at The University of Texas at Austin. He also is a member of the faculty in the Computational Science, Engineering, and Mathematics (CSEM) interdisciplinary PhD program in ICES, serves as Director of the KAUST-UT Austin Academic Excellence Alliance, and holds courtesy appointments in Computer Science, Biomedical Engineering, the Institute for Geophysics, and the Texas Advanced Computing Center. He earned BS, MS, and PhD degrees from Duke University in 1984, 1986, and 1988. He has general research interests in simulation and modeling of complex geophysical, mechanical, and biological systems on supercomputers, with specific interest in inverse problems and associated uncertainty quantification for large-scale systems. His center's current research is aimed at large-scale forward and inverse modeling of whole-earth, plate-boundary-resolving mantle convection; global seismic wave propagation; dynamics of polar ice sheets and their land, atmosphere, and ocean interactions; and subsurface flows, as well as the underlying computational, mathematical, and statistical techniques for making tractable the solution and uncertainty quantification of such complex forward and inverse problems on parallel supercomputers. He received the 1998 Allen Newell Medal for Research Excellence, the 2004/2005 CMU College of Engineering Outstanding Research Prize, the SC2002 Best Technical Paper Award, the 2003 IEEE/ACM Gordon Bell Prize for Special Accomplishment in Supercomputing, the SC2006 HPC Analytics Challenge Award, and the 2008 TeraGrid Capability Computing Challenge award, and was a finalist for the 2008, 2010, and 2012 Bell Prizes. He has served on the editorial boards or as associate editor of 12 journals, has been co-organizer of 12 conferences and workshops and served on the scientific or program committees of 40 others, has delivered plenary lectures at 23 international conferences, and has been a member or chair of 20 national or international professional committees.

Title: The Stochastic Newton Method: Combining Large-Scale Optimization and Markov Chain Monte Carlo Methods for the Solution of PDE-Constrained Bayesian Inverse Problems

Date: Thursday, August 15, 4:30pm-5:30pm

Abstract: We address the problem of quantifying uncertainties in the solution of ill-posed inverse problems governed by expensive forward models (e.g., PDEs) and characterized by high-dimensional parameter spaces (e.g., discretized heterogeneous parameter fields). The problem is formulated in the framework of Bayesian inference, leading to a solution in the form of a posterior probability density. To explore this posterior density, we propose several variants of a so-called Stochastic Newton Markov chain Monte Carlo (MCMC) method, which employs, as an MCMC proposal, a local Gaussian approximation whose covariance is the inverse of a local Hessian of the negative log posterior, made tractable via randomized low rank approximations and adjoint-based matrix-vector products. We apply this Stochastic Newton method to several large-scale geophysical inverse problems and study its performance.

This is joint work with Tan Bui-Thanh, Carsten Burstedde, Tobin Isaac, James Martin, Noemi Petra, and Georg Stadler.

Speaker Biography

Ignacio Grossmann

Rudolph R. and Florence Dean University Professor of Chemical Engineering
Carnegie Mellon University
grossmann@cmu.edu

Prof. Ignacio E. Grossmann is the Rudolph R. and Florence Dean University Professor of Chemical Engineering, and former Department Head at Carnegie Mellon University. He obtained his B.S. degree in Chemical Engineering at the Universidad Iberoamericana , Mexico City, in 1974, and his M.S. and Ph.D. in Chemical Engineering at Imperial College in 1975 and 1977, respectively. After working as an R&D engineer at the Instituto Mexicano del Petróleo in 1978, he joined Carnegie Mellon in 1979. He was Director of the Synthesis Laboratory from the Engineering Design Research Center in 1988-93. He is director of the "Center for Advanced Process Decision-making" which comprises a total of 20 petroleum, chemical and engineering companies. Ignacio Grossmann is a member of the National Academy of Engineering , Mexican Academy of Engineering, and associate editor of AIChE Journal and member of editorial board of Computers and Chemical Engineering, Journal of Global Optimization, Optimization and Engineering, Latin American Applied Research, and Process Systems Engineering Series. He was Chair of the Computers and Systems Technology Division of AIChE , and co-chair of the 1989 Foundations of Computer-Aided Process Design Conference and 2003 Foundations of Computer-Aided Process Operations Conference. He is a member of the American Institute of Chemical Engineers, Sigma Xi, Institute for Operations Research and Management Science, and American Chemical Society.

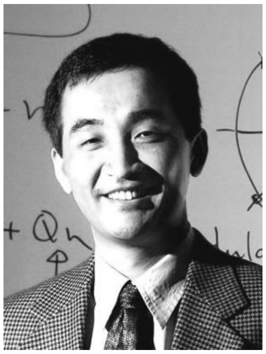
Title: Relaxations for Convex Nonlinear Generalized Disjunctive Programs and their Application to Nonconvex Problems

Date: Thursday, August 15, 11:00am-12:00pm

Abstract: This talk deals with the theory of reformulations and numerical solution of generalized disjunctive programming (GDP) problems, which are expressed in terms of Boolean and continuous variables, and involve algebraic constraints, disjunctions and propositional logic statements. We propose a framework to generate alternative MINLP formulations for convex nonlinear GDPs that lead to stronger relaxations by generalizing the seminal work by Egon Balas (1988) for linear disjunctive programs. We define for the case of convex nonlinear GDPs an operation equivalent to a basic step for linear disjunctive programs that takes a disjunctive set to another one with fewer conjuncts. We show that the strength of relaxations increases as the number of conjuncts decreases, leading to a hierarchy of relaxations. We prove that the tightest of these relaxations, allows in theory the solution of the convex GDP problem as an NLP problem. We present a guide for the generation of strong relaxations without incurring in an exponential increase of the size of the reformulated MINLP. We apply the proposed theory for generating strong relaxations to a dozen convex GDPs which are solved with a NLP-based branch and bound method. Compared to the reformulation based on the hull relaxation, the computational results show that with the proposed reformulations significant improvements can be obtained in the predicted lower bounds, which in turn translates into a smaller number of nodes for the branch and bound enumeration. We then briefly describe an algorithmic implementation to automatically convert a convex GDP into an MILP or MINLP using the concept of basic steps, and applying both big-M and hull relaxation formulations to the set of disjunctions.

Finally, we address the extension of the above ideas to the solution of nonconvex GDPs that involve bilinear, concave and linear fractional terms. In order to solve these nonconvex problems with a spatial branch and bound method, a convex GDP relaxation is obtained by using suitable under- and over-estimating functions of the nonconvex constraints. In order to predict tighter lower bounds to the global optimum we exploiting the hierarchy of relaxations for convex GDP problems. We illustrate the application of these ideas in the optimization of several process systems to demonstrate the computational savings that can be achieved with the tighter lower bounds.

Speaker Biography



Zhi-Quan (Tom) Luo

Department of Electrical and Computer Engineering
ADC Chair in Digital Technology
University of Minnesota, Twin Cites
luozq@ece.umn.edu

Zhi-Quan (Tom) Luo is a professor in the Department of Electrical and Computer Engineering at the University of Minnesota (Twin Cities) where he holds an endowed ADC Chair in digital technology. He received his B.Sc. degree in Applied Mathematics in 1984 from Peking University, China, and a Ph.D degree in Operations Research from MIT in 1989. From 1989 to 2003, Dr. Luo was with the Department of Electrical and Computer Engineering, McMaster University, Canada, where he later served as the department head and held a senior Canada Research Chair in Information Processing. His research interests lie in the union of optimization algorithms, data communication and signal processing.

Dr. Luo is a fellow of IEEE and SIAM. He is a recipient of the IEEE Signal Processing Society's Best Paper Award in 2004, 2009 and 2011, as well as the EURASIP Best Paper Award and the ICC's Best Paper Award in 2011. He was awarded the Farkas Prize from the INFORMS Optimization Society in 2010. Dr. Luo has chaired of the IEEE Signal Processing Society's Technical Committee on Signal Processing for Communications and Networking (SPCOM) during 2010-2012. He has held editorial positions for several international journals, including currently being the editor-in-chief for IEEE Transactions on Signal Processing.

Title: On the Linear Convergence of the Alternating Direction Method of Multipliers

Date: Wednesday, August 14, 8:30am-9:30am

Abstract: We analyze the convergence rate of the alternating direction method of multipliers (ADMM) for minimizing the sum of two or more nonsmooth convex separable functions subject to linear constraints. Previous analysis of the ADMM typically assumes that the objective function is the sum of only two convex functions defined on two separable blocks of variables even though the algorithm works well in numerical experiments for three or more blocks. Moreover, there has been no rate of convergence analysis for the ADMM without strong convexity. In this work, we establish the global linear convergence of the ADMM for minimizing the sum of any number of convex separable functions. This result settles a key question regarding the convergence of the ADMM when the number of blocks is more than two or if the strong convexity is absent. It also implies the linear convergence of the ADMM for several contemporary applications including LASSO, Group LASSO and Sparse Group LASSO without any strong convexity assumption. Our proof is based on estimating the distance from a dual feasible solution to the optimal dual solution set by the norm of a certain proximal residual.

Speaker Biography

Jorge Nocedal

Director of Optimization Center
Professor Electrical Engineering and Computer Science
Northwestern University
nocedal@eecs.northwestern.edu

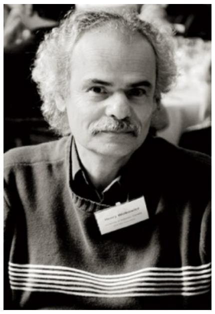
Jorge Nocedal is a professor in the Industrial Engineering Department at Northwestern University. His research interests are in optimization algorithms and their application in areas such as machine learning and energy management. His current research is being driven by a collaboration with Google Research. Jorge is passionate about undergraduate education; he was one of the developers of the "Engineering First" Curriculum at Northwestern that exposes students to engineering design in their freshman year. He is currently the Editor in Chief for the SIAM Journal on Optimization, is a SIAM Fellow, and was awarded the 2012 George B. Dantzig Prize.

Title: Some Matrix Optimization Problems Arising in Machine Learning

Date: Wednesday, August 14, 5:00pm-6:00pm

Abstract: The research presented in this talk is motivated by three applications: recommendation systems, speech recognition, and the training of vary large neural nets. In all these applications there is a need to solve large nonlinear optimization problems in which the unknown is a matrix. We describe state-of-the-art methods for solving these problems, and illustrate their performance using realistic data sets.

Speaker Biography



Henry Wolkowicz

Professor
Department of Combinatorics and Optimization
The University of Waterloo
hwolkowi@uwaterloo.ca

Henry Wolkowicz is currently a professor in mathematics, in the department of combinatorics and optimization at the University of Waterloo in Canada. Prior, he was a professor at the University of Delaware and the University of Alberta. He received his Ph.D. from McGill University in Mathematics in 1978. Dr. Wolkowicz's research deals with applications of optimization and matrix theory to algorithmic development for both continuous and discrete optimization problems. His research interests include: optimization in finite dimensional and abstract spaces; linear, nonlinear and semidefinite programming; matrix eigenvalue problems; and numerical analysis of algorithms. His combinatorial optimization work applies convex relaxations to hard combinatorial optimization problems. The relaxations are based on Lagrangian duality, and in many cases they result in Semidefinite Programming relaxations.

Dr. Wolkowicz was chair for the SIAM Activity Group on Optimization (SIAG/OPT) from 2001-2004 and the SIAM Council from 2005-2011. He is the Associate Editor of the SIAM J. of Optimization; Math. Progr. B; J. of Computational Optimization and Applications , COAP; J. of Combinatorial Optimization, JOCO; Optimization and Engineering, OPTE; American J. of Mathematical and Management Sciences and has been organizer of several conferences and workshops. Dr. Wolkowicz has held several visiting research positions at Universite Paul Sabatier, Princeton University, Emory University and the University of Maryland.

Title: Taking Advantage of Degeneracy in Cone Optimization with Applications to Sensor Network Localization and Molecular Conformation

Date: Friday, August 16, 11:00am-12:00pm

Abstract: The elegant theoretical results for strong duality and strict complementarity for linear programming, LP, lie behind the success of current algorithms. However, the theory and preprocessing techniques that are successful for LP can fail for cone programming over nonpolyhedral cones.

Surprisingly, many instances of semidefinite programming, SDP, problems that arise from relaxations of hard combinatorial problems are degenerate. (Slater's constraint qualification fails.) Rather than being a disadvantage, we show that this degeneracy can be exploited. In particular, several huge instances of SDP completion problems can be solved quickly and to extremely high accuracy. In particular, we illustrate this on the sensor network localization and Molecular conformation problems.

AIMMS/MOPTA Optimization Modeling Competition 2013

The fifth AIMMS/MOPTA Optimization Modeling Competition is a result of cooperation between Paragon Decision Technology (the developers of the AIMMS modeling system) and the organizers of the MOPTA conference. Teams of two or three graduate students participated and solved a problem of critical importance to hospital organizations. The teams were asked to consider an Operating Room (OR) manager's task of scheduling and sequencing surgeries in a set of ORs, where, besides the inherent complexity of typical scheduling problems, OR scheduling is further complicated by the uncertainty of the time required to perform surgical procedures (including preparation, surgery, and clean-up times). The teams were asked to develop a tool to handle the scheduling and sequencing of surgeries in a hospital that aims to reduce the downtime for an OR, waiting time for a surgeon, and overtime for the OR staff, all of which create costs for the hospital organization.

The teams had to form a mathematical model of the problem, implement it in AIMMS, solve it, create a graphical user interface, and write a 15 page report for the project. We are happy that 11 teams from 7 different countries participated in the competition. The panel of judges (Robert Storer and Luis F. Zuluaga from Lehigh University and Peter Nieuwesteeg from Paragon Decision Technology) selected the following three teams for the final:

Team "OptNAR", Universidad Politécnica de Madrid and INTEC
Raul Pulido Martinez, Natalia Ibañez Herrero (TU-Madrid), Adrian Marcelo Aguirre (INTEC)
advised by Miguel Ortega Mier (TU-Madrid)

Team "ORopt", Technische Universität Berlin and ZIB
Alexander Tesch (TU-Berlin)
advised by Ralf Borndörfer (ZIB)

Team "Universiteit Twente", Universiteit Twente
Corine Laan, Clara Stegehuis
advised by Bodo Manthey

Team "ORTEC", ORTEC, University of Amsterdam
Harmen Boersma, Tristan Hands, Jan-Willem Arentshorst
advised by Frans van Helden

The finalist teams will each give 25 minute presentations (20 minute talks + 5 minutes for questions) on their work on Thursday starting at 9:00am in the Perella Auditorium. The winning team will be announced at the conference banquet on Thursday evening.

One other team has received honorable mention for their work:

Team "PolytHEC", École Polytechnique de Montréal and HEC
Jean Bertrand Gauthier (HEC), Antoine Legrain, Étienne Beauchamp (École Polytechnique de Montréal)
Advised by Louis-Martin Rousseau (École Polytechnique de Montréal)

We thank all the teams for their participation. We believe that it has been a very positive experience for all parties involved in the process.

Detailed Abstracts
(Alphabetical by Speaker's Surname)

Speaker: **Pramod Abichandani** (Drexel University, `pva23@drexel.edu`)
Title: **Mixed Integer Nonlinear Programming for Multi Vehicle Motion Planning: Ground and Underwater Vehicles**
Abstract: Mixed Integer Nonlinear Programming (MINLP) techniques are increasingly used to address challenging problems in robotics, especially Multi-Vehicle Motion Planning (MVMP). In this talk, we present recent work in the area of Multi-Vehicle Path Coordination (MVPC) under communication connectivity constraints. We focus on two different groups of vehicles — the first being ground based vehicles and the second group being underwater vehicles.

For the ground based robots, we present technical approach and experimental results for MVPC. In this case, each vehicle robot starts from a fixed start point and moves toward a goal point along a fixed path, so as to avoid collisions and remain in communication connectivity with other robots. To the best of our knowledge this is the first experimental implementation of a real-time MINLP framework for solving MVMP.

For the underwater robots, we present novel acoustic communication connectivity constraint formulations for the MVPC problem. These constraints account for the attenuation due to signal propagation and delays arising from multi-path propagation in noisy communication environments, and specify inter-vehicle connectivity in terms of a signal-to-noise ratio (SNR) threshold. Simulation scenarios including up to 4 robots are simulated to demonstrate (i) the effect of communication connectivity requirements on robot velocity profiles, and (ii) the dependence of the solution computation time on the communication connectivity requirement.

In both scenarios, the optimization improved connectivity at no appreciable cost in journey time (as measured by the arrival time of the last-arriving robot). Results also demonstrate the responsive nature of robot trajectories to safety requirements with collision avoidance being achieved at all times despite overlapping and intersecting paths.

Speaker: **Abdul-Rahim Ahmad** (Rowe School of Business, Dalhousie University, Canada, `Ahmad@dal.ca`)
Title: **A Novel Adaptive Boundary Search Algorithm for Solving Facility Layout Problems**
Abstract: A survey of literature in the Facility Layout Planning area indicates that, despite the reported effectiveness of analytical algorithms, very few analytical methods have been published in the last decade. The paper focuses on the open space facilities layout planning involving modules with constant aspect ratios. The paper presents a definition for "Local Optimum Layout" and introduces a "Near-Optimality Hypothesis". Based on these definitions, a hybrid algorithm is presented that ensures convergence to a Local Optimal Layout at each iteration cycle. This algorithm is a novel combination of steepest descent and corner search. The algorithm is basically analytical with construction-cum-improvement hybridization and heuristics. The construction cycle places a new module at the optimal location on the boundary of previously formed cluster of modules. The improvement cycle moves each module to its optimal location in the direction of steepest descent and heuristically removes and resulting overlaps. The improvement cycle alternates boundary search and steepest descent moves until convergence to the Local Optimal Layout. Layout solutions produced by the proposed algorithm for well-known test problems were found superior to the published layouts as well as the best layouts produced by commercial layout design software VIP-PLANOPT.
Coauthor(s): **Imran A. Tasadduq** (`iatasadduq@uqu.edu.sa`) , **M.H. Imam** (`mmimam@uqu.edu.sa`)

Speaker: **Amir Ali Ahmadi** (IBM Watson Research Center, `a_a_a@mit.edu`)
Title: **Approximation of the Joint Spectral Radius via Dynamic and Semidefinite Programming**
Abstract: The joint spectral radius (JSR) of a finite set of matrices is a nonnegative number that characterizes the maximum growth rate that can be achieved by multiplying the matrices in arbitrary order. It is a natural generalization of the notion of the spectral radius of a single matrix and has numerous applications across applied mathematics. Unlike the spectral radius, however, the JSR is notoriously hard to compute; e.g., the decision problem "Is the JSR less than or equal to one?" is algorithmically undecidable.

In this talk, we give an introduction to the joint spectral radius and its applications. We then present algorithms based on dynamic and semidefinite programming that either compute the JSR exactly for special cases or approximate it with guaranteed accuracy in the general case.

Based on joint works with Parrilo, and with Jungers, Parrilo, and Roozbehani.

Speaker: **Brendan Ames** (Institute for Mathematics and its Applications, `bpames@ima.umn.edu`)
Title: **Finding hidden cliques and dense subgraphs via convex optimization**
Abstract: Identifying sets of densely connected nodes in graphs plays a significant role in a wide range of applications, such as information retrieval, pattern recognition, computational biology, and image processing. We consider the problem of identifying the densest k-node subgraph in a given graph. Although the original combinatorial problem is NP-hard, we show that the densest k-subgraph can be recovered from the solution of a particular convex relaxation for certain program inputs. In particular, we establish exact recovery in the case that the input graph contains a single planted clique plus noise in the form of corrupted adjacency relationships.

Speaker: **Miguel Anjos** (Polytechnique Montreal, `anjos@stanfordalumni.org`)
Title: **Optimization of Wind, Diesel and Battery Systems for Remote Areas**
Abstract: Imagine a mine in Nunavut (Canada) that is 1000 km away from the closest electrical grid. The high extension cost of the grid means that electrical energy must be produced locally and autonomously. Traditionally electricity was supplied by diesel generation. This technology is easy to implement but is also expensive. The use of wind turbines in remote areas to reduce fuel consumption was proposed in the 1990s. This technology is now widely used in off-grid sites. The recent developments in storage technology mean that batteries may further reduce the use of diesel generators. The challenge in optimizing such hybrid energy systems is to find both the optimal sizing and the optimal operational strategy: the two are linked and impact each other. Because hybrid systems are often designed by simulation, dispatch rules must be set a priori, and this necessarily influences the outcome. We present an integer linear optimization model to find the optimal design and dispatching scenario without the need for dispatch rules. The best implementable rules are then deduced from the optimal solution. Because our solution represents a perfect dispatch, it provides a reference to benchmark dispatch strategies.
Coauthor(s): **Thibault Barbier** (`thibault.barbier@polymtl.ca`) , **Gilles Savard** (`gilles.savard@polymtl.ca`)

Speaker: **Arash Asadpour** (NYU Stern School of Business, `aasadpou@stern.nyu.edu`)
Title: **Rounding by Sampling**
Abstract: Linear Programming relaxation is a widely used approach to solve combinatorial optimization problems. The caveat however, is to round the fractional optimal solution of the LP formulation to a (nearly) optimal solution for the original discrete problem. Various rounding methods have been proposed in the last twenty five years. In this talk I will introduce a new probabilistic technique for transforming the fractional solution to an integral one so that the underlying combinatorial structure of the problem is preserved. The technique is based on sampling from maximum entropy distributions over combinatorial structures hidden in such problems. In order to present the idea and provide the high-level intuition behind it, I will go through the generalization of the Traveling Salesman Problem (Asymmetric TSP) and show how we can improve the worst-case performance guarantee for this problem after almost 30 years. We will also see other applications of this technique in assignment problems and fair resource allocation.

Speaker: **Negar Soheili Azad** (Tepper, Carnegie Mellon University, `nsoheili@andrew.cmu.edu`)
Title: **A Deterministic Rescaled Perceptron Algorithm**
Abstract: The classical perceptron algorithm is a separation-based algorithm for solving conic-convex feasibility problems in a number of iterations that is bounded by the reciprocal of the square of the cone thickness. We propose a modified perceptron algorithm that leverages periodic rescaling for exponentially faster convergence, where the iteration bound is proportional to the logarithm of the reciprocal of the cone thickness and another factor that is polynomial in the problem dimension.
Coauthor(s): **Javier Pena** (`jfp@andrew.cmu.edu`)

Speaker: **Onur Babat** (Lehigh University, `onur.babat@lehigh.edu`)
Title: **Linear solution scheme for the cardinality constrained portfolio allocation models**
Abstract: The cardinality-constrained portfolio allocation models can be formulated as a MIQP when the risk is measured by the portfolio return variance. Thus it can be difficult to solve especially for the large scale instances. To tackle this inherent difficulty, we propose a linear solution scheme based on Benders reformulation. The effectiveness of the linear solution schemes is illustrated by numerical experiments.
Coauthor(s): **Luis Zuluaga** (`luis.zuluaga@lehigh.edu`)

Speaker: **Xi Bai** (Lehigh University, `xib210@lehigh.edu`)
Title: **Risk parity in portfolio selection: models and algorithms**
Abstract: The risk parity optimization problem aims to find such portfolios for which the contributions of risk from all assets are equally weighted. Portfolios constructed using risk parity approach are a compromise between two well-known techniques: minimum variance optimization approach (MVO) and equally weighted approach (EW). In this talk, we discuss the problem of finding portfolios that satisfy risk parity of either individual assets or groups of assets. We describe the set of all risk parity solutions by using convex optimization techniques over quadrants, and also propose an alternative nonconvex least-square model whose set of optimal solutions includes all risk parity solutions, and propose a modified formulation which aims at selecting the most desirable risk parity solution (according to some criteria). Furthermore, we propose an alternating linearization framework to solve this nonconvex model. Numerical experiments indicate the effectiveness of our technique in terms of both speed and accuracy.
Coauthor(s): **Katya Scheinberg** (`katyas@lehigh.edu`)

Speaker: **Rimvydas Baltaduonis** (Gettysburg College, `rbaltadu@gettysburg.edu`)
Title: **An Experimental Study of Complex-Offer Auctions: Payment Cost Minimization versus Offer Cost Minimization**
Abstract: A Payment Cost Minimization auction has been proposed as an alternative to the Offer Cost Minimization auction for use in wholesale electric power markets with an intention to lower procurement cost of electricity. Efficiency concerns are raised for this proposal assuming that the true production costs would be revealed to the auctioneer in a competitive market. Using an experimental approach, I compare the performance of two auctions, controlling for the level of unilateral market power. I find that neither auction results in allocations that correspond to the true cost revelation. Two auctions perform similarly in terms of procurement cost and efficiency. Surprisingly, consumer prices in a competitive environment approach the prices of an environment with market power. It appears that the expected institutional effects for procurement cost and efficiency are greatly dominated by the effects of anti-competitive behavior due to the offer complexity and a cyclical nature of market demand.

Speaker: **Soutir Bandyopadhyay** (Lehigh University, `sob210@lehigh.edu`)
Title: **Multiresolution Gaussian Process Model for the Analysis of Large Spatial Data Sets.**
Abstract: The recent breakthroughs in Bayesian hierarchical models have added new classes of models for handling nonstationary spatial data and indirect measurements of the spatial process. This development in spatial statistics is coincident with emerging challenges in the geosciences involving new types of observations and comparisons of data to complex numerical models. For example, as attention in climate science shifts to understand the regional and local changes in future climate there is a need to analyze high resolution regional simulations from climate models and to compare them to surface and remotely sensed observations at fine levels of details. These kinds of geoscience applications are characterized by large numbers of spatial locations and the application of standard spatial statistics techniques is often not feasible or will take an unacceptably long time given typical computational resources. Moreover, geophysical processes tend to be nonstationary over space and there is also the need to apply statistical methods that do not assume a constant spatial dependence across a region. In this work we develop a new statistical model that addresses both of these features of geophysical data and so fills a gap in current statistical methodology. Our approach combines the representation of a field using a multiresolution basis with statistical models for processes on a lattice and introduces sparsity into the computations in a way that does not compromise covariance models with large scale correlations and models with many degrees of freedom.

Speaker: **Getachew K Befekadu** (University of Notre Dame, `gbefekadu1@nd.edu`)
Title: **On the connection between the reliability of systems and the notion of invariance entropy**
Abstract: The purpose of this talk is to establish a connection between the problem of reliability (when there is an intermittent control-input channel failure that may occur between actuators, controllers and/or sensors in the system) and the notion of controlled-invariance entropy of a multi-channel system (with respect to a subset of control-input channels and/or a class of control functions). We remark that such a connection could be used for assessing the reliability (or the vulnerability) of the system, when some of these control-input channels are compromised with an external "malicious" agent that may try to prevent the system from achieving more of its goal (such as from attaining invariance of a given compact state and/or output subspace).
Coauthor(s): **Vijay Gupta** (`vgupta2@nd.edu`) , **Panos J. Antsaklis** (`Antsaklis.1@nd.edu`)

Speaker: **Hande Y. Benson** (Drexel University, `benson@drexel.edu`)
Title: **Interior-Point Methods within a MINLP Framework**
Abstract: In this talk, we present details of MILANO (Mixed-Integer Linear and Nonlinear Optimizer), a Matlab-based toolbox for solving mixed-integer optimization problems. For MINLP, it includes implementations of branch-and-bound and outer approximation algorithms and solves the nonlinear subproblems using an interior-point penalty method introduced by Benson and Shanno (2005) for warmstarts. Special consideration is given for problems with cone constraints.

Speaker: **Xiaoqiang Cai** (The Chinese University of Hong Kong, `xqcai@se.cuhk.edu.hk`)
Title: **Optimal Dynamic Stochastic Scheduling with Partial Losses of Work**
Abstract: Stochastic scheduling subject to random machine breakdowns has been the focus of study in an extensive literature over decades. Prior research in this area has been conducted, nevertheless, with the implicit assumption that a machine breakdown causes either no loss of the work achieved on a job at all, or a total loss of the work achieved. In many practical problems, however, the work achieved on a job is neither fully preserved nor totally lost after a breakdown.
In this article, we develop a unified approach to deal with any level of partial losses due to machine breakdowns. More specifically, we consider a problem to process a number of jobs with arbitrary random processing times by a machine subject to general stochastic breakdowns, where each breakdown may cause an uncertain loss of the work achieved on the job being processed. The objective is to maximize the expected weighted discounted reward of completing the jobs. We develop a general framework to model uncertain losses of work caused by breakdowns as a semi-Markov transition process. We obtain the optimal dynamic polices using multi-armed bandit process methodology, which are characterized by a set of Gittins indices as solutions to a system of integral equations.
Coauthor(s): **Xianyi Wu** (`xywu@stat.ecnu.edu.cn`), **Xian Zhou** (`xian.zhou@mq.edu.au`)

Speaker: **Elcin Cetinkaya** (Lehigh University , `elcin.cetinkaya@gmail.com`)
Title: **Portfolio Risk Management with Moment Matching Approach**
Abstract: We investigate the problem minimizing the probability of obtaining a portfolio return less than a threshold while keeping the expected portfolio return no worse than a target. We propose a tractable solution involving an algorithm based on log-Normally distributed stock returns assumption and the Fenton-Wilkinson approximation method to the problem difficult to solve using exact methods. We compare its performance to that of some benchmark methods. We extend our approach to design basket options.
Coauthor(s): **Aurelie Thiele** (`aurelie.thiele@gmail.com`)

Speaker: **Chen Chen** (Lehigh University, `morningchen1983@gmail.com`)
Title: **MPC-based Appliance Scheduling for Residential Building Energy Management Controller**
Abstract: With the emerging smart grid enabling two-way communication, customers will be able to receive time-varying prices of electricity; the price variations will in turn serve as incentives for customers to alter their power usage profiles. Many residential appliances, e.g., clothes washer/dryer and plug-in electric vehicle (PEV), provide operational flexibilities that customers can exploit to take advantage of these pricing incentives. This flexibility can simultaneously benefit electric utilities and grid operators by relieving peak demand. However, current residential load control activities are mainly operated manually, which poses great challenges to customers seeking to optimally schedule appliance operations in the presence of time-varying electricity prices. Hence, an automated building energy management controller (BEMC) is necessary to optimize the appliances' operation on behalf of customers.
In this work, we propose an optimization method for the BEMC to schedule appliances within buildings. Both thermostatically-controlled appliances (e.g., electric heaters) and non-thermal appliances (e.g., dishwasher, clothes washer/dryer, PEVs) with flexibilities are considered in the proposed method. For non-thermal appliance scheduling, in which delay and/or power consumption flexibilities are available, we model the BEMC operations as a mixed-integer linear programming (MILP) problem, where operation dependence of *inter-appliance* and *intra-appliance* is integrated to further exploit electricity price variations. For thermal appliance scheduling, the thermal mass of the building, which serves as thermal storage, is integrated into the linear programming problem by modeling the thermodynamics of rooms in a building as constraints. Within the comfort range modeled by the predicted mean vote (PMV) index, thermal appliances are scheduled smartly together with thermal mass storage to hedge against high prices and exploit low-price periods. To cope with uncertainty of prices and weather information, model predictive control (MPC) method, which incorporates both forecasts and newly updated information, is utilized to build a rolling-based finite-horizon optimization. Simulation results show that customers have notable energy cost savings on their electricity bills when using the proposed BEMC optimization in the presence of time-varying prices.
Coauthor(s): **Shalinee Kishore** (`skishore@lehigh.edu`), **Jianhui Wang** (`jianhui.wang@anl.gov`), **Yeonsook Heo** (`yheo@anl.gov`)

Speaker: **Boris Defourny** (Princeton University, `defourny@princeton.edu`)
Title: **A Nested Look-Ahead Model for Unit Commitment with Joint Ramping Capability Requirements**
Abstract: We propose a formulation of the unit commitment problem where joint ramping capability requirement constraints over multiple durations are introduced to help mitigating the risk posed by poorly predicted variations of wind energy supply over multiple time scales. The optimization model implements short-horizon look-aheads inside a main look-ahead over the planning horizon.
Coauthor(s): **Hugo P. Simao** (`hpsimao@princeton.edu`), **Warren B. Powell** (`powell@princeton.edu`)

Speaker: **Jonathan Donadee** (Carnegie Mellon University, `jdonadee@andrew.cmu.edu`)
Title: **Co-Optimization of Grid-to-Vehicle Charging and Ancillary Services**
Abstract: This talk investigates the charging of an electric vehicle (EV) that has access to both energy and ancillary services markets. The EV's decision optimization problem is formulated as a finite horizon MDP with multiple sources of Markovian uncertainty. The MDP is solved using a novel heuristic backwards recursion. This heuristic leverages linear programming theory to create piecewise-linear convex value functions and enables optimization over a continuous space of actions.
Coauthor(s): **Marija Ilic** (`milic@ece.cmu.edu`)

Speaker: **Hongbo Dong** (University of Wisconsin-Madison, `hdong6@wisc.edu`)
Title: **Conic relaxations for convex quadratic optimization with indicator variables**
Abstract: We consider the problem of globally solving convex quadratic optimization with indicator variables, which has applications in portfolio optimization, sparse filter design, etc. We construct multiple convex conic relaxations, with special focus on second order cone programming and sparse semidefinite programming. Together with valid inequalities generated by exploiting relevant convex hulls in small dimensions, we evaluate the strength-complexity trade-offs of these convex relaxations.
Coauthor(s): **Jeff Linderoth** (`linderoth@wisc.edu`)

Speaker: **Yang Dong** (Lehigh University, `yad210@lehigh.edu`)
Title: **Robust Manager Allocation for Investment Management**
Abstract: A key difficulty for an investment manager is to quantify fund managers' skill when he may not know managers' allocation precisely. We propose a portfolio optimization framework that takes into account the uncertainty in fund allocation and consider both a robust optimization approach and a stochastic perspective. We then provide insights into the impact of the uncertainty related to the asset allocation and the asset returns on portfolio performance and the manager selection policy.
Coauthor(s): **Aurelie Thiele** (`aut204@lehigh.edu`)

Speaker: **Xingyuan Fang** (Princeton University, `xingyuan@princeton.edu`)
Title: **Online PRSM**
Abstract: Online optimization has been shown to be powerful for large scale problem. We present a new online optimization method Online PRSM which applies to a wide range of applications. An ergodic $O(1/\sqrt{t})$ convergence rate in expectation is also derived.

Speaker: **Farbod Farhadi** (University of Massachusetts Amherst, `ffarhadi@som.umass.edu`)
Title: **Column Generation and Accelerating Schemes for Mixed-Mode Aircraft Sequencing Problems**
Abstract: We discuss and contrast alternative accelerations schemes for a column generation approach with application to mixed-mode aircraft sequencing problems. Such enhancements include solving the pricing sub-problem with dynamic programming vs. MIP along with stabilization strategies. Computational results are reported.
Coauthor(s): **Ahmed Ghoniem** (`aghoniem@isenberg.umass.edu`)

Speaker: **Hanan Mostaghimi Ghomi** (University of Windsor,)
Title: **Three Dimensional Knapsack Problem with Vertical Stability and Pre-Placed Boxes**
Abstract: A three-dimensional knapsack problem packs a subset of rectangular boxes inside a bin with fixed size such that the utilization of the bin's volume is maximized. Each box has its own value and size and can be freely rotated into any of the six positions while its edges are parallel to the bin's edges. A knapsack algorithm based on Eglebad & Pisinger (2009) sequence triple representation is developed. The sequence triple shows the relative position where the boxes must be packed. The proposed algorithm considers box rotation and vertical stability. Simulated annealing technique and FFD algorithm are used to model the problem. Moreover, the situation where some boxes are pre-placed in the bin is investigated. These pre-placed boxes represent potential obstacles. Numerical experiments have been conducted for bins with and without obstacles. The initial results provide bin's utilization of about 87%. More experiments are still conducted to refine the results.
Coauthor(s): **Walid Abdul-Kader** (`kader@uwindsor.ca`), **Hanan Mostaghimi** (`mostaghh@uwindsor.ca`)

Speaker: **Julio Góez** (Lehigh University, `jcg207@lehigh.edu`)
Title: **Full characterization of disjunctive-conic-cuts for mixed integer second order cone optimization**
Abstract: Mixed integer second order cone optimization (MISOCO) problems have an increasing number of engineering applications including supply chain, finance, and networks design. In this talk we analyze the derivation of Disjunctive-Conic-Cuts (DCCs) for MISOCO problems. We present a full characterization of the DCCs when the disjunctive set considered is defined by parallel hyperplanes. We also present the results of some preliminary computational experiences with the novel DCCs.

Speaker: **Walter Gomez** (Universidad de La Frontera, `wgomez@ufro.cl`)
Title: **Consumer demand systems based on discrete-continuous models**
Abstract: We consider the problem of describing consumer choice situations characterized by the simultaneous demand for multiple alternatives that are imperfectly substitutes for one another. The econometric technique to deal with this problem is the so called Kuhn-Tucker multiple discrete-continuous economic consumer demand model. This model is usually stated with suitable nonsymmetric error distribution such that closed forms for the underlying probability function of consumption patterns can be obtained.
In this paper we modify the model in two ways. On the one we use another probability distribution for the error that is symmetric and also provides closed forms. On the other hand, we include semidefinite constraints into the optimization problem arising by doing statistical inference with the model. Numerical experiments with the new model are presented.
Coauthor(s): **Ignacio Vidal** (`ividal@inst-mat.utalca.cl`), **Felipe Vasquez** (`fvasquez@udec.cl`), **Alejandro Llanos** (`allanos@ufro.cl`)

Speaker: **Clovis C. Gonzaga** (Federal University of Santa Catarina, Brazil, `ccgonzaga1@gmail.com`)
Title: **On the complexity of steepest descent methods for minimizing convex quadratic functions**
Abstract: We discuss the performance of the steepest descent algorithm for minimizing a quadratic function with hessian matrix eigenvalues between $1/C$ and 1. Steepest descent methods differ exclusively on the choice of the step length at each iteration. We develop a scheme for choosing the step lengths with the following result: the number K of iterations needed to reduce the objective function, the gradient norm and the distance to the optimal solution by a factor ϵ is bounded by $K \leq \sqrt{C}\log(1/\epsilon)$. This is contrasted to the linear dependence predicted by Kantorovich's analysis.

Speaker: **Chaitra Gopalappa** (Futures Institute, `cgopalappa@fututresinstitute.org`)
Title: **Simulation model for the analyses and cost estimates of combination HIV-prevention strategies for the elimination of HIV**
Abstract: UNAIDS aims at achieving zero new HIV infections, zero HIV-related deaths, and zero discrimination. We analyze alternative combinations of HIV-intervention programs to identify strategies that can achieve the goals on new infections and deaths and estimate the corresponding costs of the strategies. These programs, along with current key HIV-prevention programs such as prevention of mother to child transmission and treatment with antiretroviral therapy (ART), also include new technologies such as ART as a prevention strategy to reduce risks of transmission (test and treat), pre-exposure prophylaxis to reduce risk of acquisition of infection, and the prospective role of an effective HIV vaccine if it becomes available. We used a compartmental model, Goals, to simulate the strategies for 24 countries that contribute to 85% of new infections in low and middle income countries. We scaled-up the results to estimate the total resources needed for 139 low and middle income countries. Estimates indicate that only a combination of all programs, current and new technologies, can lead to a sustainable reduction in new infections and deaths and hence will be critical to achieving the UNAIDS targets.
Coauthor(s): **John Stover** , **Carel Pretorius** (on behalf of the New Prevention Technology Study Group)

Speaker: **Jackie Griffin** (Northeastern University, `ja.griffin@neu.edu`)
Title: **Patient-bed Assignments in Hospital Systems**
Abstract: To alleviate overcrowding in hospitals, hospitals may implement policies that address the management of patient arrivals through the redirection of patients to other hospitals. We model the hospital unit as a Markov chain and develop type-specific threshold policies for patient assignment while simultaneously addressing three distinct objectives.
Coauthor(s): **Pinar Keskinocak** (`pinar@isye.gatech.edu`)

Speaker: **Bin Han** (University of Maryland, College Park, `danielh@math.umd.edu`)
Title: **Efficient Learning of Donor Retention Strategies for the American Red Cross**
Abstract: We present a new sequential decision model for adaptively allocating a fundraising campaign budget for a non-profit organization such as the American Red Cross. The campaign outcome is related to a set of design features using linear regression. We derive the first simulation allocation procedure for simultaneously learning unknown regression parameters and unknown sampling noise. The large number of alternatives in this problem makes it difficult to evaluate the value of information. We apply convex approximation with a quantization procedure and derive a semidefinite programming relaxation to reduce the computational complexity. Simulation experiments based on historical data demonstrate the efficient performance of the approximation.
Coauthor(s): **Ilya Ryzhov** (`iryzhov@rhsmith.umd.edu`) , **Boris Defourny** (`defourny@princeton.edu`)

Speaker: **Zheng Han** (Lehigh University, `zhh210@lehigh.edu`)
Title: **A primal-dual active-set algorithm for large-scale convex quadratic optimization**
Abstract: Active-set methods enjoy great popularity in practical nonlinear optimization problems despite the possible drawback of slow update of the active-set estimate. We present a primal-dual active-set framework for large-scale convex quadratic optimization that can make multiple simultaneous changes in the active-set estimate and converge from arbitrary initial points. The iterates of our framework are the active-set estimates themselves, where with each estimate a primal-dual solution is uniquely defined via a reduced subproblem. The computational cost of each subproblem is typically only modestly more than solving a reduced linear system. Moreover, we can potentially undercut further the cost of solving the subproblem by incorporating inexactness. Preliminary numerical results illustrate that our method is efficient and can often lead to rapid identification of the optimal active-set even for poorly conditioned problems.
Coauthor(s): **Frank E. Curtis** (`frank.e.curtis@lehigh.edu`) , **Daniel P. Robinson** (`daniel.p.robinson@jhu.edu`)

Speaker: **Lin He** (Lehigh University, `lih308@lehigh.edu`)
Title: **Inventory Management for a Distribution System Subject to Supply Disruptions**
Abstract: We study inventory optimization for continuous-review multi-echelon distribution systems subject to supply disruptions, with Poisson customer demands under a first-come, first-served allocation policy. We develop a recursive optimization heuristic, which applies a bottom-up approach that sequentially approximates the base-stock levels of all the locations. A preliminary numerical study shows that it performs very well, reaching within 1% of optimal for most instances tested.
Coauthor(s): **Larry Snyder** (`lvs2@lehigh.edu`)

Speaker: **Jason Hicken** (Rensselaer Polytechnic Institute, hickej2@rpi.edu)
Title: **A Flexible Iterative Trust-Region Algorithm for Nonstationary Preconditioners**
Abstract: Matrix-free optimization algorithms are typically based on Krylov iterative methods that, in principle, require only matrix-vector products. Such algorithms are attractive for reduced-space PDE-constrained optimization, where the Hessian and Jacobian are computationally expensive to form explicitly. In practice, Krylov solvers also require preconditioning, especially for large-scale problems with many degrees of freedom. Quasi-Newton preconditioners have been used successfully in several applications, but this class of preconditioner may require many iterations before it is effective. To remain truly matrix-free, one possibility is to use a nested (inner) iterative solver as a preconditioner. Iterative solvers are nonstationary, in general, so we need to consider so-called flexible outer methods. Flexible Krylov methods present unique challenges in the context of optimization, because they destroy the symmetry present in the system. In this work, we present a flexible iterative trust-region method based on solving the trust-region subproblem in a projected subspace. The proposed algorithm uses an ad hoc strategy to resolve the conflict between preconditioning the linear system and estimating the largest negative eigenvalue of the Hessian. Numerical experiments verify the method and demonstrate its effectiveness on a PDE-constrained optimization problem.

Speaker: **Hassan Lionel Hijazi** (NICTA, hassan.hijazi@nicta.com.au)
Title: **Convex Quadratic Approximations of AC Power Flows**
Abstract: New convex quadratic approximations of the AC power flow equations are studied. The approximation is motivated by hybrid discrete/continuous applications in power systems that operate outside normal conditions. Under such circumstances, which arise in power restoration and renewable energy integration, existing approximations are inaccurate to be useful in practice. The convex quadratic approximations remedy these limitations by capturing reactive power and voltage magnitude accurately. Two case studies in optimal power flows and capacitor placement, demonstrate the benefits of the new formulations in terms of accuracy and efficiency.
Coauthor(s): **Carleton Coffrin** (Carleton.Coffrin@nicta.com.au) , **Pascal Van Hentenryck** (pvh@nicta.com.au)

Speaker: **Robert Howley** (Lehigh University, roh210@lehigh.edu)
Title: **Computing semiparametric bounds on the expected payments of insurance instruments via column generation**
Abstract: It has been recently shown that numerical semiparametric bounds on the expected payoff of financial or actuarial instruments can be computed using semidefinite programming. However, this approach has practical limitations. Here we use column generation, a classical optimization technique, to address these limitations. From column generation, it follows that practical univariate semiparametric bounds can be found by solving a series of linear programs. In addition to moment information, the column generation approach allows the inclusion of extra information about the random variable; for instance, unimodality and continuity, as well as the construction of corresponding worst/best-case distributions in a simple way.
Coauthor(s): **Bob Storer** (rhs2@lehigh.edu) , **Luis Zuluaga** (luis.zuluaga@lehigh.edu) , **Juan Vera** (j.c.veralizcano@uvt.nl)

Speaker: **Cho-Jui Hsieh** (UT Austin, cjhsieh@cs.utexas.edu)
Title: **Sparse Inverse Covariance Matrix Estimation Using Quadratic Approximation**
Abstract: The L1-regularized Gaussian maximum likelihood estimator (MLE) has been shown to have strong statistical guarantees in recovering a sparse inverse covariance matrix, or alternatively the underlying graph structure of a Gaussian Markov Random Field, from very limited samples. We propose a novel algorithm for solving the resulting optimization problem which is a regularized log-determinant program. In contrast to recent state-of-the-art methods that largely use first order gradient information, our algorithm is based on Newton's method and employs a quadratic approximation, but with some modifications that leverage the structure of the sparse Gaussian MLE problem. We show that our method is superlinearly convergent, and present experimental results using synthetic and real-world application data that demonstrate the considerable improvements in performance of our method when compared to other state-of-the-art methods.
Coauthor(s): **Matyas Sustik** (sustik@cs.utexas.edu) , **Inderjit Dhillon** (inderjit@cs.utexas.edu) , **Pradeep Ravikumar** (pradeepr@cs.utexas.edu)

Speaker: **Brian J. Hunt** (Johnson C. Smith University, `bjhunt@jcsu.edu`)
Title: **A Modeling and Simulation Approach to Emergency Management**
Abstract: We present a model of North Carolina Emergency Management's disaster logistics process for fulfilling disaster supply requests from state and local agencies. The model will provide an advance planning tool to determine the optimum logistics process resources (request processors, supply purchasers, delivery trucks, etc.) required to meet performance objectives for delivery depending on predicted daily demand levels. Data collected during the responses to Hurricanes Irene (Category 1, 2011) and Floyd (Category 3, 1999) was used to develop the model.
Coauthor(s): **Paul Latham** (`paul.latham@ncdps.gov`)

Speaker: **Jhi-Young Joo** (Carnegie Mellon University, `jjoo@ece.cmu.edu`)
Title: **Adaptive Load Management: Scheduling And Coordination Of Demand Resources In Power Systems**
Abstract: Demand response refers to techniques that manage end-users' electricity consumption in order to help the power system operate in a more cost-efficient and reliable way. It is becoming more important with increasing renewable and distributed energy resources incorporated into the system. Our proposed demand response framework, namely Adaptive Load Management, provides a comprehensive structure for demand response by formulating the complex power system objective as many sub-problems of diverse supply and demand entities in the system over multiple time horizons. In this talk, we will focus on the short-term scheduling of supply and demand resources, with an emphasis on managing flexible demand resources of small end-users. The difficulty of this problem comes from the uncertainty of loads and supply, limitations on communication and information exchange among a large number of supply and demand entities, and modeling different values of electric energy seen by diverse end-users/loads. We will address how we tackle these issues, and present simulation results that demonstrate how our methodology works.
Coauthor(s): **Marija Ilic** (`milic@ece.cmu.edu`)

Speaker: **Abdullah Konak** (Penn State Berks, `konak@psu.edu`)
Title: **Cyclic Facility Layout Problem: A Hybrid Exact/Heuristic Optimization Approach**
Abstract: This presentation introduces a special case of Dynamic Facility Layout Problem (DFLP) where product types, product demands, and departmental area requirements are seasonal. There are several production periods in each planning horizon, and the production periods repeat themselves in consecutive planning horizons. Therefore, this new problem is called Cyclic Facility Layout Problem (CFLP). In this study, first, a mixed integer programming formulation is introduced for the CFLP. The proposed formulation relaxes the assumption of fixed department shapes, which is commonly accepted in the DFLP literature. In addition, department sizes are allowed to change over the planning horizon. This relaxation is required particularly in real-world cases where the area requirements of departments are also seasonal, and the facility size is limited. Then, a large scale hybrid simulated annealing (LS-HSA) is proposed to solve the proposed formulation for problem instances with practical sizes. The proposed LS-HSA has shown to be effective and versatile as it can be applied to various facility layout problems.
Coauthor(s): **Sadan Kulturel-Konak** (`sadan@psu.edu`)

Speaker: **Sadan Kulturel-Konak** (Penn State Berks, `sadan@psu.edu`)
Title: **Solving the Unequal Area Facility Layout Problem: An Effective Hybrid Optimization Strategy Coupled with the Location/Shape Representation**
Abstract: In this study, an innovative integration of Genetic Algorithms (GA) and Linear Programming (LP) is proposed to solve the Facility Layout Problem (FLP) on a continuous plane with unequal-area departments. In addition, a new encoding scheme, called the location/shape representation, has been developed. The proposed hybrid LP/GA approach is different from previously reported hybrid heuristic/exact algorithms in several ways. LP is not only used to evaluate solutions represented in the GA's encoding scheme but also, the output of the LP solution is directly integrated into the GA's encoding. The GA generates new solutions by recombining prior solutions obtained by the LP. This integration of the output of the LP into the GA's encoding is enabled by the location/shape representation. The superior performance of the proposed hybrid GA/LP approach can be attributed to the location/shape representation and how the information gained by the LP is integrated into the GA's encoding using the location/shape representation.
Coauthor(s): **Abdullah Konak** (`konak@psu.edu`)

Speaker: **Andrew Lambe** (University of Toronto, `lambe@utias.utoronto.ca`)
Title: **A Matrix-Free Augmented Lagrangian Algorithm for Large-Scale Structural Design**
Abstract: This talk considers the problem of minimum-mass structural design subject to stress constraints. Problems in this class include not only PDE constraints, but also a large number of general (i.e. maximum stress) constraints. Many structures found in aircraft design problems need to be modeled with high-order finite element methods to accurately predict their behavior. However, in the reduced-space form of the problem, the cost of computing the gradients to all the stress constraints dominates the computational cost. We present an augmented Lagrangian optimization algorithm for solving this reduced-space problem that is matrix-free, i.e. the algorithm requires neither the full Hessian nor full Jacobian of the optimization problem, only appropriate matrix-vector products. Test results show that this matrix-free approach is competitive with an SQP algorithm (which requires the full Jacobian) on the reduced-space problem and scales well with refinement of the finite element mesh. We also comment on extensions of this work to solving full-space PDE-constrained problems.
Coauthor(s): **Sylvain Arreckx** (`sylvain.arreckx@polymtl.ca`) , **Joaquim Martins** (`jrram@umich.edu`) , **Dominique Orban** (`dominique.orban@gerad.ca`)

Speaker: **Eric Landquist and Francis Vasko** (Kutztown University, `elandqui@kutztown.edu`)
Title: **A Simple and Efficient Strategy for Solving Large Generalized Cable-Trench Problems**
Abstract: Vasko et al. (2002) defined the Cable-Trench Problem (CTP) as a combination of the Shortest Path and Minimum Spanning Tree Problems. Specifically, let $G = (V, E)$ be a connected weighted graph with specified vertex $v_1 \in V$ (referred to as the root node), weight $l(e) \geq 0$ for each $e \in E$, and positive parameters τ and γ. The Cable-Trench Problem (CTP) is the problem of finding a spanning tree T of G such that $\tau l_\tau(T) + \gamma l_\gamma(T)$ is minimized, where $l_\tau(T)$ is the total length of the spanning tree T and $l_\gamma(T)$ is the total path length in T from v_1 to all other vertices of V. Recently, Jiang et al. (2011) modeled the vascular connectivity problem in medical image analysis as a large generalization of the CTP. They proposed an efficient solution based on a modification of Prim's algorithm (MOD_PRIM), but did not elaborate on it. In this paper, we will formally define the Generalized CTP (GCTP) and describe MOD_PRIM in detail. We show that MOD_PRIM gives nearly optimal results for small GCTPs and describe two heuristics which further improve the results of MOD_PRIM. These algorithms are capable of finding nearly optimal solutions of very large GCTPs as efficiently as theoretically possible. Empirical results for graphs with up to 25,000 vertices and about 11 million edges will be given.
Coauthor(s): **Francis Vasko** (`vasko@kutztown.edu`) , **Gregory Kresge** (`gkres121@live.kutztown.edu`) , **Adam Tal** (`atal822@live.kutztown.edu`) , **Yifeng Jiang** (`jiang1feng@gmail.com`) , **Xenophon Papademetris** (`xenophon.papademetris@yale.edu`)

Speaker: **Yanchao Liu** (University of Wisconsin-Madison, `yliu67@wisc.edu`)
Title: **Modeling Demand Response for FERC Order 745**
Abstract: We study the FERC Order 745 regarding demand response compensation in organized wholesale energy markets, and explore different approaches to model and solve a compliant implementation of the Order. In the economics sense, demand response in the Order context is a trade of "consuming right" instead of a trade of energy, therefore it must be dispatched separately from the economic dispatch of energy. This dictates that in general, simultaneous clearing of demand response and energy can only be achieved in one of the two ways: an iterative process, or a hierarchical model. We find a bi-level optimization model to be a suitable one for the given problem. The lower level performs the economic dispatch of energy and generates the price, and the upper level minimizes the total compensation for demand response subject to the net benefit requirement. We show that the con-convex net benefit test requirement can be transformed to a linear constraint in the bi-level framework, which greatly eases the computational complexity. Experiments show that the solution process is reliable and significantly outperforms, in terms of accuracy and speed, a heuristic algorithm implementing the iterative approach. We apply the model to various data cases and settings, and generate useful insight for dispatch operations in compliance with the Order.
Coauthor(s): **Michael C. Ferris** (`ferris@cs.wisc.edu`)

Speaker: **Roger Lueken** (Carnegie Mellon University, `rlueken@andrew.cmu.edu`)
Title: **The effects of bulk electricity storage on the PJM market**
Abstract: In this talk, we will present a unit commitment and economic dispatch (UCED) model of the PJM Interconnection. This model is a mixed integer linear optimization that minimizes the total operational costs of providing electricity. Similar UCED models are used to manage all major restructured electricity markets. Our model, entitled PHORUM, is open source and is designed to be easily used and improved upon by other researchers interested in electricity policy. We will next discuss an application of PHORUM: analyzing the effect of bulk electricity storage on grid operations. In today's electricity industry, storing large quantities of power is economically infeasible. Therefore, total generation must match demand at all times. This inefficiency prevents the electric sector from operating as a conventional competitive market that relies on inventory. However, new affordable grid-scale storage technologies such as advanced batteries are emerging that will allow supply and demand to decouple, fundamentally altering how the electric system and its markets are operated. Our research analyzes how grid operations change when large amounts of storage are available. We are interested in how this deployment will affect the following: Emissions of CO_2, and other pollutants; Electricity prices for consumers; Profits of generators; Profits of storage operators.
Coauthor(s): **Jay Apt** (`apt@cmu.edu`)

Speaker: **Biao Mao** (Rensselaer Polytechnic Insitute, `maob@rpi.edu`)
Title: **Environmental SuperOPF Electricity Market Planning Tool**
Abstract: There are quite wide ranges of optimization problems in the power system and electricity market. Optimization problems dealing with the short run include unit dispatch and operation of markets. Optimization problems dealing with the long run include design of markets and optimal investment. Furthermore renewable energy generation will be increasingly integrated in the power system in the future so it is also very important to evaluate the impacts of changes in technology as well as environmental regulations promoting them. Instead of breaking down all the relevant optimization problems into several sub-problems, our "SuperOPF Planning Tool" is a framework which integrates engineering, economic and environmental models of the power system through co-optimization methods across multiple scenarios. The foundation of the SuperOPF is the extensible optimal power flow formulation according to laws of physics. Then it predicts and optimizes system operation, investments, and retirements through a multi-scenario co-optimization approach, which also includes environmental impacts such as emissions and estimated health damage. One of the activities we can do through all of these models and methods is estimate the long-run effects of environmental policies on the electricity grid. We develop a model of power grid in the eastern US and Canada which includes the transmission lines, locational demand functions, the grid operator's decision-making, and locational marginal prices. We then use these to predict the impact of a carbon dioxide cap-and-trade program, a continuation of the current subsidies for wind and solar power generators, a ban on new coal-burning power plants, and higher-than-expected natural gas prices. In order to predict the impacts of these policy and price conditions in the long run, we simulate the model over three time periods. The base year is 2012, while investment is allowed in the decades ending in 2022 and 2032. The results of these simulations show that this model can predict optimal operation, investment, retirement, prices, economic surplus, emissions, and health effects of policies that affect the electric power industry.
Coauthor(s): **Daniel L. Shawhan** (`shawhd@rpi.edu`), **John T. Taber** (`jtt24@cornell.edu`), **Ray D. Zimmerman** (`rz10@cornell.edu`), **Di Shi**, **Daniel Tylavsky** (`tylavsky@asu.edu`), **Charles M. Marquet** (`cmm363@cornell.edu`), **Jubo Yan** (`jy489@cornell.edu`), **Richard E. Schuler**, **William D. Schulze**

Speaker: **Nikola Markovic** (University of Maryland, College Park, `nikola.didi@gmail.com`)
Title: **Evasive Flow Capture: Optimal Location of Weigh-in-Motion Systems, Tollbooths, and Safety Checkpoints**
Abstract: The flow-capturing location-allocation problem (FCLAP) consists of locating facilities in order to maximize the number of flow-based customers that encounter at least one of these facilities along their predetermined travel paths. In FCLAP, it is assumed that if a facility is located along (or "close enough" to) a predetermined path of a flow, the flow of customers is considered captured. However, existing models for FCLAP do not consider the likelihood that targeted users may exhibit non-cooperative behavior by changing their travel paths to avoid fixed facilities. Examples of facilities that targeted subjects may have an incentive to avoid include weigh-in-motion stations used to detect and fine overweight trucks, tollbooths, and security and safety checkpoints. This paper introduces a new type of flow capturing model, called the "Evasive Flow Capturing Problem" (EFCP), which generalizes the FCLAP and has relevant applications in transportation, revenue management, and security and safety management. We discuss several variants of EFCP and formulate a model for the optimal location of weigh-in-motion stations. We analyze structural properties of EFCP, propose exact and approximate solution techniques, and show an application to a real-world transportation network.
Coauthor(s): **Ilya O. Ryzhov** (`iryzhov@rhsmith.umd.edu`), **Paul Schonfeld** (`pschon@umd.edu`)

Speaker: **Tim Mitchell** (Courant Institute of Mathematical Sciences, New York University, `tim.mitchell@cims.nyu.edu`)
Title: **A BFGS-based SQP Method for Constrained Nonsmooth, Nonconvex Optimization**
Abstract: We consider constrained nonsmooth, nonconvex optimization problems, where both the objective and the constraints may be nonsmooth and nonconvex and are not assumed to have any special structure. In 2012, Curtis and Overton presented a gradient-sampling-based SQP algorithm with a steering strategy to control exact penalty penalization, proving convergence results that generalize the results of Burke, Lewis and Overton and Kiwiel for the unconstrained problem. This algorithm uses BFGS approximation to define a "Hessian" matrix H that appears in the the QPs, but in order to obtain convergence results, upper and lower bounds on the eigenvalues of H must be enforced. On the other hand, Lewis and Overton have argued that in the unconstrained case, a simple BFGS method is much more efficient in practice than gradient sampling, although the Hessian approximation H typically becomes very ill conditioned and no general convergence results are known. We consider an SQP method for the constrained problem based on BFGS approximation without gradient sampling, and ask the question: does allowing ill-conditioning in H lead to the same desirable convergence behavior in practice as in the unconstrained case, or does the disadvantage of solving ill-conditioned QPs overcome any benefit gained by ill-conditioning? We test the algorithm on some simple examples as well as some challenging applied problems from feedback control.
Coauthor(s): **Frank E. Curtis** (`frank.e.curtis@lehigh.edu`), **Michael L. Overton** (`overton@cs.nyu.edu`)

Speaker: **M.Mohsen Moarefdoost** (Lehigh University, `mom211@lehigh.edu`)
Title: **Generation and Storage Dispatch in Electricity Networks with Generator Disruptions**
Abstract: We present methods for optimizing generation and storage decisions in an electricity network with multiple unreliable generators, each co-located with one storage unit, and multiple loads under power flow constraints. This problem cannot be optimized easily using stochastic programming and/or dynamic programming (DP) approaches. Therefore, in this study, we present several heuristic methods to find an approximate optimal solution for this system. Each heuristic involves decomposing the network into several single- generator, single-battery, multi-load systems and solving them optimally using dynamic programming, then obtaining a solution for the original problem by recombining. We discuss computational performance of the proposed heuristics as well as insights gained from the models.
Coauthor(s): **Lawrence V. Snyder**

Speaker: **Murat Mut** (Lehigh University, `mhm309@lehigh.edu`)
Title: **A Tight Iteration-complexity Bound for IPM via Redundant Klee-Minty Cubes**
Abstract: We consider two curvature integrals for the central path of a polyhedron. Redundant Klee-Minty cubes (Nematollahi et al., 2007) have central path whose geometric curvature is exponential in the dimension of the cube. We prove an analogous result for the curvature integral introduced by Sonnevend et al. 1990. Within an algorithmic framework, we rigorously prove that the iteration-complexity upper bound for the Klee-Minty cubes is tight.
Coauthor(s): **Tamás Terlaky** (`terlaky@lehigh.edu`)

Speaker: **Selvaprabu (Selva) Nadarajah** (Tepper School of Business, Carnegie Mellon University, `snadaraj@andrew.cmu.edu`)
Title: **Relaxations of Approximate Linear Programs for the Real Option Management of Commodity Storage**
Abstract: The real option management of commodity conversion assets gives rise to intractable Markov decision processes (MDPs). This intractability is due primarily to the high dimensionality of a commodity forward curve, which is part of the MDP state when using high dimensional models of the evolution of this curve, as commonly done in practice. Focusing on commodity storage, we develop a novel approximate dynamic programming approach to obtain value function approximations from tractable relaxations of approximate linear programs (ALPs). We estimate lower bounds and dual upper bounds on the value of an optimal policy on existing natural gas storage instances using the value function approximation from each of our models. Our ALP relaxations significantly outperform their corresponding ALPs in terms of both the estimated lower and upper bounds. Our approach is also relevant for the approximate solution of MDPs that arise in the real option management of other commodity conversion assets, as well as the valuation and management of real and financial options that depend on forward curve dynamics.
Coauthor(s): **Francois Margot** (`fmargot@andrew.cmu.edu`), **Nicola Secomandi** (`ns7@andrew.cmu.edu`)

Speaker: **Daniel Olivares** (University of Waterloo, `dolivare@uwaterloo.ca`)
Title: **A Centralized Energy Management System for Isolated Microgrids**
Abstract: This work presents the mathematical formulation of the microgrid's energy management problem and its implementation in a centralized Energy Management System (EMS) for isolated microgrids. Using model predictive control, the optimal operation of the microgrid is determined using an extended horizon of evaluation and recourse, which allows proper dispatch of generators and energy storage units. The microgrid is modelled as a three-phase unbalanced system with presence of both dispatchable and non-dispatchable distributed generation. In order to avoid a mixed-integer non-linear formulation, the energy management problem is decomposed into a mixed-integer linear programming problem for Unit Commitment (UC), and a non-linear formulation for a multi-stage Optimal Power Flow (OPF). A novel EMS architecture is proposed, which allows the multi-stage OPF to communicate reactive power problems to be corrected in the UC problem by committing additional capacity.
The proposed EMS is tested in an isolated microgrid model based on a CIGRE medium-voltage benchmark system. Results justify the need for detailed three-phase models of the microgrid in order to properly account for voltage limits and reactive power support.
Coauthor(s): **Claudio Canizares** (`ccanizares@uwaterloo.ca`) , **Mehrdad Kazerani** (`mkazeran@ecemail.uwaterloo.ca`)

Speaker: **Camilo Ortiz** (Georgia Institute of Technology, `camiort@gatech.edu`)
Title: **An inexact block-decomposition CG hybrid method for dense and large-scale conic programming**
Abstract: In this paper we introduce a new inexact two-block-decomposition first-order method for large-scale conic semidefinite programming. With a proper decomposition of the optimality conditions and the use of inexact error criteria in the subproblems, this method permits the use of iterative methods like the conjugate gradient (CG) to approximately project onto the manifold defined by the affine constraints. We prove the rate of convergence of the algorithm, taking into account the error measures of the approximate solutions obtained from the CG method. As a result of allowing inexact projections onto the manifold, this method can solve problems of size and density that no other state-of-art block-decomposition/split-operator method could solve before. In particular, we solve instances with more than five million constraints and more than fifty million non-zero coefficients in the affine constraints.
Coauthor(s): **Renato D. C. Monteiro** (`monteiro@isye.gatech.edu`) , **Benar F. Svaiter** (`benar@impa.br`)

Speaker: **Haotian Pang** (Princeton University, `hpang@princeton.edu`)
Title: **Estimating Sparse Precision Matrix by the Parametric Simplex Method**
Abstract: We use a variant of simplex method called the parametric simplex method to estimate the sparse precision matrix for some given data. The method is based on an important sparse precision matrix estimator called CLIME and a parametric simplex linear programming solver developed by us.
Coauthor(s): **Han Liu** (`hanliu@princeton.edu`) , **Robert Vanderbei** (`rvdb@princeton.edu`)

Speaker: **Dimitrios Papadimitriou** (UGent & Bell Labs, `dimitrios.papadimitriou@ugent.be`)

Title: **Multi-agent information routing under dynamic and uncertain conditions**

Abstract: In today's communication networks, distributed control functions such as routing, are driven by memory consumption, routing path quality properties (such as cost and length), adaptation cost, and convergence time. Direct formulations of the problem of determining an optimal routing obeying the protocol rules are complex to solve, and integer programming approaches can typically resolve only small to medium size routing problems [Bley2010]. Moreover, in large-scale information networks additional constraints appear (such as cache occupancy and content availability) that are difficult to integrate in a mixed-integer programming formulations. Therefore, heuristics are often necessary to find good feasible solutions in a limited computing time. These heuristics also allow taking into account additional robustness requirement like, e.g., demand uncertainty [Altin2013]. To compensate the absence of mathematical models for optimization, most approaches rely on simulation and scenario-based execution. Both exact and simulation-based approaches suffer however from two main drawbacks: 1) they only provide centralized optimization techniques contradicting the intrinsic distributed computation nature of the decision problem and 2) they hardly take into account uncertainties in the demand or the changes that arise in the underlying network such as link/node failures or unavailability of information servers. Note that uncertainty itself becomes a major element to consider for ensuring robustness when designing large-scale information networks.

Distributed Constraint Optimization Problem (DCOP) is a well-known attempt to perform distributed optimization in a multi-agent framework, in which a group of agents must, in a distributed way, choose values for a set of variables such that the cost is either minimized or maximized and a set of constraints over the variables is satisfied (ADOPT [Pragnesh2005] and its improved version BnB-ADOPT [Yeoh2010]). More recently, attempts have been made to integrate Lagrangean relaxation techniques [Gordon2012] and stochastic models [Nisan2012] in this framework. On the other hand, demand uncertainties can be modeled with the help of probabilistic distributions, although solving the resulting problem is difficult. Another more conservative approach consists in ensuring the good behavior in the worst-case scenario. In both approaches, the resulting optimization model is often too large to be addressed by off-the-shelve solvers.

Consequently, the procedures and their associated parameters that drive the behavior of the distributed routing function are designed in such a way that they arise naturally for the optimization models, allowing in turn for scalable and distributed procedures that approximate as much as possible the optimal solution of the global model. For this purpose, we integrate decomposition-based methods for large scale optimization problem in the information routing functions. More precisely, we embed decomposition methods such as Benders, Dantzig-Wolfe or Lagrangean decomposition in DCOP (DCOP) in order for the distributed routing algorithm to perform as an asynchronous multi-agent system while the sub-problems appearing during the decomposition need to be solved very quickly. One of the most important tasks when designing these models is to find a decomposition scheme that allows the sub-problems to be solved efficiently in a distributed way. Moreover, by design, re-optimization in the event of varying network conditions and demands performs naturally in a smooth and distributed way.

References:

[Altin2013] A.Altin, B.Fortz, M. Thorup, and H.Umit, Intra-domain traffic engineering with shortest path routing protocols, Annals of Operations Research, vol.204, pp.65Ð95, 2013.

[Bley2010] A.Bley, B.Fortz, E.Gourdin, K.Holmberg, O.Klopfenstein, M.PiŮro, A. Tomaszewski, and H.Ęmit. Optimization of OSPF Routing in IP Networks, In A. Koster and X. Munoz, editors, Graphs and Algorithms in Communication Networks: Studies in Broadband, Optical, Wireless and Ad Hoc Networks, Ch.8, pp.199-240, Springer, 2010.

[Gordon2012] G.J. Gordon, P.Varakantham, W.Yeoh, H.C.Lau, A.S.Aravamudhan, and S.-F.Cheng, Lagrangian relaxation for large-scale multi-agent planning, Proc. of AAMAS 2012, pp.1227-1228, Valencia, Spain, June 2012.

[Pragnesh2005] J.M.Pragnesh, W.-M.Shen, M.Tambe, and M.Yokoo, Adopt: asynchronous distributed constraint optimization with quality guarantees. Artificial Intelligence, vol.161(1-2), pp.149-180, 2005.

[Yeoh2010] W.Yeoh, A.Felner, and S.Koenig, BnB-ADOPT: An Asynchronous Branch-and-Bound DCOP Algorithm. Journal of Artificial Intelligence Reseasrch (JAIR), vol.38, pp.85-133, 2010.

Coauthor(s): **Bernard Fortz** (`bernard.fortz@ulb.ac.be`)

Speaker: **Eugene Perevalov** (Lehigh University, `eup2@lehigh.edu`)
Title: **On optimal information extraction from large-scale datasets**
Abstract: The main promise of Big Data lies in the potential availability of information relevant for many practically important problems. The main challenge is in the extraction of this information from the overwhelming volume of irrelevant data. We consider a general information-theoretic framework for description of information accuracy and relevance attributes (as opposed to just quantity) and its application to the Big Data challenge.
Coauthor(s): **David Grace** (`dpg3@lehigh.edu`)

Speaker: **Rommel G. Regis** (Saint Joseph's University, `rregis@sju.edu`)
Title: **Handling Equality Constraints in Expensive Black-Box Optimization Using Radial Basis Function Surrogates**
Abstract: Surrogate models or metamodels have been used to approximate inequality constraints in expensive black-box optimization. In particular, algorithms that utilize radial basis function (RBF) surrogates have been successfully applied to a problem with over a hundred decision variables and with many black-box inequality constraints even when no feasible starting points are given. However, not much work has been done on using surrogate models for optimization problems with expensive black-box equality constraints. This talk will present an RBF algorithm that can handle expensive black-box equality constraints and provide numerical results on test problems.

Speaker: **Ekkehard W. Sachs** (University of Trier, `sachs@uni-trier.de`)
Title: **Preconditioners for PDE Constrained Optimization**
Abstract: In this talk we consider preconditioning quadratic optimization problems which stem from optimization with partial differential equations. We review some of the recent literature in this field. We propose an approach where a reduced order model is used to design a preconditioner. This falls into the class of deflated Krylov space method. We present numerical results which show the efficiency of the approach.
Coauthor(s): **X. Ye** (`ye@uni-trier.de`)

Speaker: **Umit Saglam** (Drexel University, `us26@drexel.edu`)
Title: **Multiperiod Portfolio Optimization with Cone Constraints and Discrete Decisions**
Abstract: We consider a portfolio optimization problem where the investor's objective is to choose a trading strategy that maximizes expected return penalized by transaction costs. We include portfolio diversification constraints in our single and multiperiod models. The overall problem is a mixed-integer second-order cone programming problem, which we solve with the Matlab-based solver MILANO. This talk will focus on the solution and warm-start of the second-order cone programming subproblems.
Coauthor(s): **Hande Benson** (`hvb22@drexel.edu`)

Speaker: **Ali Kemal Sinop** (IAS, `asinop@cs.cmu.edu`)
Title: **Approximation Algorithms for Graph Partitioning Problems using SDP Hierarchies**
Abstract: Graph partitioning is a fundamental optimization problem that has been intensively studied. Many graph partitioning formulations are important as building blocks for divide-and-conquer algorithms on graphs as well as to many applications such as VLSI layout, packet routing in distributed networks, clustering and image segmentation. Unfortunately such problems are notorious for the huge gap between best known approximation algorithms and hardness of approximation results. In this talk, I will present an intuitive rounding algorithm for such problems using Lasserre/Parillo SDPs and relate the quality of its output to the spectral and isoperimetric profiles of the underlying graph.

Speaker: **Lawrence V. Snyder** (Lehigh University, `lvs2@lehigh.edu`)
Title: **Optimizing Locations for Wave Energy Farms under Uncertainty**
Abstract: We present models and algorithms for choosing optimal locations of ocean wave-energy conversion (WEC) devices within a wave farm. The location problem can have a significant impact on the total power output of the farm due to the hydrodynamic interactions between ocean waves and the waves created by the WECs themselves. The problem is highly nonconvex and few rigorous optimization approaches have been proposed to solve it. Moreover, many authors have lamented the fact that a wave farm optimized for a particular wave environment tends to perform quite poorly when the environment (e.g., wave angle or frequency) changes even slightly.
In this talk, we introduce heuristics for solving both deterministic and stochastic or robust WEC location problems. We show that significantly more robust solutions than those in the literature can be obtained through stochastic or robust optimization approaches, the first such demonstration of this fact. We also describe qualitative analysis such as how the WEC locations change as the characteristics of the uncertain parameters, or the approach to uncertainty, changes.
Coauthor(s): **Lizhou Mao** (`lim311@lehigh.edu`)

Speaker: **Yunfei Song** (Lehigh University, `yus210@lehigh.edu`)
Title: **Convex Sets as Invariant Sets for Linear Systems**
Abstract: We propose a novel, unified, general approach to analyze sufficient and necessary conditions under which polyhedra, polyhedral cones, ellipsoids, or Lorenz cones are invariant sets for a linear continuous or discrete system. We show that the forward Euler method preserves positive invariance for polyhedra or polyhedral cones, while the backward Euler method preserves positive invariance for all the four sets.
Coauthor(s): **Tamás Terlaky** (`terlaky@lehigh.edu`)

Speaker: **Arun Sridharan** (Indian Institute of Technology Madras, Chennai, India, `arunsriker@gmail.com`)
Title: **Scheduling of multiproduct pipelines for transporting liquid fuels**
Abstract: Petroleum products from refineries are transported to various distribution depots through multi-product pipelines, road tankers, rail tankers and water carriers. Among them multi-product pipelines are gaining a lot of importance and have several advantages over others. They carry various liquid fuels like gasoline, kerosene, diesel etc. that are pumped back-to-back as batches through the same pipeline from the refinery to various distribution depots and then to the marketing terminals to meet the overall customer demand. Between the product batches in the pipeline an interface material called transmix is formed by mixing of products. These materials are either removed at the end of the pipeline or mixed with a lower grade of the same product. Drag reducing agents (DRA) is injected in the pipeline which reduces the frictional pressure drop thereby increasing the throughput and/or reducing the pumping cost.
The challenge in multi-product pipeline operation is to select an optimum product sequence (volume and flow rate of product to be shipped) so as to minimize overall operating costs subject to constraints. The operating costs include the pumping cost of products from refineries to distribution depots, the inventory cost of products at refinery and distribution depots, cost of DRA, reprocessing cost of interface material and high-energy interval cost which results in a higher pumping cost when pipeline is operated during high-energy interval.
In the literature, there are various approaches for solving scheduling problems. But the use of DRA in solving the problem is not addressed in the literature. The proposed approach is based on improving the continuous-time Mixed-integer linear programming (MILP) formulation developed by Cafaro and CerdĞ (2004) by incorporating DRA component in the model that minimizes the overall operating costs subjected to various constraints. Constraints include product-sequencing constraints, product-tracking constraints, product-inventory constraints etc. The model is capable of assigning discrete levels of DRA concentration to various batches and thus achieving a reduction in pumping cost. The resulting optimization problem is a MILP which is modelled in the ILOG/OPL framework and solved using CPLEX.
Cafaro, D. C., & Cerdá, J. (2004). Optimal scheduling of multiproduct pipeline systems using a non-discrete MILP formulation. Computers and Chemical Engineering, 28, 2053.
Coauthor(s): **Sridharakumar Narasimhan** (`sridharkrn@iitm.ac.in`), **Shankar Narasimhan** (`naras@iitm.ac.in`)

Speaker: **Andy Sun** (Georgia Institute of Technology, `andy.sun@isye.gatech.edu`)
Title: **Security-Constrained Optimal Power Flow with Sparsity Control and Efficient Parallel Algorithms**
Abstract: In this paper, we propose a new model for security-constrained DC optimal power flow problem, which can find a post-contingency corrective action with a minimum number of adjustments. Our proposed formulation produces a generation schedule, which has essentially the same low generation cost as the conventional corrective model, but requires much fewer number of corrective actions. We also propose two decomposition algorithms to solve the problem, which can be parallelized. Extensive computational results are presented for several standard IEEE test systems and large-scale real-world power networks.
Coauthor(s): **Dzung T. Phan** (`phandu@us.ibm.com`)

Speaker: **Daniel B. Szyld** (Temple University, `szyld@temple.edu`)
Title: **Inexact and truncated Parareal-in-time Krylov subspace methods for parabolic optimal control problems**
Abstract: We study the use of inexact and truncated Krylov subspace methods for the solution of the linear systems arising in the discretized solution of the optimal control of a parabolic partial differential equation. An all-at-once temporal discretization and a reduction approach are used to obtain a symmetric positive definite system for the control variables only, where a Conjugate Gradient (CG) method can be used at the cost of the solution of two very large linear systems in each iteration. We propose to use inexact Krylov subspace methods, in which the solution of the two large linear systems are not solved exactly, and their approximate solutions can be progressively less exact. The option we propose is the use of the parareal-in-time algorithm for approximating the solution of these two linear systems. The use of less parareal iterations makes it possible to reduce the time integration costs and to improve the time parallel scalability, and therefore, making it possible to really consider optimization in real time. We also show that truncated methods could be used without much delay in convergence, but with important savings in storage. Spectral bounds are provided and numerical experiments with the full orthogonalization method (FOM), and with inexact and truncated version of FOM are presented, illustrating the potential of the proposed methods.
Coauthor(s): **Xiuhong Du** (`du@alfred.edu`), **Marcus Sarkis** (`msarkis@wpi.edu`), **Christian E. Schaerer** (`cschaer@pol.una.py`)

Speaker: **Xiaocheng Tang** (Lehigh University, `xiaocheng.t@gmail.com`)
Title: **Complexity of Inexact Proximal Newton method**
Abstract: Recently several methods were proposed for sparse optimization which make careful use of second- order information to improve local convergence rates. These methods construct a composite quadratic approximation using Hessian information, optimize this approximation using a first-order method, such as coordinate descent and employ a line search to ensure sufficient descent. Here we propose a general method, which improves upon these ideas to improve the practical performance and prove a global convergence analysis in the spirit of proximal gradient methods.
Coauthor(s): **Katya Scheinberg** (`katyascheinberg@gmail.com`)

Speaker: **Aurelie Thiele** (Lehigh University, `aurelie.thiele@lehigh.edu`)
Title: **Robust Partial Capitation**
Abstract: We investigate the optimal trade-off between fee-for-service and flat-fee payment (capitation) systems, the combination of which is recognized by health policy experts as having strong potential to slow rising healthcare costs. We incorporate high cost uncertainty through a robust optimization approach and analyze several capitation models in theory and practice.

Speaker: **Nghia Tran** (Wayne State University, `nghia@math.wayne.edu`)
Title: **Full stability in nonlinear optimization with applications to semidefinite programming**
Abstract: The paper concerns a systematic study of full stability in general optimization models including its conventional Lipschitzian version as well as the new Hölderian one. We derive various characterizations of both Lipschitzian and Hölderian full stability in nonsmooth optimization. The characterizations obtained are given in terms of second-order growth conditions and also via second-order generalized differential constructions of variational analysis. We develop effective applications of our general characterizations of full stability to conventional models of nonlinear programming and semidefinite programming.
Coauthor(s): **Boris S. Mordukhovich** (`boris@math.wayne.edu`)

Speaker: **Robert Vanderbei** (Princeton University, `rvdb@princeton.edu`)
Title: **Fast-Fourier Optimization**
Abstract: Many interesting and fundamentally practical optimization problems involve constraints on the Fourier transform of a function. It is well-known that the fast Fourier transform (fft) is a recursive algorithm that can dramatically improve the efficiency for computing the discrete Fourier transform. In this paper, we explain the main idea behind the fast Fourier transform and show how to adapt it in such a manner as to make it encodable as constraints in an optimization problem. We will show that the "fast Fourier" version of the optimization constraints produces a larger but sparser constraint matrix and therefore one can think of the fast Fourier transform as a method of sparsifying the constraints in an optimization problem. We demonstrate a real-world problem from the field of high-contrast imaging.

Speaker: **Shuyi Wang** (Lehigh University, `shw210@lehigh.edu`)
Title: **Robust Value-Based Insurance Design**
Abstract: Value-based insurance design (VBID) encourages positive behavior from the insured by, for instance, providing preventive care for free or with lower coinsurance. We describe quantitative models to set cost-sharing levels for an Essential Benefit Package's tiered benefits. We tie the probability of a patient undergoing a procedure to the financial burden the coinsurance would represent, given income. We use robust optimization to capture uncertainty on customer behavior and procedure benefit.
Coauthor(s): **Aurélie Thiele** (`aut204@lehigh.edu`)

Speaker: **Jingjie Xiao** (Purdue University, School of Industrial Engineering, `jingjie.xiao@gmail.com`)
Title: **Implementing Real-Time Pricing in Wholesale Electricity Markets**
Abstract: A key hurdle for implementing real-time pricing of electricity is the lack of consumers' responses. Solutions to overcome the hurdle include energy management systems that can automatically optimize household appliance usage such as EV/PEV charge (and discharge with V2G) via two-way communication with the grid. One of the main goals of this talk is to present how real-time retail pricing, aided by control automation devices, can be integrated into wholesale electricity markets under various uncertainties through approximate dynamic programming (ADP). What distinguishes this paper from existing work in the literature is that wholesale electricity prices are endogenously determined as we have an explicit economic dispatch model embedded in the dynamic programming problem. This ADP-based modeling framework will allow the feedback loop between electricity prices and electricity consumption to be fully captured. We use deterministic linear programming benchmarks to demonstrate the quality of our ADP solutions. The other goal of the talk is to use the modeling framework to provide numerical evidence to the debate that if the dynamic rate structure is superior than the current flat rate structure in terms of both economic and environmental impacts.
Coauthor(s): **Andrew L. Liu** (`liu334@purdue.edu`)

Speaker: **Tengjiao Xiao** (Lehigh University, `tex209@lehigh.edu`)
Title: **Robust Risk Adjustment in Health Insurance**
Abstract: This paper introduces robust optimization models to address ambiguity and uncertainty in risk adjustment which is used to quantify payment transfers across health plans. In particular, this paper develops robust scoring mechanisms, investigates the usefulness of having multiple risk scores instead of a single number, and tests the impact of the time horizons involved. Learning is also incorporated in the risk adjustment models, since more information will become available over time for the newly insured when they submit claims.
Coauthor(s): **Aurelie Thiele** (`aut204@lehigh.edu`)

Speaker: **Sanjay Yadav** (GL Noble Denton, `sanjay.yadav@gl-group.com`)
Title: **Piecewise-constant regression with implicit filtering**
Abstract: We will examine a piecewise-constant regression problem in the context of optimization of gas pipeline operations. The decision variables in these optimization problems are pipeline operational parameters. When solving such problems, it is often convenient to allow the decision variables to vary with arbitrary frequency. However, in practice, there are constraints on how frequently operational changes can be made in a pipeline. Once we have an optimal pipeline operational strategy, a more practical operational strategy can be constructed by fitting a piecewise-constant function to the original optimal strategy. In this piecewise-constant regression problem, the location and number of breakpoints are not known a priori. We will examine the use of implicit filtering optimization to solve this piecewise-constant regression problem.
Coauthor(s): **Richard Carter** (`richard.carter@gl-group.com`), **Omar Hyjek** (`omar.hyjek@gl-group.com`)

Speaker: **Boshi Yang** (The University of Iowa, `boshi-yang@uiowa.edu`)
Title: **The Trust Region Subproblem with Non-Intersecting Linear Constraints**
Abstract: This paper studies an extended trust region subproblem (eTRS) in which the trust region intersects the unit ball with m linear inequality constraints. When $m = 0$, $m = 1$, or $m = 2$ and the linear constraints are parallel, it is known that the eTRS optimal value equals the optimal value of a particular convex relaxation, which is solvable in polynomial time. However, it is also known that, when $m \geq 2$ and at least two of the linear constraints intersect within the ball, i.e., some feasible point of the eTRS satisfies both linear constraints at equality, then the same convex relaxation may admit a gap with eTRS. This paper shows that the convex relaxation has no gap for arbitrary m as long as the linear constraints are non-intersecting.
Coauthor(s): **Samuel Burer** (`samuel-burer@uiowa.edu`)

Speaker: **Yanhong Yang** (Lehigh University, `yay212@lehigh.edu`)
Title: **Dynamic-programming-based Link Assignment for Data Collection in Wireless Sensor Networks**
Abstract: As one of the basic applications of wireless sensor network (WSN), data collection has been discussed in the context of miscellaneous application scenarios and topology configurations. When sensors are organized into a tree-based network for data collection, the multi-channel characteristic of the transceivers can be utilized to reduce the probability of collisions and improve system throughput. Joint Frequency Time Slot Scheduling (JFTSS) is considered the state-of-the-art that approaches the optimal solution, but its number of slots grows rapidly when the link quality is unstable. In order to improve the link assignment schemes toward the optimal solution, we propose an algorithm that further exploits the network topology and maximizes concurrent communication within each time slot through dynamic programming (DP). Simulation results have shown that the number of required time slots increases slower using our algorithm when a more realistic model of link reliability is considered. In addition, the impacts of the location of the sink node and the communication range of the sensors are also analyzed.
Coauthor(s): **Liang Cheng** (`lica@lehigh.edu`), **Huan Yang** (`huy213@lehigh.edu`)

Speaker: **Luis F. Zuluaga** (Lehigh University, `luis.zuluaga@lehigh.edu`)
Title: **Extensions of Scarf's max-min order formula**
Abstract: Scarf's max-min order formula is a classical result in the field of inventory management. It finds the order quantity that minimizes the worst-case expected payoff of a single product inventory problem when only the mean and the variance of the product's demand distribution is assumed to be known. Specifically, we consider the case in which the decision maker placing the order is, besides ambiguity-averse (i.e., assumes no complete knowledge of the product's demand distribution), also risk-averse; that is, besides the expected profit, he considers the risk associated with it in terms of the profit's standard deviation.
Coauthor(s): **Donglei Du** (`ddu@unb.ca`), **Qiaoming Han** (`qmhan@nju.edu.cn`)

ISE Centers

Enterprise Systems Center

http://www.lehigh.edu/~inesc/

The Enterprise Systems Center is committed to helping students learn while simultaneously providing value for our clients. We believe that our research should be driven by industry needs and enabled by close partnerships and collaboration.

Center for Value Chain Research

http://www.lehigh.edu/~inchain/

The Center for Value Chain Research (CVCR) is committed to promoting and conducting research and information exchange through the integration of emerging theory and best practices. The Center's research focuses primarily on value chain planning and development activities, which connect corporate strategy with value chain execution systems.

Computational Optimization Research at Lehigh

http://coral.ie.lehigh.edu/

COR@L aims at promoting and conducting graduate-level research, primarily in the areas that lie at the interface of optimization and high-performance computing. Research conducted at the COR@L lab in recent years has focused on cutting edge optimization theory and development of several open source optimization software. The lab brings together faculty and graduate students aimed at establishing a multi-disciplinary research agenda. Research findings are disseminated through refereed publications, national and international conferences, and scholarly presentations.

Notes

Notes

LEHIGH UNIVERSITY

ISE Industrial and Systems Engineering

Harold S. Mohler Laboratory

200 W. Packer Ave.

Bethlehem, PA 18015

610-758-4050

Follow us!

facebook.com/LehighISE

twitter.com/lehigh_ise

www.lehigh.edu/ise