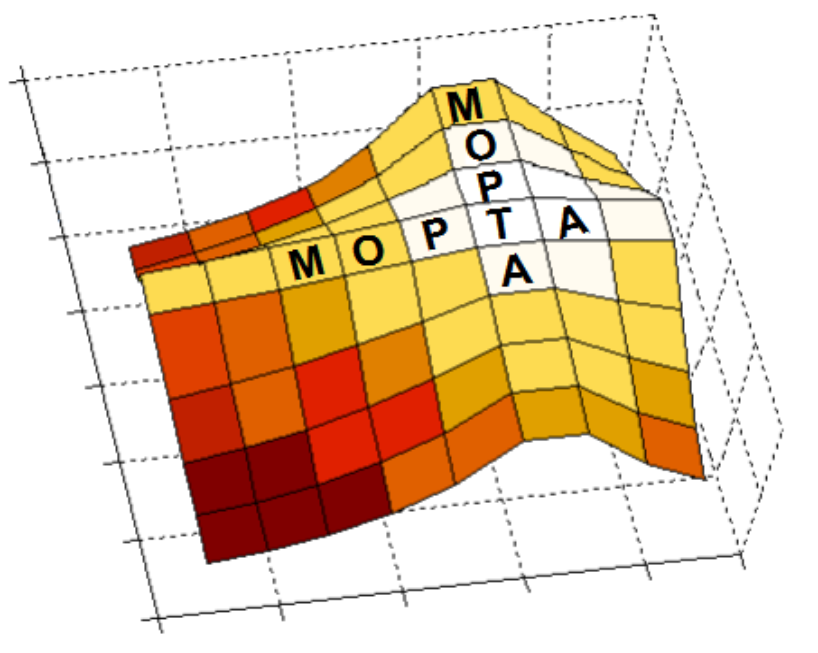
# MOPTA 2011

## *Modeling and Optimization: Theory and Applications*




**August 17-19, 2011**

**Lehigh University**

**Bethlehem, PA, USA**

# Welcome to the 2011 MOPTA Conference!

## Mission Statement

The Modeling and Optimization: Theory and Application (MOPTA) conference is planned as 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 will consist of a number 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 which 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 2011 is hosted by the Department of Industrial and Systems Engineering at Lehigh University.

## Organization Committee


Katya Scheinberg – Chair
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## We thank to our Sponsors!

# Program

## Wednesday, August 17 – Iacocca Hall

7:30-8:45 - Registration and continental breakfast – Wood Dining Room Lobby (WDR)
8:45-9:00 – Welcome and Opening Remarks: Dr. Tamás Terlaky – WDR
9:00-10:00 – **Clifford Stein, "Optimization problems in internet advertising"** – Chair: Ted Ralphs - WDR
10:00-10:30 - Coffee break - WDR
10:30-12:30 - Parallel technical sessions

| **SDP Relaxations**<br>**WDR**<br>**Chair: Farid Alizadeh** | **Linear and Integer Programming**<br>**Gov. Suite**<br>**Chair: Sanjeeb Dash** | **Applications in Econometrics**<br>**B013**<br>**Chair: Vyacheslav V. Kalashnikov** |
|---|---|---|
| "Characterization of Sum-of-Squares Cones in Algebra"<br>Farid Alizadeh | "Generating the convex hull of a disjunction for Mixed Integer Second Order Cone Optimization (MIS-OCO)"<br>Julio C. Goez | "Characterization of feedback Nash equilibria for a multi-channel system via a set of all non-fragile stabilizing state-feedback solutions and dissipativity inequalities"<br>Getachew K. Befekadu |
| "Semi-definite Relaxation of Quadratic Assignment Problems based on NonredundantMatrix Splitting"<br>Tao Zhu | "On the minimization of a class of generalized linear functions on a flow polytope"<br>Claudio Sodini | "Network Congestion Control with Markovian Multipath Routing"<br>Cristobal Guzman |
| "Globally Solving Nonconvex QP via Completely Positive Programming"<br>Jieqiu Chen | "Concise Level-2 RLT Based Formulations of 0-1 Quadratic and Cubic Programs"<br>Richard Forrester | "A Penalty Function Method To Solve Natural The Gas Bilevel Cash-Out Problem"<br>Nataliya I. Kalashnykova |
| "Solving location problems via moments, sums of squares and semidefinite programming"<br>Victor Blanco | "On the Relationship between Lattice Free Cuts and *T*-branch Split Cuts"<br>Sanjeeb Dash | "Consistent conjectural variations equilibrium in a mixed oligopoly"<br>Vyacheslav V. Kalashnikov |

12:30-1:30 - Lunch – WDR
1:30-3:30 - Parallel technical sessions

| **NonLinear Programming**<br>**WDR**<br>**Chair: David Shanno** | **Optimization Methods in Statistics**<br>**Gov. Suite**<br>**Chair: Jim Burke** | **Scheduling**<br>**B013**<br>**Chair: Andrew Conn** |
|---|---|---|
| "Localized Augmented Lagrangian Methods for Minimizing the Kohn-Sham Energy"<br>Marc Millstone | "Convex Optimization on Probability Measures"<br>Christopher Jordan-Squire | "Air traffic resolution: a comparison between stochastic and deterministic optimization methods"<br>Andrew R. Conn |
| "Mathematical Programming Approaches for Multivehicle Path Coordination Under Communication Constraints"<br>Hande Y. Benson | "Bayesian models for robust and sparse estimation using log piecewise linear quadratic densities"<br>James V. Burke | "A Network Model for Weekly Aircraft Maintenance Routing Problem and the Integration with the Fleet Assignment Problem"<br>Zhe Liang |
| "Interior-Point Methods for Nonconvex Nonlinear Programming: Convergence Analysis and Computational Performance"<br>David F. Shanno | "Polynomial programming models in optimal experimental design"<br>David Papp | "Scheduling cash replenishment for ATMs with SAS - a case study"<br>Imre Pólik |
| "Binary Matrix Factorization via Clustering"<br>Peng Jiang | "Balanced Assignment of Experimental Units in the Analysis of Covariance through Optimization"<br>Robert O. Howley | "Scheduling the reconstruction of massively-damaged networks"<br>Alexander "Sasha" Gutfraind |

3:30-4:00 - Coffee break – WDR
4:00-5:00 – **Adrian Lewis, "Nonsmooth optimization and semi-algebraic sets"** – Chair: Katya Scheinberg - WDR
5:00-5:15 – Coffee Break - WDR
5:15-6:15 - **Jorge Moré, "How noisy are your functions? Computational noise and uncertainty in complex simulations"** – Chair: Frank E. Curtis – WDR

6:30-9:30 Student Social – Graduate Student Center

# Program

## Thursday, August 18 – Iacocca Hall

7:30-8:00 - Continental Breakfast – Wood Dining Room Lobby
8:00-9:00 – **Mark Daskin, "Genetic algorithms and multiobjective optimization"** – Chair: Lawrence V. Snyder - WDR
9:00-9:30 - Coffee break - WDR
9:30-11:00 - Parallel technical sessions

| **Networking Configuration Problems**<br>**WDR**<br>**Chair: David Phillips** | **Optimization, Information and Complexity**<br>**Gov. Suite**<br>**Chair: Eugene Perevalov** | **Logistics Applications**<br>**B013**<br>**Chair: Francis J. Vasko** |
|---|---|---|
| "First-order methods for maximizing algebraic connectivity of weighted graphs"<br>Rui Zhang | "Additional information acquisition in stochastic optimization"<br>David Grace | "Lagrangian heuristics for a class of large scale acquisition problems with supplier discounts"<br>Guoqing Zhang |
| "Split digraphs"<br>Michael Drew LaMar | "A game theoretic approach to graph clustering"<br>Supreet Mandala | "Solving a facility location and design problem with variable demand on the plane"<br>Jose Fernandez |
| "Optimization Models for Runway Configuration Management"<br>Rex K. Kincaid | "Complexity via optimization"<br>Eugene Perevalov | "Some comments on the Classic Transportation Problem"<br>Francis J. Vasko |

11:00-11:30 - Coffee break - WDR
11:30-12:30 – **Sebastián Ceria, "Equity risk management and optimization – A challenging relationship"** – Chair: Aurélie Thiele - WDR
12:30-1:30 – Lunch - WDR
1:30-3:00 - AIMMS /MOPTA Optimization Modeling Competition Final (Winner will be announced at banquet)

| **AIMMS/MOPTA Optimization Modeling Competition Final - WDR – Chair: Peter Nieuwesteeg** |
|---|
| **ISE-NUS, National University of Singapore, Singapore**<br>Nguyen Viet Anh and Tran Trung Hieu. Advised by Teo Kwong Meng |
| **Team ORTEC, Gouda, The Netherlands**<br>Harwin de Vries, Rianne Langenberg and Arno Witte. Advised by Cindy de Groot |
| **Team RANDOM, University of Twente, The Netherlands**<br>Arturo E. Perez Rivera and Rick van Urk. Advised by Bodo Manthey |

3:00-3:15 – Coffee Break - WDR
3:15-4:45 - Parallel Session

| **Nonlinear Programming**<br>**WDR**<br>**Chair: Frank E. Curtis** | **First Order Methods**<br>**Gov. Suite**<br>**Chair: Javier Peña** | **Stochastic and Robust Optimization**<br>**B013**<br>**Chair: Aurélie Thiele** |
|---|---|---|
| "Finding saddle points of mountain pass type with quadratic models on affine spaces"<br>C.H. Jeffrey Pang | "A Sparsity Preserving Stochastic Gradient Method for Composite Optimization"<br>Qihang Lin | "Valuation of Mortgages with Prepayments and Defaults in Continuous Time"<br>Stephen M. Mansour |
| "An Adaptive Gradient Sampling Algorithm for Unconstrained Optimization"<br>Xiaocun Que | "A First Order Method for Finding Minimal Norm-Like Solutions of Convex Optimization Problems."<br>Shoham Sabach | "Robust Project Selection with Percentile Optimization"<br>Aurélie Thiele |
| "A Penalty-SQP Method with Rapid Infeasibility Detection"<br>Hao Wang | "Regularization of the Alternating Least-Squares Method for Tensor Decomposition"<br>Carmeliza Navasca | "A Binomial Tree Representation of General Gaussian Markov Processes"<br>Daniel Scansaroli |

4:45-5:00 – Coffee Break - WDR
5:00-6:00 – **Michael Ferris, "Multiple optimization problems with equilibrium constraints"** – Chair: Bob Storer - WDR
6:00-6:30 – Transportation to Conference Banquet

6:30-9:30 - Conference Banquet and Competition Results – Asa Packer Dining Room – Lehigh University Center
Dinner Remarks: Dr. S. David Wu, Dean of the P.C. Rossin College of Engineering and Applied Science at Lehigh University

# Program

## Friday, August 19 – Iacocca Hall

7:30-8:00 - Continental Breakfast – Wood Dining Room Lobby
8:00-9:00 – **Javier Peña, "Condition numbers for optimization problems"** – Chair: Katya Scheinberg - WDR
9:00-9:30 - Coffee break - WDR
9:30-10:30 – **Philippe Toint, "The cubic regularization algorithm and complexity issues for nonconvex optimization"** – Chair: Tamás Terlaky – WDR
10:30-11:00- Coffee Break - WDR
11:00-12:30 - Parallel technical sessions

| **Derivative-Free and Simulation-Based Optimization**<br>**B023**<br>**Chair: Katya Scheinberg** | **AIMMS Session**<br>**Gov. Suite**<br>**Chair: Peter Nieuwesteeg** | **Optimal Design**<br>**B013**<br>**Chair: Guanghui Lan** |
|---|---|---|
| "Quasi-Newton Methods for Stochastic Optimization With Application to Simulation-Based Parameter Estimation"<br>Brent Castle | "Using Commercial Software in Teaching OR: Free AIMMS Academic License"<br>Peter Nieuwesteeg<br>**(1 hour session)** | "Optimal Design of Combined EWMA Control Charts"<br>Chang-Ho Chin |
| "A Surrogate Model Algorithm for Solving Expensive Black-Box Nonlinear Integer Programming Problems"<br>Juliane Mueller | "Using Commercial Software in Teaching OR: Free AIMMS Academic License"<br>Peter Nieuwesteeg | "Optimal Design of Cuscore charts"<br>Aida Mercado |
| "Filter Implicit Filtering (FIF) for Constrained Derivative-free Optimization"<br>Ahmad Almomani | | |

# Program Highlights

## Wednesday, August 17

9:00a.m.-10:00a.m. – **Clifford Stein**, Columbia University (see page 13)

4:00p.m.-5:00p.m. – **Adrian Lewis**, Cornell University (see page 10)

5:15p.m.-6:15p.m. – **Jorge Moré**, Argonne National Laboratory (see page 11)

## Thursday, August 18

8:00a.m.-9:00a.m. – **Mark Daskin**, University of Michigan (see page 8)

11:30a.m.-12:30p.m. – **Sebastián Ceria**, Axioma (see page 7)

1:30p.m. – 3:00p.m. - **AIMMS/MOPTA Optimization Modeling Competition Final** (see page 15)

5:00p.m.-6:00p.m. – **Michael Ferris**, The University of Wisconsin - Madison (see page 9)

## Friday, August 19

8:00a.m.-9:00a.m. – **Javier Peña**, Carnegie Mellon University (see page 12)

9:30a.m.-10:30a.m. – **Philippe Toint**, The University of Namur (FUNDP) (see page 14)

# Social Program

## Wednesday, August 17

7:30a.m.-8:45a.m. – **Continental Breakfast (Wood Dining Room Lobby)**

10:00a.m.-10:30a.m. - Coffee break

12:30p.m.-1:30p.m. - **Lunch (WDR)**

3:30p.m.-4:00p.m. - Coffee break

5:00p.m.-5:15p.m. - Break

6:30p.m.-9:30p.m. - **Student Social (Graduate Student Center)**

## Thursday, August 18

7:30a.m.-8:00a.m. - **Continental Breakfast (Wood Dining Room Lobby)**

9:00a.m.-9:30a.m. - Coffee break

11:00a.m.-11:30a.m. - Coffee break

12:30p.m.-1:30p.m. - **Lunch (WDR)**

3:00p.m.-3:15p.m. - Coffee break

4:45p.m.-5:00p.m. – Coffee break

6:30p.m.-9:30p.m. - **Conference Banquet and Competition Results (Asa Packer Dining Room – University Center)**

## Friday, August 19

7:30a.m.-8:00a.m. - **Continental Breakfast (Wood Dining Room Lobby)**

9:00a.m.-9:30a.m. - Coffee break

10:30a.m.-11:00 a.m. – Coffee break

# Speaker Biographies

## Sebastián Cera

Chief Executive Officer
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Dr. Sebastián Ceria is the Chief Executive Officer of Axioma. Before founding Axioma, Ceria was an Associate Professor of Decision, Risk and Operations at Columbia Business School from 1993 to 1998.

Ceria has worked extensively in the area of optimization and its application to portfolio management. He is the author of many articles in publications including Management Science, Mathematical Programming, Optima and Operations Research. Most recently, Ceria's work has focused on the area of robust optimization in portfolio management. He has co-authored numerous papers on the topic, including, "Incorporating Estimation Errors into Portfolio Selection: Robust Portfolio Construction," which was published in The Journal of Asset Management. He is a recipient of the Career Award for Operations Research from the National Science Foundation. Ceria completed his PhD in Operations Research at Carnegie Mellon University's Graduate School of Industrial Administration.

**Talk Title: Equity risk management and optimization – A challenging relationship**
**Date: Thursday, August 18 – 11:30 a.m. – WDR**

**Abstract:** The construction of optimized portfolios in asset management entails the complex interaction between three key entities: the risk factors, the alpha factors and the constraints. The problems that arise due to mutual misalignment between these three entities are collectively referred to as Factor Alignment Problems (FAP). Examples of FAP include risk-underestimation of optimized portfolios, undesirable exposures to factors with hidden and unaccounted systematic risk, consistent failure in achieving ex-ante performance targets, and inability to harvest high quality alphas into above-average IR. In this talk we discuss FAP and propose a solution approach which is based on augmenting the user risk model with a single additional factor, the Alpha Alignment Factor (AAF). We will show how the Alpha Alignment Factor provides a natural and effective remedy to FAP. The Alpha Alignment Factor not only corrects for the risk underestimation bias of optimal portfolios but also pushes the ex-post efficient frontier upwards thereby empowering portfolio managers to access portfolios that lie above the traditional risk-return efficient frontier.

# Speaker Biographies

## Mark Daskin

Clyde W. Johnson Professor
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Professor Daskin received his BS from MIT, certificate of post-graduate study in engineering from Cambridge University, and his Ph.D. from MIT. His research focuses on the application of operations research techniques to problems in transportation, supply chain management and facility location modeling, and healthcare. He is the author of two books: Network and Discrete Location: Models, Algorithms and Applications (John Wiley, 1995) and Service Science (John Wiley, 2010). He is currently the Clyde W. Johnson professor and chair of the Department of Industrial and Operations Engineering at the University of Michigan.

Professor Daskin has served as the editor-in-chief of both Transportation Science and IIE Transactions, was the president of INFORMS in 2006 and vice-president for publication from 1996-1999. He also served as the chair of the Department of Industrial Engineering and Management Sciences at Northwestern University from 1995-2001. He is a fellow of both INFORMS and the Institute of Industrial Engineers. Daskin has also received the Fred C. Crane Award for Distinguished Service from the Institute of Industrial Engineers as well as the Institute's Technical Innovation Award. In 2009, he received the George E. Kimball Medal for service to the profession from INFORMS.

**Talk Title: Genetic algorithms and multiobjective optimization**
**Date: Thursday, August 18 – 8:00 a.m. - WDR**

**Abstract:** Genetic algorithms are shown to be a natural means of solving multiobjective problems. Issues associated with the use of genetic algorithms for multiobjective optimization are presented as are methods of resolving those issues. Example problems from facility location modeling and supply chain analysis are presented. Finally, other multiobjective problems that are amenable to heuristic solution are discussed.

# Speaker Biographies

## Michael Ferris

Professor of Computer Sciences and Industrial and Systems Engineering
The University of Wisconsin - Madison
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Dr. Ferris' research is concerned with algorithmic and interface development for large scale problems in mathematical programming, including links to the GAMS and AMPL modeling languages, and general purpose software such as PATH, NLPEC and FATCOP. He has worked on several applications of both optimization and complementarity, including cancer treatment planning, transmission line switching, video-on-demand data delivery, economic and traffic equilibria, structural and mechanical engineering.

Ferris is an INFORMS fellow and received the Beale-Orchard-Hays prize from the Mathematical Programming Society and is a past recipient of a NSF Presidential Young Investigator Award, and a Guggenheim Fellowship. He serves as co-editor of Mathematical Programming, and is on the editorial boards of SIAM Journal on Optimization, Transactions of Mathematical Software, and Optimization Methods and Software.

**Talk Title: Multiple optimization problems with equilibrium constraints**
**Date: Thursday, August 18 - 5:00p.m. - WDR**

**Abstract:** We present a mechanism for describing and solving collections of optimization problems that are linked by equilibrium conditions. Included in this class are classical models such as the PIES model and agent based formulations arising from Nash Games. We demonstrate this mechanism in the context of energy planning problems, specifically for capacity expansion, hydro operation, and transmission line switching. We show how to incorporate stochastic information into these systems and give examples of their use and their possible extensions to hierarchical modeling.

# Speaker Biographies

## Adrian S. Lewis

Professor and Director of Operations Research and
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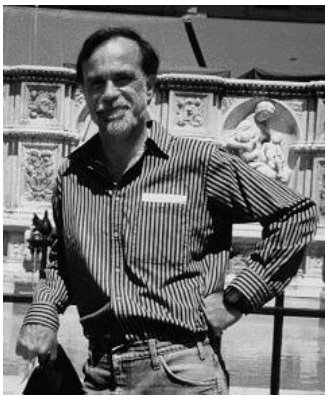
Adrian S. Lewis was born in England in 1962. He is a Professor at Cornell University in the School of Operations Research and Industrial Engineering. Following his B.A., M.A., and Ph.D. degrees from Cambridge, and Research Fellowships at Queens' College, Cambridge and Dalhousie University, Canada, he worked in Canada at the University of Waterloo (1989-2001) and Simon Fraser University (2001-2004). He is an Associate Editor of the SIAM Journal on Optimization, Mathematics of Operations Research, and the SIAM/MPS Book Series on Optimization, and is a Co-Editor for Mathematical Programming. He received the 1995 Aisenstadt Prize, from the Canadian Centre de Recherches Mathematiques, the 2003 Lagrange Prize for Continuous Optimization from SIAM and the Mathematical Programming Society, and an Outstanding Paper Award from SIAM in 2005. He co-authored "Convex Analysis and Nonlinear Optimization" with J.M. Borwein.

Lewis' research concerns variational analysis and nonsmooth optimization, with a particular interest in optimization problems involving eigenvalues.

**Talk Title: Nonsmooth optimization and semi-algebraic sets**
**Date: Wednesday, August 17 - 4:00p.m. - WDR**

**Abstract:** Concrete optimization problems, while often nonsmooth, are not pathologically so. The class of "semi-algebraic" sets and functions - those arising from polynomial inequalities - nicely exemplifies nonsmoothness in practice. Semi-algebraic sets (and their generalizations) are common, easy to recognize, and richly structured, supporting powerful variational properties. In particular I will discuss a generic property of such sets - partial smoothness - and its relationship with a proximal algorithm for nonsmooth composite minimization, a versatile model for practical optimization.

# Speaker Biographies



## Jorge Moré

Mathematics and Computer Science Division
Argonne National Laboratory
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Jorge J. Moré is an Argonne Distinguished Scholar (Emeritus) in the Mathematics and Computer Science Division at Argonne National Laboratory. His current research centers on developing algorithms and software for complex (noisy) simulations. He was a major contributor to the NEOS and TAO projects, and served on a number of boards, including the SIAM Journal on Optimization, Mathematical Programming, SIAM Series on Software, Environments, Tools, and the Wilkinson Prize for Numerical Software. He also served as the Director of Argonne's Laboratory for Advanced Numerical Simulations (LANS).

**Talk Title: How noisy are your functions? Computational noise and uncertainty in complex simulations**
**Date: Wednesday, August 17 - 5:15p.m. - WDR**

**Abstract:** How do we compute the noise level and uncertainty in a deterministic simulation? We address this issue with a series of examples that illustrate several sources of computational noise: large-scale calculations, iterative and adaptive algorithms, and mixed-precision calculations. We present a new algorithm, ECnoise, for quantifying the noise level of a computed function. Our theoretical framework is based on stochastic noise but does not assume a specific distribution for the noise. We show that ECnoise produces reliable results in few function evaluations and offers new insights into building blocks of large scale simulations.

We also discuss two applications of computational noise. We first show that noise level information can be used to obtain near-optimal finite difference estimates of the derivatives of a noisy deterministic function. We also show how computational noise can destroy the accuracy of derived calculations, in particular, the computation of derivatives.

# Speaker Biographies

## Javier Peña

Associate Professor of Operations Research
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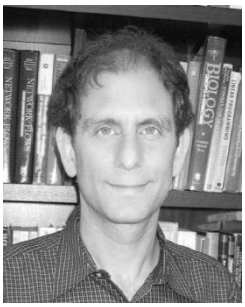
Javier Pena is Professor of Operations Research at the Tepper School of Business, Carnegie Mellon University. Prior to joining Carnegie Mellon, he earned his Ph.D. in Applied Mathematics from Cornell University in 1998, and held a postdoctoral position at the Mathematical Sciences Research Institute in Berkeley, California from 1998--1999. He does research on theory and algorithms for convex optimization, applications of optimization models in finance, and equilibrium computation in game theory.

**Talk Title: Condition numbers for optimization problems**
**Date: Friday, August 19 - 8:00a.m. - WDR**

**Abstract:** Conditioning plays a central role in numerical linear algebra. The condition number of a problem, such as finding a solution to a linear or polynomial system of equations, is a measure of the problem's well posedness. The condition number is closely connected with the performance and stability of algorithms, as well as with other intrinsic properties of the problem.

This talk will provide an overview of several concepts of conditioning for optimization that have proposed over the last two decades. We will discuss how these concepts of conditioning appear naturally in the analysis of the most popular algorithms for convex optimization. We will also discuss other interesting properties of condition numbers including its connection with smooth complexity analysis, metric regularity, and the classical Eckart-Young identity for matrices.

# Speaker Biographies



## Clifford Stein

Professor
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Clifford Stein is Professor and Chair of the Industrial Engineering and Operations Research Department at Columbia University. He also holds an appointment as Professor of Computer Science at Columbia. He received his B.S.E. from Princeton University in 1987 and his Ph.D. degree from MIT in 1992. His research interests include the design and analysis of algorithms, combinatorial optimization, operations research, network algorithms, scheduling, algorithm engineering and internet algorithms. He has published over 60 scientific papers and occupied a variety of editorial positions including the journals ACM Transactions on Algorithms, Mathematical Programming, Journal of Algorithms, SIAM Journal on Discrete Mathematics and Operations Research Letters. He has been the recipient of an NSF Career Award and an Alfred Sloan Research Fellowship. He is also the co-author of the two textbook, Introduction to Algorithms, with T. Cormen, C. Leiserson and R. Rivest and Discrete Math for Computer Science, with Ken Bogart and Scot Drysdale.

**Talk Title: Optimization problems in internet advertising**
**Date: Wednesday, August 17 - 9:00a.m. – WDR**

**Abstract:** The use of the internet has led to the creation of fundamentally new forms of advertising. In turn, this advertising provides the financial support for many on-line companies and technological breakthroughs. The development of online advertising has raised many new questions in economics, mathematics, computer science and engineering, particularly around the design of auctions and markets, and in the design of algorithms to efficiently manage them.

Several problems of deciding which ads should be shown to users can be framed as online stochastic packing integer programs (which are in turn generalization of matching/flow problems). In this talk, we will discuss results on solving these problems from theoretical and practical standpoints.

We first present a near-optimal online algorithm for a general class of packing integer programs which model various online resource allocation problems including online variants of routing, ad allocations, generalized assignment, and combinatorial auctions. As our main theoretical result, we prove that a simple dual training-based algorithm achieves a $(1-o(1))$-approximation guarantee in the random order stochastic model.

We then focus on the online display ad allocation problem and study the efficiency and fairness of various training-based and online allocation algorithms on data sets collected from real-life display ad allocation system. Our experimental evaluation confirms the effectiveness of training-based algorithms on real data sets, and also indicates an intrinsic trade-off between fairness and efficiency. This talk presents joint work with Jon Feldman, Nitish Korula, Vahab Mirrokni and Monika Henzinger.

# Speaker Biographies

## Philippe Toint

Department of Mathematics
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Philippe Louis Marie Jacques Toint is full Professor at the University of Namur (FUNDP), in Belgium. He received his Ph. D. in Mathematics (Cambridge, UK 1978), under the guidance of Prof. M.J.D. Powell, on methods for large-scale nonlinear optimization and on a model for urban traffic forecasting. He is the head of the Numerical Optimization Laboratory, and of the Transportation Research Group (TRG), since 1979. Philippe was head of the University Computing Centre between 1998 and 2002 and head of the Department of Mathematics between 2006 and 2009.

His scientific interests and working areas include: largescale optimization, nonconvex problems, numerical software development, numerical analysis, computer science, operations research, numerical linear algebra, transportation systems, dynamic modeling, behavioral approaches, and travel survey techniques. Philippe served on the editorial boards of the SIAM Journal on Optimization, SIAM Journal on Numerical Analysis, Mathematical Programming, IMA Journal of Numerical Analysis, Operations Research, Optimization Methods and Software, Transportation Science, RTS, Investigacion Operativa. He is member of the scientific committees for CERFACS, BRRC, CERTU, ATEC and is past-editor in chief of the MPS-SIAM series on Optimization. He is also the SIAM Fellow and IFIP TC7 national representative than being member of various scientific committees.

Philippe has authored or co-authored of 5 books, scientific editor of 8 proceedings volumes. He has authored or co-authored of more than 120 publications in refereed international scientific publications and 95 research and expertise reports in the above mentioned fields (see http://perso.fundp.ac.be/˜ phtoint/toint.html for more details).

**Talk Title: The cubic regularization algorithm and complexity issues for nonconvex optimization**
***Philippe Toint (with Coralia Cartis and Nick Gould)***
**Date: Friday, August 19 - 9:30a.m. – WDR**

**Abstract:** The talk will survey recent developments in the analysis of worst-case complexity bounds for algorithms intended for solving nonconvex continuous optimization problems. The convergence to first- and second-order critical points in the unconstrained case will be considered first, and methods such as steepest descent, Newton and several of its variants will be revisited. The talk will also present some new approaches for the constrained case. Some relatively surprising results will be given and the special nature of the cubic regularization method (ARC) will be pointed out.

# AIMMS/MOPTA Optimization Modeling Competition 2011

The third 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 localization in ad hoc sensor networks. Each team had to develop an optimization model to recover the location of sensors distributed over a rough terrain. The goal is to use the sensors to map a physical quantity, such as temperature, over the terrain. The easiest cases are when pair-wise measurements between nearby sensors are all known exactly. However, the teams also needed to account for missing measurements and errors in the data when developing their models.

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 on the project. We are happy that 14 teams from 8 countries registered and downloaded the problem. Ten teams submitted a complete project. The panel of judges (Robert Storer and Frank E. Curtis from Lehigh University and Peter Nieuwesteeg from Paragon Decision Technology) selected the following three teams for the final:

**ISE-NUS, National University of Singapore, Singapore**
Nguyen Viet Anh and Tran Trung Hieu. Advised by Teo Kwong Meng

**Team ORTEC, Gouda, The Netherlands**
Harwin de Vries, Rianne Langenberg and Arno Witte. Advised by Cindy de Groot

**Team RANDOM, University of Twente, The Netherlands**
Arturo E. Perez Rivera and Rick van Urk. Advised by Bodo Manthey

The finalist teams will each give 30 minute presentations (20 minute talks + 10 minutes for questions) on their work on Thursday starting at 1:30pm in the Wood Dining Room. The winning team will be announced at the conference banquet on Thursday evening.

Three other teams have received an honorable mention for their work:

**Konrad's Networkers, Zuse Institute Berlin, Germany**
Stefan Heinz, Gregor Hendel and Kai Hennig. Advised by Christian Raack

**Save Our Ship, University of Wisconsin – Madison**
Aditya Gore, Jesse Holzer and Lisa Tang. Advised by Michael Ferris

**Team IWR, University of Heidelberg, Germany**
Janick Frasch, Dennis Janka and Robert Kircheis. Advised by Dr. Stefan Koerkel

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 Program and Abstracts

Wednesday, August 17

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|---|---|---|
| 7:30am-8:45am | Registration/Breakfast | Wood Dining Room (2nd floor) |
| 8:45am-9:00am | Welcome Remarks, Tamas Terlaky (Lehigh University) | Wood Dining Room (2nd floor) |
| 9:00am-10:00am | Plenary presentation | Wood Dining Room (2nd floor) |
| *Chair*: | Ted Ralphs | |
| *Speaker*: | **Cliff Stein** (Columbia University, cliff@ieor.columbia.edu) | |
| *Title*: | **Optimization Problems in Internet Advertising** | |
| *Abstract*: | The use of the internet has led to the creation of fundamentally new forms of advertising. In turn, this advertising provides the financial support for many on-line companies and technological breakthroughs. The development of online advertising has raised many new questions in economics, mathematics, computer science and engineering, particularly around the design of auctions and markets, and in the design of algorithms to efficiently manage them.<br>Several problems of deciding which ads should be shown to users can be framed as online stochastic packing integer programs (which are in turn generalization of matching/flow problems). In this talk, we will discuss results on solving these problems from theoretical and practical standpoints. We first present a near-optimal online algorithm for a general class of packing integer programs which model various online resource allocation problems including online variants of routing, ad allocations, generalized assignment, and combinatorial auctions. As our main theoretical result, we prove that a simple dual training-based algorithm achieves a $(1-o(1))$-approximation guarantee in the random order stochastic model.<br>We then focus on the online display ad allocation problem and study the efficiency and fairness of various training-based and online allocation algorithms on data sets collected from real-life display ad allocation system. Our experimental evaluation confirms the effectiveness of training-based algorithms on real data sets, and also indicates an intrinsic trade-off between fairness and efficiency.<br>This talk presents joint work with Jon Feldman, Nitish Korula, Vahab Mirrokni and Monika Henzinger. | |
| 10:00am-10:30am | Coffee break | Wood Dining Room (2nd floor) |
| 10:30am-12:30pm | Parallel session (Track 1 of 3) | Wood Dining Room (2nd floor) |
| *Session title*: | SDP RELAXATIONS | |
| *Session chair*: | Farid Alizadeh | |
| *Speaker*: | **Farid Alizadeh** (RUTCOR and School of Business, Rutgers University, alizadeh@rutcor.rutgers.edu) | |
| *Title*: | **Characterization of Sum-Of-Squares Cones in Algebras** | |
| *Abstract*: | We extend Nesterov's semidefinite programming (SDP) characterization of squared functional systems to abstract algebras. We present short proofs of SDP characterization of the cone of Sum-Of-Square (SOS) elements in such algebras. Using algebraic techniques such as isomorphisms, linear isomorphisms, tensor products (along with Youla' theorem), and sums of algebras we construct new SOS cones. In particular we examine SOS cones in vector valued polynomial spaces and functional systems. We present some applications such as minimal ellipsoids containing an entire space curve and estimation of covariance matrix of correlated time series | |
| *Coauthor(s)*: | **David Papp** (dpapp@iems.northwestern.edu) | |
| *Speaker*: | **Tao Zhu** (University of Illinois at Urbana-Champaign, taozhu1@illinois.edu) | |
| *Title*: | **Semi-definite Relaxation of Quadratic Assignment Problems based on Nonredundant Matrix Splitting** | |
| *Abstract*: | Recently, a new class of semi-definite relaxations for QAPs based on matrix splitting has been shown to be strong yet cheap to compute. In this work, we consider the issue of how to choose a matrix splitting scheme so that the resulting relaxation can provide strong bounds. | |
| *Coauthor(s)*: | **Jiming Peng** (pengj@illinois.edu) , **Hezhi Luo** (hzluo@zjut.edu.cn) | |

*Speaker*: **Jieqiu Chen** (Argonne National Lab, jieqchen@mcs.anl.gov)
*Title*: **Globally Solving Nonconvex QP via Completely Positive Programming**
*Abstract*: Nonconvex quadratic programming (QP) is an NP-hard problem that optimizes a general quadratic function over linear constraints. This talk introduces a new global optimization algorithm for this problem, which combines two ideas from the literature–finite branching based on the first-order KKT conditions and polyhedral-semidefinite relaxations of completely positive (or copositive) programs. Through a series of computational experiments comparing the new algorithm with existing codes on a diverse set of test instances, we demonstrate that the new algorithm is an attractive method for globally solving nonconvex QP.
*Coauthor(s)*: **Sam Burer** (samuel-burer@uiowa.edu)

*Speaker*: **Victor Blanco** (Universidad de Granada, vblanco@ugr.es)
*Title*: **Solving location problems via moments, sums of squares and semidefinite programming**
*Abstract*: We consider the problem of minimizing the ordered median (or weighted average) function of finitely many rational functions over a compact semialgebraic set. Ordered weighted averages of rational functions are not, in general, neither rational functions nor the supremum of rational functions so that current results available for the minimization of rational functions cannot be applied to handle these problems. We prove that the problem can be transformed into a new problem embedded in a higher dimension space where it admits a convenient representation. This reformulation admits a hierarchy of SDP relaxations that approximates, up to any degree of accuracy, the optimal value of those problems. We apply this very general framework to a broad family of continuous location problems showing that some difficult problems (convex and non-convex) that up to date could only be solved on the plane and with Euclidean distance, can be reasonably solved with different $\ell_p$-norms a! nd in any finite dimension. We illustrate this methodology with some extensive computational results on location problems in the plane and the 3-dimensional space.
*Coauthor(s)*: **Safae El-Haj-Ben-Ali** (anasafae@gmail.com) , **Justo Puerto** (puerto@us.es)

10:30am-12:30pm Parallel session (Track 2 of 3) Governor's Suite (2nd floor)
*Session title*: LINEAR AND INTEGER PROGRAMMING
*Session chair*: Sanjeeb Dash

*Speaker*: **Julio C. Goez** (Lehigh University, jgoez1@gmail.com)
*Title*: **Generating the convex hull of a disjunction for Mixed Integer Second Order Cone Optimization (MISOCO)**
*Abstract*: We consider the intersection of the continuous relaxation of the MISOCO feasible set, assumed to be an ellipsoid, and a disjunction. We show that under mild conditions the convex hull of that intersection can be enclosed in a second order cone. Here we present a procedure to obtain that unique second order cone, which we call a Disjunctive Conic Cut. This cone provides a novel conic cut for MISOCO and thus can be incorporated in branch-and-cut algorithms for MISOCO problems.
*Coauthor(s)*: **Pietro Belotti** (pbelott@clemson.edu) , **Imre Pólik** (imre@polik.net) , **Ted Ralphs** (ted@lehigh.edu) , **Tamas Terlaky** (terlaky@lehigh.edu)

*Speaker*: **Claudio Sodini** (University of Pisa, csodini@ec.unipi.it)
*Title*: **On the minimization of a class of generalized linear functions on a flow polytope**
*Abstract*: The aim of this paper is to propose a solution method for the minimization of a class of generalized linear functions on a flow polytope. The minimization of classes of generalized linear functions on a general polyhedron has been approached in the literature by means of the so called "optimal level solutions" method. In this paper we aim to describe a specialized version of this approach which uses the particular network structure of flow polytopes, thus improving the performance and reducing the numerical errors. Results of a computational test are also provided.
*Coauthor(s)*: **Riccardo Cambini** (cambric@ec.unipi.it)

*Speaker*: **Richard Forrester** (Dickinson College, forrestr@dickinson.edu)
*Title*: **Concise Level-2 RLT Based Formulations of 0-1 Quadratic and Cubic Programs**
*Abstract*: We present a new strategy for linearizing certain classes of 0-1 quadratic and cubic programs that yields a model which posses the desirable properties of concise size and tight relaxation strength. Specifically, using a repeated application of GloverÕs linearization for quadratic programs, we generate a compact linear model that has the strength of the level-2 RLT of Adams and Sherali. Preliminary computational experience is provided.

*Speaker*: **Sanjeeb Dash** (IBM TJ Watson Research Center, sanjeebd@us.ibm.com)
*Title*: **On the Relationship between Lattice Free Cuts and $T$-branch Split Cuts**
*Abstract*: We show how to express cuts based on lattice-free sets in $R^n$ as $t$-branch split cuts (introduced by Li and Richard, 2008) for some integer $t > 0$. We prove an exponential lower bound on t, by constructing lattice-free sets in $R^n$ which cannot be covered by a sub-exponential number of split sets. We use these results to construct a pure cutting plane algorithm for mixed-integer programs based on $t$-branch split cuts. Finally, we settle a conjecture of Li and Richards on $t$-branch split cuts.

10:30am-12:30pm Parallel session (Track 3 of 3) B013 (1st floor)
*Session title*: APPLICATIONS IN ECONOMETRICS
*Session chair*: Vyacheslav V. Kalashnikov

*Speaker*: **Getachew K. Befekadu** (University of Notre Dame, gbefekadu1@nd.edu)
*Title*: **Characterization of feedback Nash equilibria for a multi-channel system via a set of all non-fragile stabilizing state-feedback solutions and dissipativity inequalities**
*Abstract*: We consider the problem of state-feedback stabilization for multi-channel systems in the differential-game theoretic framework where the class of admissible strategies for the players is induced from a solution set of the individual objective functions that are associated with certain dissipativity inequality properties. In such a framework, we characterize the feedback Nash equilibria over a set of non-fragile stabilizing state-feedback solutions corresponding to the constrained dissipativity problems. Moreover, we show that the existence of a weak-optimal solution to the constrained dissipativity problem is a sufficient condition for the existence of a feedback Nash equilibrium, whereas the set of non-fragile stabilizing state-feedback solutions is fully described in terms of a set of dilated linear matrix inequalities.
*Coauthor(s)*: **Vijay Gupta** (vgupta2@nd.edu) , **Panos J. Antsaklis** (antsaklis.1@nd.edu)

*Speaker*: **Cristobal Guzman** (Georgia Institute of Technology, cguzman@gatech.edu)
*Title*: **Network Congestion Control with Markovian Multipath Routing**
*Abstract*: Routing and congestion control are basic components of packet-switched communication networks. While routing is responsible for determining efficient paths along which the sources communicate to their corresponding receivers, congestion control manages the transmission rate of each source in order to keep network congestion within reasonable limits.
Mathematical modeling in network engineering copes with both of these problems, but usually in a separate manner, i.e., solving one problem when the variables of the other are fixed. Network Utility Maximization (NUM) is a widely used model for analyzing congestion control as a convex optimization problem. On the other hand, there has been some progress in the last 10 years in modelling and design of distributed routing protocols for large networks, even for the multipath case.
In this work, we present a model that combines rate control and routing, where rate control is based on the NUM model, and routing based on discrete choice distribution models that lead to a Markovian Traffic Equilibrium. The combination of these models leads to a system of equations that corresponds to the optimality conditions of a strictly convex unconstrained program of low dimension, where the variables are link congestion prices. This characterization allows to establish existence and uniqueness of an equilibrium.
Finally, we propose an algorithm (the Method of Successive Averages) that solves this problem for a wide family of utility functions. Moreover, we show how this algorithm can be implemented in a distributed fashion by slight modifications on current internet protocols.
*Coauthor(s)*: **Roberto Cominetti** (rccc@dii.uchile.cl)

*Speaker*: **Nataliya I. Kalashnykova** (FCFM, UANL, nkalash2009@gmail.com)
*Title*: **A Penalty Function Method To Solve The Natural Gas Bilevel Cash-Out Problem**
*Abstract*: This paper studies a special bi-level programming problem that arises from the dealings of a Natural Gas Shipping Company and the Pipeline Operator, with facilities of the latter used by the former. Because of the special business relationships between these two actors, the timing and objectives of their decision-making process are different and sometimes even opposed. In order to model that, bi-level programming was traditionally used in previous works. Later, the problem was expanded and theoretically studied to facilitate its solution; this included extension of the upper level objective function, linear reformulation, heuristic approaches, and branch-and-bound techniques. In this paper, a linear programming reformulation of the latest version of the model is presented, which proves to be significantly faster to solve when implemented computationally. More importantly, this new formulation makes it easier to theoretically analyze the problem, allowing one to draw important conclusions about the nature of the solution of the modified problem. Numerical results concerning the running time, convergence, and optimal values, are provided and compared to previous reports, showing a significant improvement in speed without actual sacrifice of the solutionÕs quality.
*Coauthor(s)*: **Vyacheslav V. Kalashnikov** (kalash@itesm.mx) , **Gerardo A. Perez-Valdes** (gerardo.perez@gmx.com) , **Stephan Dempe** (dempe@math.tu-freiberg.de)

*Speaker*: **Vyacheslav V. Kalashnikov** (ITESM, Campus Monterrey, kalash@itesm.mx)
*Title*: **Consistent conjectural variations equilibrium in a mixed oligopoly**
*Abstract*: The paper studies a model of mixed oligopoly with conjectural variations equilibrium (CVE). The agentsÕ conjectures concerning the price variations depend upon their production outputÕs increase or decrease. The existence and uniqueness results for the conjectural variations equilibrium (called an exterior equilibrium) for any set of feasible conjectures are established. To introduce the notion of an interior equilibrium, a consistency criterion for the conjectures (referred to as influence coefficients) is introduced and the existence theorem for the interior equilibrium (understood as a CVE with consistent conjectures) is proven. To prepare the base for the extension of our results to the case of non-differentiable demand functions, the behavior of the consistent conjectures in dependence upon a parameter representing the demand functionÕs derivative with respect to the market price is also examined.
*Coauthor(s)*: **Nataliya I. Kalashnykova** (nkalash2009@gmail.com) , **Vladimir A. Bulavsky** (lapissa@hotbox.ru) , **Felipe J. Castillo** (felipecastilloxx@hotmail.com)

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12:30pm-1:30pm Lunch Wood Dining Room (2nd floor)

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1:30pm-3:30pm Parallel session (Track 1 of 3) Wood Dining Room (2nd floor)
*Session title*: NONLINEAR PROGRAMMING
*Session chair*: David Shanno

*Speaker*: **Marc Millstone** (IBM T.J. Watson Research, mszetom@us.ibm.com)
*Title*: **Localized Augmented Lagrangian Methods for Minimizing the Kohn-Sham Energy**
*Abstract*: The combination of ever increasing computational power and new mathematical models has fundamentally changed the field of computational chemistry. One example of this is the use of new algorithms for computing the charge density of a molecular system from which one can predict many physical properties of the system.
We will present an augmented Lagrangian-based algorithm for minimizing the Kohn-Sham energy, which is used to describe a system of non-interacting electrons through a set of single-particle wavefunctions. By exploiting a known localization region of the wavefunctions, each algorithm evaluates the Kohn-Sham energy function and gradient at a set of iterates that have a special sparsity structure. We have chosen to represent the problem in real-space using finite-differences, allowing us to efficiently evaluate the energy function and gradient using sparse linear algebra. Detailed numerical experiments are provided on a set of representative molecules demonstrating the performance and robustness of these methods.

*Speaker*: **Hande Y. Benson** (Drexel University, benson@drexel.edu)
*Title*: **Mathematical Programming Approaches for Multivehicle Path Coordination Under Communication Constraints**
*Abstract*: We present a mathematical programming approach for generating time-optimal velocity profiles for a group of vehicle robots that must follow fixed and known paths while maintaining communication connectivity. Each robot is required to arrive at its goal as quickly as possible, and stay in communication with a certain number of other robots in the arena throughout its journey despite the presence of jammer robots. We formulate the centralized problem as a discrete time mixed-integer nonlinear programming problem (MINLP) with constraints on robot kinematics, dynamics, collision avoidance, and communication connectivity. We investigate the efficient solution of the MINLP via a nonlinear programming reformulation and the scalability of the proposed approach by testing scenarios involving up to fifty (50) robots. Finally, we present results on the corresponding decentralized problem.
*Coauthor(s)*: **Pramod Abichandani** (pramod@minerva.ece.drexel.edu) , **Moshe Kam**

*Speaker*: **David F. Shanno** (Rutgers University - RUTCOR (Retired), shannod@comcast.net)
*Title*: **Interior-Point Methods for Nonconvex Nonlinear Programming: Convergence Analysis and Computational Performance**
*Abstract*: In this talk, we present global convergence results for an interior-point method for nonlinear programming and analyze the computational performance of its implementation. The algorithm uses an L-1 penalty approach to relax all constraints, to provide regularization, and to bound the Lagrange multipliers. The penalty problems are solved using a simplified version of Chen and GoldfarbÕs strictly feasible interior-point method. The global convergence of the algorithm is proved under mild assumptions. Numerical testing on a set of general nonlinear programming problems, including degenerate problems and infeasible problems, confirm the theoretical results. We also provide comparisons to a highly-efficient nonlinear solver and thoroughly analyze the effects of enforcing theoretical convergence guarantees on the computational performance of the algorithm.
*Coauthor(s)*: **Hande Y. Benson** (benson@drexel.edu) , **Arun Sen** (arunsen77@gmail.com)

*Speaker*: **Peng Jiang** (University of Illinois at Urbana-Champaign, pjiang2@illinois.edu)
*Title*: **Binary Matrix Factorization via Clustering**
*Abstract*: Binary Matrix Factorization (BMF) —a NP-hard discrete optimization problem—arises in various applications, such as association rule mining, pattern discovery and data clustering. In this paper, BMF is reformulated as a clustering problem, which can be solved by an effective heuristic to obtain a feasible solution of the original problem with guaranteed approximation error bound. Refinement strategies are proposed for accelerating the clustering process, and experimental results are reported for both synthetic and real world datasets.
*Coauthor(s)*: **Jiming Peng** (pengj@illinois.edu) , **Michael Heath** (heath@illinois.edu)

1:30pm-3:30pm Parallel session (Track 2 of 3) Governor's Suite (2nd floor)
*Session title*: OPTIMIZATION METHODS IN STATISTICS
*Session chair*: Jim Burke

*Speaker*: **Christopher Jordan-Squire** (University of Washington, cjordan1@uw.edu)
*Title*: **Convex Optimization on Probability Measures**
*Abstract*: We consider a range of problems from nonparametric statistics that can be posed as convex optimization problems on the space of regular Borel probability measures. These include constrained maximum likelihood, optimal experimental design, and entropy optimization. A general framework is given where we explore convex duality, constraint qualifications, and solution recovery.
*Coauthor(s)*: **James V. Burke** (burke@math.washington.edu)

*Speaker*: **James V. Burke** (University of Washington, burke@math.washington.edu)
*Title*: **Bayesian models for robust and sparse estimation using log piecewise linear quadratic densities**
*Abstract*: Piecewise linear quadratic (PLQ) penalties play a crucial role in many statistical learning algorithms. They are often used to enhance the robustness of an estimator with respect to outliers in the data or to promote sparsity of the reconstructed parameters. Well known examples include the $L_2$, Huber, $L_1$ and Vapnik losses. We provide conditions that allow the interpretation of such losses as negative log likelihoods of true probability distributions. This correspondence also allows the construction of general multi-dimensional PLQ distributions with specified means and variances from simple scalar building blocks. Some of these ideas are illustrated with an application to Kalman filters.
*Coauthor(s)*: **Aleksandr Aravkin** (sasha.aravkin@gmail.com) , **Bradley Bell** (brad@apl.washington.edu) , **Gianluigi Pillonetto** (giapi@dei.unipd.it)

*Speaker*: **David Papp** (Northwestern University, IEMS, dpapp@iems.northwestern.edu)
*Title*: **Polynomial programming models in optimal experimental design**
*Abstract*: Optimal experimental design problems are concerned with the data collection phase of controlled statistical experiments. Design problems for regression naturally admit continuous optimization models, but these are non-convex models in infinite dimensional spaces even for the two simplest (and most common) model families: univariate polynomial regression and Fourier regression. After discussing the standard formulation, we show that when the underlying regression model involves only rational functions or trigonometric polynomials (which includes the above two cases), this formulation reduces to polynomial programming. This immediately makes univariate design problems very easy to solve, and leads to interesting open problems related to the global optimization of multivariate polynomials.

*Speaker*: **Robert O. Howley** (Lehigh University, roh210@Lehigh.EDU)
*Title*: **Balanced Assignment of Experimental Units in the Analysis of Covariance through Optimization**
*Abstract*: In a designed experiment with covariates experimental units are typically assigned to treatments randomly and analysis of covariance is used to account for the covariate. In cases where the covariate is known beforehand, the possibility exists to assign experimental units systematically to achieve a ÒbalancedÓ covariate distribution in each treatment. This balance can be accomplished by solving a multi-criteria number partitioning problem. We discuss approximate methods for solving this NP hard optimization problem and present simulation results quantifying increases in the power of the statistical test for differences in treatment means.
*Coauthor(s)*: **Robert H. Storer** (rhs2@Lehigh.edu)

1:30pm-3:30pm Parallel session (Track 3 of 3) B013 (1st floor)
*Session title*: SCHEDULING
*Session chair*: Andrew Conn

*Speaker*: **Andrew R. Conn** (IBM TJ Watson Research Center, arconn@us.ibm.com)
*Title*: **Air traffic resolution: a comparison between stochastic and deterministic optimization methods**
*Abstract*: In the future, air traffic control will have to deal with a doubling of the traffic while maintaining equivalent standards of safety. The SESAR (Single European Sky Air Traffic Management Research) project aims to find solutions by automating the current system, providing decision support to the air traffic controllers. We develop a methodology to obtain the optimal conflict resolution in terms of a minimal acceptable separation distance from the direct path, and we take a tactical point of view (i.e. using a relatively short twenty minutes time horizon). The main idea of is to combine a smooth trajectory model, based upon B-splines, with an optimization method. B-splines feature important properties such as twice-continuity (crucial for modeling smooth aircraft trajectories), robustness and flexibility. We use three control points for each trajectory : the start and end points, and a middle point. The middle point location will be determined by our optimization method. Using this "tuneable" control point, we can alter trajectories and as a consequence, solve any potential conflicts. We will detail how we combine B-splines and a genetic algorithm. Then, we will see how we reformulate our problem to turn it into a semi-infinite programming problem. After that, we will compare the results we obtained using these two methods, including alternative means for handling derivatives.
*Coauthor(s)*: **Clement Peyronne**

*Speaker*: **Zhe Liang** (Peking University, liangzhe@coe.pku.edu.cn)
*Title*: **A Network Model for Weekly Aircraft Maintenance Routing Problem and the Integration with the Fleet Assignment Problem**
*Abstract*: In airline operation planning research, most studies focus on planning a daily schedule, and only a very few consider a weekly schedule. The weekly problems are normally much harder than the daily problems because the complexity increases drastically from daily problems to weekly problems. In this research project, we present a novel weekly rotation-tour network representation for the weekly aircraft maintenance routing problem (WAMRP). Based on this representation, we propose a new network-based mixed-integer linear programming formulation for the WAMRP, namely weekly rotation-tour network model (WRTNM). The size of WRTNM only increases linearly with the size of the weekly schedule. We propose a simple variable fixing heuristic to solve WRTNM efficiently and effectively. To assess the performance of WRTNM, we test the WRTNM using eight real life test cases. The computational results show that the proposed model is very compact and scalable, and is able to find the optimal s! olutions to the schedule with 5700 flights and 330 aircrafts, approximately the size of world's largest airlines fleet, within five minutes. We also propose an integrated model to solve the weekly fleet assignment problem (WFAP) and the WAMRP simultaneously. We test the integrated model on nine self-constructed test cases. The?computational results show that the integrated model generates near optimal solutions to the schedules with 1700 flights, 8 fleets with 120 aircrafts, approximately a medium-sized airline, in reasonable time. The computational results show that WRTNM and the integrated model provide very good LP relaxation bounds for all test cases.
*Coauthor(s)*: **Dr. W. Art Chaovalitwongse** (wchaoval@rci.rutgers.edu)

*Speaker*: **Imre Pólik** (SAS Institute, imre.polik@gmail.com)
*Title*: **Scheduling cash replenishment for ATMs with SAS - a case study**
*Abstract*: One of our clients, a major financial institution in Asia wanted to optimize the schedule to replenish a large number of banking machines with cash throughout a city. As ad-hoc or emergency cash deliveries are expensive, a good schedule can save a lot for the bank, and at the same time it increases customer satisfaction. The model uses historical data about the cashflow in each ATM, then calls SAS Forecast Studio to get an estimate on the demand for the planning horizon (a few months). SAS/OR optimization routines are then used to find the optimal schedules under different objective functions, such as total cost of deliveries, number of cashouts or the total amount of cash in the ATMs. A web-based interface is built for the user to operate the model. The entire workflow is organized using different products from SAS' offering. This is a current customer engagement of the recently created SAS Center of Excellence for Operations Research.
*Coauthor(s)*: **Ramanan Medavakkam Krishnamurthy** , **Rob Pratt** , **Necip Kacar** , **Aysegül Peker** , **Ivan Oliveira**

*Speaker*: **Alexander "Sasha" Gutfraind** (Los Alamos National Laboratory, agutfraind.research@gmail.com)
*Title*: **Scheduling the reconstruction of massively-damaged networks**
*Abstract*: A natural disaster may cause extensive damage to a network, such as a power grid. During recovery operations it is desirable to re-install the network with the least cost, where the cost of installing a node depends on which other nodes have already been installed (those could act as supply nodes). Finding the optimal installation sequence turns out to be a hard optimization problem over the n! permutations. Fortunately, there exist efficient approximation algorithms as well as exact solutions using dynamic programming. Many open problems remain in this area, but it is clear that optimization of network recovery operations would save the country a lot of resources in future disaster situations.
*Coauthor(s)*: **Milan Bradonjic** , **Tim Novikoff**

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3:30pm-4:00pm Coffee break Wood Dining Room (2nd floor)

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| 4:00pm-5:00pm | Plenary presentation | Wood Dining Room (2nd floor) |
| *Chair*: | Katya Scheinberg | |
| *Speaker*: | **Adrian Lewis** (Cornell University, adrian.lewis@cornell.edu) | |
| *Title*: | **Nonsmooth optimization and semi-algebraic sets** | |
| *Abstract*: | Concrete optimization problems, while often nonsmooth, are not pathologically so. The class of "semi-algebraic" sets and functions - those arising from polynomial inequalities - nicely exemplifies nonsmoothness in practice. Semi-algebraic sets (and their generalizations) are common, easy to recognize, and richly structured, supporting powerful variational properties. In particular I will discuss a generic property of such sets - partial smoothness - and its relationship with a proximal algorithm for nonsmooth composite minimization, a versatile model for practical optimization. | |
| 5:00pm-5:15pm | Coffee break | Wood Dining Room (2nd floor) |
| 5:15pm-6:15pm | Plenary presentation | Wood Dining Room (2nd floor) |
| *Chair*: | Frank E. Curtis | |
| *Speaker*: | **Jorge Moré** (Argonne National Laboratory, more@mcs.anl.gov) | |
| *Title*: | **How noisy are your functions? Computational Noise and Uncertainty in Complex Simulations** | |
| *Abstract*: | How do we compute the noise level and uncertainty in a deterministic simulation? We address this issue with a series of examples that illustrate several sources of computational noise: large-scale calculations, iterative and adaptive algorithms, and mixed-precision calculations. We present a new algorithm, ECnoise, for quantifying the noise level of a computed function. Our theoretical framework is based on stochastic noise but does not assume a specific distribution for the noise. We show that ECnoise produces reliable results in few function evaluations and offers new insights into building blocks of large scale simulations. We also discuss two applications of computational noise. We first show that noise level information can be used to obtain near-optimal finite difference estimates of the derivatives of a noisy deterministic function. We also show how computational noise can destroy the accuracy of derived calculations, in particular, the computation of derivatives. | |
| 6:30pm-9:30pm | Graduate Student Social | Graduate Student Center |

## Thursday, August 18

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|---|---|---|
| 7:30am-8:00am | Registration/Breakfast | Wood Dining Room (2nd floor) |
| 8:00am-9:00am | Plenary presentation | Wood Dining Room (2nd floor) |
| *Chair*: | Larry Snyder | |
| *Speaker*: | **Mark Daskin** (University of Michigan, msdaskin@umich.edu) | |
| *Title*: | **Genetic Algorithms and Multiobjective Optimization** | |
| *Abstract*: | Genetic algorithms are shown to be a natural means of solving multiobjective problems. Issues associated with the use of genetic algorithms for multiobjective optimization are presented as are methods of resolving those issues. Example problems from facility location modeling and supply chain analysis are presented. Finally, other multiobjective problems that are amenable to heuristic solution are discussed. | |
| 9:00am-9:30am | Coffee break | Wood Dining Room (2nd floor) |

9:30am-11:00am Parallel session (Track 1 of 3) Wood Dining Room (2nd floor)

*Session title*: NETWORK CONFIGURATION PROBLEMS

*Session chair*: David Phillips

*Speaker*: **Rui Zhang** (The College of William & Mary, rzhang@math.wm.edu)

*Title*: **First-order methods for maximizing algebraic connectivity of weighted graphs**

*Abstract*: We consider the problem of constructing a weighted graph with maximum algebraic connectivity and a fixed degree sequence. We formulate the problem as a semidefinite program and describe two first-order, iterative algorithms that only use gradient information. The first method is based on algorithms from packing and covering, and can be interpreted as a smoothing of the Lagrangian in the primal space. The second method is based on recent algorithms from the field of non-smooth optimization, and can be interpreted as a primal smoothing combined with a smoothing in the dual space to increase the step size. A novelty of our methods is that the positive semidefinite constraint is penalized but not the linear constraints. We show the algorithms are efficient theoretically and give computational evidence that the algorithms are also practically efficient.

*Coauthor(s)*: **David Phillips** (djphil@wm.edu) , **Alan Papir** (aspapir@wm.edu)

*Speaker*: **Michael Drew LaMar** (The College of William and Mary, mdlama@wm.edu)

*Title*: **Split digraphs**

*Abstract*: We discuss an extension of split graphs to the directed case and give both a structural and degree sequence characterization. Conjectures on their applicability to directed cases of situations where split graphs have been useful will also be discussed.

*Speaker*: **Rex K. Kincaid** (College of William and Mary, rrkinc@wm.edu)

*Title*: **Optimization Models for Runway Configuration Management**

*Abstract*: The Runway Configuration Management (RCM) problem governs what combinations of airport runways are in use at a given time for an airport or a collection of airports. Runway configurations (groupings of runways), operate under Runway Configuration Capacity Envelopes(RCCEs) which limit arrival and departure capacities. The RCCE identifies unique capacity constraints based on which runways are used for arrivals, departures, and their direction of travel. When switching between RCCEs, due to a change in weather conditions or a change in the demand pattern, some decrement in arrival and departure capacities is incurred during the transition. A two-stage computational experiment is conducted to collect data. We report computational experience with two distinct model approaches—robust optimization, and a deterministic mixed integer linear program. Strengths and weaknesses of each approach are discussed. Test case scenarios are based on data from the John F. Kennedy international airport in New York.

*Coauthor(s)*: **Rui Zhang** (rzhang@math.wm.edu)

9:30am-11:00am Parallel session (Track 2 of 3) Governor's Suite (2nd floor)

*Session title*: OPTIMIZATION, INFORMATION, AND COMPLEXITY

*Session chair*: Eugene Perevalov

*Speaker*: **David Grace** (Lehigh University, dpg3@lehigh.edu)

*Title*: **Additional information acquisition in stochastic optimization**

*Abstract*: We explore the information structure of stochastic optimization problems with a view towards acquiring additional information in an optimal way with regards to improving the solution quality. We consider possible measures of difficulty of additional information acquisition and discuss estimating the parameters involved in these measures.

*Coauthor(s)*: **Eugene Perevalov** (eup2@lehigh.edu)

*Speaker*: **Supreet Mandala** (The Pennsylvania State University, Supreet@pus.edu)
*Title*: **A game theoretic approach to graph clustering**
*Abstract*: Last decade has witnessed an explosion in the modeling of complex systems. Predominantly, graphs are used to represent these systems. The problem of detecting overlapping clusters in graphs is of utmost importance as it provides insights into the organizational principles of the complex system. We present a novel first principles definition of overlapping clusters. A noncooperative game is proposed such that the equilibrium conditions of the game correspond to the clusters in the graph. Several properties of the game are analyzed and exploited to show the existence of a pure Nash Equilibrium (NE) and compute it effectively. We present two algorithms to compute NE and prove their convergence. Empirically, the complexity of both algorithms are nearly linear in the number of edges. Also, one of the algorithms can be readily parallelized, making it scalable. Finally, our approach is compared to an existing overlapping cluster detection algorithm and validated on several artificial and real datasets.
*Coauthor(s)*: **Soundar Kumara** (skumara@pus.edu) , **Kalyan Chatterjee** (kchatterjee@pus.edu)

*Speaker*: **Eugene Perevalov** (Lehigh University, eup2@lehigh.edu)
*Title*: **Complexity via optimization**
*Abstract*: A new way of evaluating complexity of systems is proposed. In this approach, the basic notion is complexity of a task (optimization problem) defined as the minimum amount of information that needs to be learned of acquired in order to solve the optimization problems with the excess expected loss – defined as the expected loss in excess of the minimum possible – not exceeding a given fraction of the original loss that obtained before the new information was acquired. The more standard self-generated system complexity (measured by the statistical complexity, for instance) is obtained when the optimal prediction problem is used in the general definition and the fraction is set to zero. The proposed definition allows to treat complexity of different tasks – including optimization, control and prediction – on equal footing and, among other things, allows to distinguish between different systems of infinite statistical complexity.
*Coauthor(s)*: **David Grace** (dpg3@lehigh.edu)

9:30am-11:00am Parallel session (Track 3 of 3) B013 (1st floor)
*Session title*: LOGISTICS APPLICATIONS
*Session chair*: Francis J. Vasko

*Speaker*: **Guoqing Zhang** (University of Windsor, gzhang@uwindsor.ca)
*Title*: **Lagrangian heuristics for a class of large scale acquisition problems with supplier discounts**
*Abstract*: We develop Lagrangian heuristics for a class of large scale acquisition problems with supplier discounts. The basic problem is to determine optimal order quantities when the demands are uncertain and suppliers offer discount, which is formulated with a MINLP model. We compare the heuristics with GAMS and its solvers. Extension to the problem and applications are also discussed.
*Coauthor(s)*: **Jianmai Shi** (jianmaishi@gmail.com)

*Speaker*: **Jose Fernandez** (University of Murcia (Spain), josefdez@um.es)
*Title*: **Solving a facility location and design problem with variable demand on the plane**
*Abstract*: In most competitive location models available in the literature, it is assumed that the demand is fixed independently of market conditions. However, demand may vary depending on prices, distances to the facilities, etc., especially when the goods are not essential. Taking variable demand into consideration increases the complexity of the problem and, therefore, the computational effort needed to solve it, but it may make the model more realistic.
A new planar competitive location "and design" problem "with variable demand" is presented. By using it, it is shown numerically for the first time in the literature that the assumption of fixed demand influences the location decision very much, and therefore, that the selection of the type of demand (fixed or variable) must be made with care when modeling location problems.
An exact interval Branch-and-Bound method and an evolutionary algorithm called UEGO are proposed to cope with the problem.
*Coauthor(s)*: **Aranzazu G. Arrondo** (agarrondo@um.es) , **Juana L. Redondo** (jlredondo@ual.es) , **Pilar M. Ortigosa** (ortigosa@ual.es)

*Speaker*: **Francis J. Vasko** (Kutztown University, vasko@kutztown.edu)
*Title*: **Some comments on the Classic Transportation Problem**
*Abstract*: The classic transportation problem is a central topic in all operations research textbooks. This talk will report empirical results for 16 heuristics used to solve 4320 classic transportation problems. Additionally, the impact of how the dummy column/row is processed by a transportation heuristic will be discussed. This talk summarizes two papers published in OR Insight this year.

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11:00am-11:30am Coffee break Wood Dining Room (2nd floor)

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11:30am-12:30pm Plenary presentation Wood Dining Room (2nd floor)
*Chair*: Aurelie Thiele

*Speaker*: **Sebastian Ceria** (Axioma, Inc., SCeria@axioma.com)
*Title*: **Equity Risk Management and Optimization - A challenging relationship**
*Abstract*: The construction of optimized portfolios in asset management entails the complex interaction between three key entities: the risk factors, the alpha factors and the constraints. The problems that arise due to mutual misalignment between these three entities are collectively referred to as Factor Alignment Problems (FAP). Examples of FAP include risk-underestimation of optimized portfolios, undesirable exposures to factors with hidden and unaccounted systematic risk, consistent failure in achieving ex-ante performance targets, and inability to harvest high quality alphas into above-average IR. In this talk we discuss FAP and propose a solution approach which is based on augmenting the user risk model with a single additional factor, the Alpha Alignment Factor (AAF). We will show how the Alpha Alignment Factor provides a natural and effective remedy to FAP. The Alpha Alignment Factor not only corrects for the risk underestimation bias of optimal portfolios but also pushes the ex-post efficient frontier upwards thereby empowering portfolio managers to access portfolios that lie above the traditional risk-return efficient frontier.

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12:30pm-1:30pm Lunch Wood Dining Room (2nd floor)

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1:30pm-3:00pm AIMMS-MOPTA Modeling Competition Finalist Presentations Wood Dining Room (2nd floor)
*Session chair*: Peter Nieuwesteeg

*Finalist*: Team ISE-NUS
*Institution*: National University of Singapore, Singapore
*Member*: **Nguyen Viet Anh** (nguyenvietanh@nus.edu.sg)
*Member*: **Tran Trung Hieu** (g0600324@nus.edu.sg)
*Advisor*: **Teo Kwong Meng** (isetkm@nus.edu.sg)

*Finalist*: Team ORTEC
*Institution*: ORTEC, The Netherlands
*Member*: **Arno Witte** (arno.witte@ortec.com)
*Member*: **Harwin de Vries** (harwin.devries@ortec.com)
*Member*: **Rianne Langenberg** (rianne.langenberg@ortec.com)
*Advisor*: **Cindy de Groot** (cindy.degroot@ortec.com)

*Finalist*: Team RANDOM
*Institution*: University of Twente, The Netherlands
*Member*: **Rick van Urk** (r.vanurk@student.utwente.nl)
*Member*: **Arturo E. Perez Rivera** (a.e.perezrivera@student.utwente.nl)
*Advisor*: **Bodo Manthey** (b.manthey@utwente.nl)

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3:00pm-3:15pm Coffee break Wood Dining Room (2nd floor)

3:15pm-4:45pm Parallel session (Track 1 of 3) Wood Dining Room (2nd floor)
*Session title*: NONLINEAR PROGRAMMING
*Session chair*: Frank E. Curtis

*Speaker*: **C.H. Jeffrey Pang** (Massachusetts Institute of Technology, chj2pang@mit.edu)
*Title*: **Finding saddle points of mountain pass type with quadratic models on affine spaces**
*Abstract*: The problem of computing saddle points is important in problems in numerical partial differential equations and computational chemistry. We propose an algorithm to find saddle points of mountain pass type. The key step is to minimize the distance between level sets by using quadratic models on affine spaces.

*Speaker*: **Xiaocun Que** (Lehigh University, xiq209@lehigh.edu)
*Title*: **An Adaptive Gradient Sampling Algorithm for Unconstrained Optimization**
*Abstract*: We present an algorithm for the minimization of an objective function $f : \mathbb{R}^n \to \mathbb{R}$, assumed to be locally Lipschitz and continuously differentiable in an open dense subset $\mathcal{D}$ of $\mathbb{R}^n$. The method has benefits for both smooth and nonsmooth problems. For smooth problems, the developed adaptive gradient sampling procedure, coupled with novel quasi-Newton Hessian approximation strategies, can be seen to rival other (limited-memory) quasi-Newton techniques. The primary targets of the proposed techniques, however, are nonsmooth problems, and for these applications the procedure differs from previous gradient sampling methods in that a quasi-Newton Hessian approximation is used, but also that gradients are sampled adaptively. This latter feature precludes the need for an excessive number of gradient calculations during each iteration, and allows for effective warm-starting of the quadratic optimization subproblem solver. Global convergence properties of the algorithm are presented along with numerical results for diverse sets of test problems.
*Coauthor(s)*: **Frank E. Curtis** (frank.e.curtis@lehigh.edu)

*Speaker*: **Hao Wang** (Lehigh University, haw309@lehigh.edu)
*Title*: **A Penalty-SQP Method with Rapid Infeasibility Detection**
*Abstract*: We present an algorithm for nonlinear constrained optimization. The method is of the sequential quadratic optimization variety, uses l1-norm regularization to handle inconsistent subproblem constraints, and employs a backtracking line search to promote global convergence. The algorithm is designed to enjoy all of the strong convergence properties of previously proposed SQP techniques. However, the novelties of the algorithm are the mechanisms in place including how the penalty parameter is adjusted at every iteration, which promote fast local convergence to infeasible stationary points when the algorithm is presented with an infeasible problem. The global and local convergence guarantees of the algorithm are proved under common assumptions and numerical results are presented for a set of test problems.
*Coauthor(s)*: **Frank E. Curtis** (frank.e.curtis@lehigh.edu)

3:15pm-4:45pm Parallel session (Track 2 of 3) Governor's Suite (2nd floor)
*Session title*: FIRST ORDER METHODS
*Session chair*: Javier Pena

*Speaker*: **Qihang Lin** (Carnegie Mellon University, qihangl@andrew.cmu.edu)
*Title*: **A Sparsity Preserving Stochastic Gradient Method for Composite Optimization**
*Abstract*: We propose new stochastic gradient algorithms for solving convex composite optimization problems. In each iteration, our algorithms utilize a stochastic oracle of the gradient of the smooth component in the objective function. Our algorithms are based on a stochastic version of the estimate sequence technique introduced by Nesterov (Introductory Lectures on Convex Optimization: A Basic Course, Kluwer, 2003). We establish convergence results for the expectation and variance as well as large deviation properties of the objective value of the iterates generated by our algorithm. When applied to sparse regression problems, our algorithms have the advantage of readily enforcing sparsity at all iterations. We present some numerical experiments on simulated data sets.
*Coauthor(s)*: **Xi Chen** (xichen@cs.cmu.edu) **Javier Peña** (jfp@andrew.cmu.edu)

*Speaker*: **Shoham Sabach** (Technion - Israel Institute of Technology, ssabach@tx.technion.ac.il)
*Title*: **A First Order Method for Finding Minimal Norm-Like Solutions of Convex Optimization Problems.**
*Abstract*: We consider a general class of convex optimization problems in which one seeks to minimize a strongly convex function over a closed and convex set which is by itself an optimal set of another convex problem. We introduce a gradient-based method, called the minimal norm gradient method, for solving this class of problems, and establish the convergence of the sequence generated by the algorithm as well as a rate of convergence of the sequence of function values. A portfolio optimization example is given in order to illustrate our results.
*Coauthor(s)*: **Prof. Amir Beck** (becka@ie.technion.ac.il)

*Speaker*: **Carmeliza Navasca** (Clarkson University, cnavasca@gmail.com)
*Title*: **Regularization of the Alternating Least-Squares Method for Tensor Decomposition**
*Abstract*: We study the convergence of the Regularized Alternating Least-Squares (RALS) algorithm for tensor decompositions. As a main result, we have shown that given the existence of some critical points of the Alternating Least-Squares method, the limit points of the converging subsequences of the RALS are the critical points of the least squares cost functional. Some numerical examples indicate a faster convergence rate for the RALS in comparison to the standard alternating least squares method.
*Coauthor(s)*: **S. Kindermann** (kindermann@indmath.uni-linz.ac.at) , **N. Li** (nali@clarkson.edu)

3:15pm-4:45pm Parallel session (Track 3 of 3) B013 (1st floor)
*Session title*: STOCHASTIC AND ROBUST OPTIMIZATION
*Session chair*: Aurelie Thiele

*Speaker*: **Stephen M. Mansour** (Lehigh University, smm205@lehigh.edu)
*Title*: **Valuation of Mortgages with Prepayments and Defaults in Continuous Time**
*Abstract*: Our mortgage model consists of three basic parts: the amortization model which examines the mortgage cash flows, the interest rate model which affects the mortgage price, and the prepayment model which measures the rates of mortgage termination when a property is sold, refinanced or foreclosed. A technique known as eigenfunction expansion has proven to be useful in pricing continuous-time mortgages. Using this technique, we propose three modifications to existing models: (1) to generalize the existing interest rate Cox-Ingersoll-Ross model and to include simpler models such as Vasicek and then compare the results obtained by these methods, (2) to refine the relationship between interest rates and prepayment rates to reflect empirical data more accurately, particularly in low interest rate scenarios, and (3) to expand the prepayment model to include mortgage defaults. Non-Linear optimization is used to find the three interest rate parameters: the long-term mean, a measure of the volatility, and the strength of the mean-reversion. For the prepayment model, we use linear regression techniques to determine the refinancing threshold(s) and the refinacing intensity at each threshold. The optimized parameters obtained are then used to price mortgage-backed securities.
*Coauthor(s)*: **Robert Storer, PhD** (rhs2@lehigh.edu) , **Vladimir Dobric, PhD** (vd00@lehigh.edu) , **Riaz Hussain, PhD** (hussain@scranton.edu)

*Speaker*: **Aurelie Thiele** (Lehigh University, aurelie.thiele@lehigh.edu)
*Title*: **Robust Project Selection with Percentile Optimization**
*Abstract*: We consider the problem of selecting projects to maximize total Net Present Value, for uncertain cash flows with a budget constraint. Our approach relies on a tractable approximation to the problem of maximizing a percentile of the objective, which leads to a robust optimization problem with only one new parameter and closed-form expressions of the objective coefficients. Numerical results are encouraging. We also discuss how to avoid over-conservatism when we implement the approximation.
*Coauthor(s)*: **Ruken Duzgun** (rud207@lehigh.edu)

*Speaker*: **Daniel Scansaroli** (Lehigh University, danscans@lehigh.edu)
*Title*: **A Binomial Tree Representation of General Gaussian Markov Processes**
*Abstract*: We introduce a recombining n-period binomial tree model for Gaussian Markov (GM) processes. The central limit theorem for stochastic processes established by Andersen and Dobric (1987) is the main tool used to prove that the tree, when the number of periods tends to infinity, converges weakly to the GM process. In our derivation, we take advantage of the underlying martingale representation of GM processes given by Hida (1960). This result is important in pricing of more exotic options via dynamic programming. We present an example of an American put option on a bond under the Vasicek model.
*Coauthor(s)*: **Vladimir Dobric** (vd00@lehigh.edu) , **Robert H. Storer** (rhs2@lehigh.edu)

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4:45pm-5:00pm Coffee break — Wood Dining Room (2nd floor)

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5:00pm-6:00pm Plenary presentation — Wood Dining Room (2nd floor)
*Chair*: Bob Storer

*Speaker*: **Michael Ferris** (University of Wisconsin, ferris@cs.wisc.edu)
*Title*: **Multiple optimization problems with equilibrium constraints**
*Abstract*: We present a mechanism for describing and solving collections of optimization problems that are linked by equilibrium conditions. Included in this class are classical models such as the PIES model and agent based formulations arising from Nash Games. We demonstrate this mechanism in the context of energy planning problems, specifically for capacity expansion, hydro operation, and transmission line switching. We show how to incorporate stochastic information into these systems and give examples of their use and their possible extensions to hierarchical modeling.

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6:00pm-6:30pm Transportation to Conference Banquet

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6:30-9:30 Conference Banquet — University Center ASA Packer Dining Room

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## Friday, August 19

7:30am-8:00am Registration/Breakfast — Wood Dining Room (2nd floor)

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8:00am-9:00am Plenary presentation — Wood Dining Room (2nd floor)
*Chair*: Katya Scheinberg

*Speaker*: **Javier Pena** (Carnegie Mellon University, jfp@andrew.cmu.edu)
*Title*: **Condition numbers for optimization problems**
*Abstract*: Conditioning plays a central role in numerical linear algebra. The condition number of a problem, such as finding a solution to a linear or polynomial system of equations, is a measure of the problem's well posedness. The condition number is closely connected with the performance and stability of algorithms, as well as with other intrinsic properties of the problem. This talk will provide an overview of several concepts of conditioning for optimization that have proposed over the last two decades. We will discuss how these concepts of conditioning appear naturally in the analysis of the most popular algorithms for convex optimization. We will also discuss other interesting properties of condition numbers including its connection with smooth complexity analysis, metric regularity, and the classical Eckart-Young identity for matrices.

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9:00am-9:30am Coffee break — Wood Dining Room (2nd floor)

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| 9:30am-10:30am | Plenary presentation | Wood Dining Room (2nd floor) |
| *Chair*: | Tamas Terlaky | |
| *Speaker*: | **Philippe Toint** (University of Namur, philippe.toint@fundp.ac.be) | |
| *Title*: | **The Cubic Regularization Algorithm and Complexity Issues for Nonconvex Optimization** | |
| *Abstract*: | The talk will survey recent developments in the analysis of worst-case complexity bounds for algorithms intended for solving nonconvex continuous optimization problems. The convergence to first- and second-order critical points in the unconstrained case will be considered first, and methods such as steepest descent, Newton and several of its variants will be revisited. The talk will also present some new approaches for the constrained case. Some relatively surprising results will be given and the special nature of the cubic regularization method (ARC) will be pointed out. Join work with Coralia Cartis and Nick Gould. | |

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| 10:30am-11:00am | Coffee | Wood Dining Room (2nd floor) |

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|---|---|---|
| 11:00am-12:30pm | Parallel session (Track 1 of 3) | B023 (1st floor) |
| *Session title*: | DERIVATIVE-FREE AND SIMULATION-BASED OPTIMIZATION | |
| *Session chair*: | Katya Scheinberg | |
| *Speaker*: | **Brent Castle** (Indiana University, bscastle@cs.indiana.edu) | |
| *Title*: | **Quasi-Newton Methods for Stochastic Optimization With Application to Simulation-Based Parameter Estimation** | |
| *Abstract*: | We describe an algorithm for stochastic optimization, i.e., optimization in which evaluation of the objective function is corrupted by chance variation. A typical application is optimizing the parameters of a stochastic simulation, e.g., estimating the parameters of an analytically intractable stochastic process by minimizing a measure of discrepancy between simulated samples and an observed sample. The algorithm, QNSTOP (Quasi-Newton STochastic OPtimization), synthesizes ideas from response surface methodology (constructing local approximations of the objective function by regression experiments, constructing confidence sets for constrained minimizers of quadratic objective functions) and numerical optimization (trust region methods, secant updates). The performance of QNSTOP is demonstrated by estimating the parameters of a tumor recurrence model. The model is analytically intractable, but easily simulated. The objective measures the discrepancy of the simulated samples from an actual sample, e.g., by Kolmogorov-Smirnov distance. | |
| *Coauthor(s)*: | **Michael Trosset** (mtrosset@indiana.edu) | |
| *Speaker*: | **Juliane Mueller** (Tampere University of Technology & Cornell University, jm768@cornell.edu) | |
| *Title*: | **A Surrogate Model Algorithm for Solving Expensive Black-Box Nonlinear Integer Programming Problems** | |
| *Abstract*: | Most integer optimization problems arising in management and engineering applications are NP-hard and therefore difficult to solve. Typically, algorithms based on branch and bound methods or evolutionary strategies are used to solve these kinds of problems. If however evaluating the objective and constraints requires a computationally expensive simulation, the number of function evaluations must be as low as possible in order to obtain solutions within an acceptable time. Thus, a surrogate model algorithm using radial basis functions will be proposed. Experimental results show that the surrogate model algorithm is a promising approach for solving computationally expensive integer optimization problems. | |
| *Coauthor(s)*: | **Prof. Christine A. Shoemaker** (cas12@cornell.edu) , **Prof. Robert Piché** (robert.piche@tut.fi) | |

*Speaker*: **Ahmad Almomani** (Clarkson University, almomaar@clarkson.edu)
*Title*: **Filter Implicit Filtering (FIF) for Constrained Derivative-free Optimization**
*Abstract*: We consider constraint handling for the implicit filtering algorithm for optimization, which uses a finite difference approximation to the gradient with a decreasing sequence of difference increments and a quasi-Newton approach. We extend the capabilities of implicit filtering for bound constraints using the filter method for linear and nonlinear constraints. The filter method for constraints chooses points based on either decreasing the objective function value or improving a measure of feasibility and is incorporated within the implicit filtering algorithm as opposed to aggregating the original objective function. We give a comparison of the new method to implicit filtering with penalty method on a suite of test problems that include jump discontinuities and low amplitude noise.
*Coauthor(s)*: **Khathleen Fowler** (kfowler@clarkson.edu)

11:00am-12:00pm Parallel session (Track 2 of 3) Governor's Suite (2nd floor)
*Session title*: AIMMS SESSION
*Session chair*: Peter Nieuwesteeg

*Speaker*: **Peter Nieuwesteeg** (AIMMS (Paragon Decision Technology), p.nieuwesteeg@aimms.com)
*Title*: **Using Commercial Software in Teaching OR: Free AIMMS Academic License**
*Abstract*: In this presentation, we will highlight some advanced techniques and the impactful value of data visualization with AIMMS by reviewing some of the models that were submitted for this year's MOPTA modeling competition. We will also share some experiences of other academic users and how they embraced AIMMS to better prepare their students for their future careers. By the end of this presentation, you will be ready to bring AIMMS into your OR class or research projects, too.

11:00am-12:00pm Parallel session (Track 3 of 3) B013 (1st floor)
*Session title*: OPTIMAL DESIGN
*Session chair*: Guanghui Lan

*Speaker*: **Chang-Ho Chin** (Kyung Hee University, chin@khu.ac.kr)
*Title*: **Optimal Design of Combined EWMA Control Charts**
*Abstract*: Combined control charts are widely used for monitoring processes possibly multiple types of changes. However, only heuristic design guidelines are available. We propose an optimal design approach for the combined EWMA (CEWMA) control charts which include the combined EWMA- Shewhart (CES) chart as a special case. The optimal design approach is shown to be better than conventional heuristic guidelines.
*Coauthor(s)*: **Hyerin Choe**

*Speaker*: **Aida Mercado** (Kyung Hee University, aidamh@khu.ac.kr)
*Title*: **Optimal Design of Cuscore charts**
*Abstract*: The Cuscore chart effectively detects a time-variant fault signature. Its detection capability is determined by its two components - handicap and detector. However, only simple design guidelines are available: choosing those values proportional to the fault signature of interest. We propose a Markov chain based optimal design strategy. The performance comparison with conventional Cuscore charts is made.
*Coauthor(s)*: **Seonghwan Jung** (42.195@khu.ac.kr) , **Chang-Ho Chin** (chin@khu.ac.kr)

# 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.


## Center for Engineering Logistics and Distribution

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

The Center for Engineering Logistics and Distribution (CELDi) is a multi-university, multi-disciplinary National Science Foundation-sponsored Industry/University Cooperative Research Center (I/UCRC). Research endeavors are driven and sponsored by representatives from a broad range of member organizations, including manufacturing, maintenance, distribution, transportation, information technology, and consulting.


## 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.

# Bus Schedules

## MOPTA Shuttle Schedule

| Day | Locations | Time |
|---|---|---|
| **Wednesday** | **Comfort Suites to Iacocca Hall** | **7:15am – 9:00am** |
| | **Iacocca Hall to Comfort Suites** | **6:15pm – 7:15pm** |
| | | |
| **Thursday** | **Comfort Suites to Iacocca Hall** | **7:15am – 9:00am** |
| | **Iacocca Hall to University Center** | **6:15pm – 7:00pm** |
| | **University Center to Comfort Suites** | **9:45pm – 10:30pm** |
| | | |
| **Friday** | **Comfort Suites to Iacocca Hall** | **7:15am – 9:00am** |
| | **Iacocca Hall to Comfort Suites** | **12:00pm – 1:00pm** |

Throughout the rest of the days, participants can take the Lehigh bus service to Mountaintop; buses will be running on a summer schedule and the closest stop to Comfort Suites is up Brodhead Avenue in front of the Alumni Memorial Building. Participants that plan to drive to Mountaintop should park in the guest lot on the Mountaintop campus to avoid parking fees during business hours.

| **Lehigh Shuttle Schedule Iacocca Hall** |
|---|
| --- |
| 7:40 A.M.. |
| 8:00 A.M. |
| 8:20 A.M. |
| 8:40 A.M. |
| 9:00 A.M. |
| 9:20 A.M. |
| 9:40 A.M. |
| 10:00 A.M. |
| 10:20 A.M. |
| 10:40 A.M. |
| 11:00 A.M. |
| 11:20 A.M. |
| 11:40 A.M. |
| 12:00 P.M. |
| 12:20 P.M. |
| 12:40 P.M. |
| 1:00 P.M. |
| 1:20 P.M. |
| 1:40 P.M. |
| 2:00 P.M. |
| 2:20 P.M. |
| 2:40 P.M. |
| 3:00 P.M. |
| 3:20 P.M. |
| 3:40 P.M. |
| 4:00 P.M. |
| 4:20 P.M. |
| 4:40 P.M. |
| 5:00 P.M. |
| 5:20 P.M. |

# Notes



**Harold S. Mohler Laboratory**

**200 W. Packer Ave.**

**Bethlehem, PA 18015-1518**

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