Detailed Program and Abstracts

Monday, July 30

7:30am-8:15am	Registration/Breakfast	Wood Dining Room (2nd floor)

8:15am-8:30am	Welcome, Mohamed S. El-Aasser (VP for Int'l. Affairs, Lehigh University)	Wood Dining Room (2nd floor)

8:30am-9:30am Plenary presentation — Wood Dining Room (2nd floor)
Chair: Ted Ralphs

Speaker: **Andrew Goldberg** (Microsoft Research, `goldberg@microsoft.com`)
Title: **The Hub Labeling Algorithm**
Abstract: Given a weighted graph, a distance oracle takes as an input a pair of vertices and returns the distance between them. The labeling approach to distance oracle design is to precompute a label for every vertex so that distances can be computed from the corresponding labels. This approach has been introduced by [Gavoille et al. '01], who also introduced the Hub Labeling algorithm (HL). HL has been further studied by [Cohen et al. '02]. We study HL in the context of graphs with small highway dimension (e.g., road networks). We show that under this assumption HL labels are small and the queries are sublinear. We also give an approximation algorithm for computing small HL labels that uses the fact that shortest path set systems have small VC-dimension. Although polynomial-time, precomputation given by theory is too slow for continental-size road networks. However, heuristics guided by the theory are fast, and compute very small labels. This leads to the fastest currently known practical distance oracles for road networks. The simplicity of HL queries allows their implementation inside of a relational database (e.g., in SQL), and query efficiency assures real-time response. This approach brings the power of location-based services to SQL programmers, and benefits from external memory implementation and query optimization provided by the underlying database.
Coauthor(s): **Ittai Abraham** , **Daniel Delling** , **Amos Fiat** , and **Renato Werneck**

9:30am-9:45am	Coffee break	Wood Dining Room (2nd floor)

9:45am-11:15pm Parallel session (Track 1 of 3) — Wood Dining Room (2nd floor)
Session title: QUADRATIC AND SEMIDEFINITE PROGRAMMING
Session chair: Sam Burer

Speaker: **Hongbo Dong** (University of Wisconsin-Madison, `hdong6@wisc.edu`)
Title: **The interplay between QPB and BQP**
Abstract: We consider (nonconvex) quadratic programming with box constraints and binary indicators, where each binary variable indicates the "on/off" status of the continuous variable. This problem has the structure of box-constrained quadratic program (QPB) on the continuous side, and the boolean quadric polytope (BQP) on the binary side. However, we illustrate that relaxation that solely considers QPB or BQP provides very loose bound. To improve this, we show how to lift a class of valid inequalities for QPB to include the binary information, and discuss the separation problem for these lifted cuts. Preliminary computational results are reported.
Coauthor(s): **Jeff Linderoth** (`linderoth@wisc.edu`) , **Hyemin Jeon** (`jeon5@wisc.edu`)

Speaker: **Camilo Ortiz** (Georgia Institute of Technology, `camiort@gatech.edu`)
Title: **A block-decomposition framework for solving large-scale convex optimization problems**
Abstract: This work generalizes the block-decomposition developments on conic programming (Monteiro, Ortiz and Svaiter; 2011) to the context of general convex optimization problems. We developed a simple framework, with great flexibility in the definition of each block, for solving convex optimization problems. In this talk we review the main ideas behind this framework and the corresponding complexity bounds. We also report very encouraging computational results comparing our methods with the second order algorithm SDPNAL (X. Zhao et al.) and the first order method SDPAD (Z. Wen et al.). With an appropriate definition of each block, the results on specific large-scale conic problems are quite promising.
Coauthor(s): **Renato D.C Monteiro** (`monteiro@isye.gatech.edu`) , **Benar F. Svaiter** (`benar@impa.br`)

Speaker:	**Miguel Anjos** (École Polytechnique de Montréal, `miguel-f.anjos@polymtl.ca`)
Title:	**A Semidefinite Optimization Approach to Multi-Row Facility Layout**
Abstract:	Multi-row facility layout seeks an optimal placement of departments along rows. Large single-row problems have been solved to global optimality, and very large ones to near-optimality, using semidefinite optimization. We extend the semidefinite approach to multi-row layout problems and show that it provides high-quality results in reasonable time for this more general class of layout problems.
Coauthor(s):	**Philipp Hungerländer** (`philipp.hungerlaender@uni-klu.ac.at`)

9:45am-11:15pm	Parallel session (Track 2 of 3)	Governor's Suite (2nd floor)
Session title:	CONSTRAINT PROGRAMMING	
Session chair:	Willem-Jan van Hoeve	

Speaker:	**David Bergman** (Carnegie Mellon University, `dbergman@andrew.cmu.edu`)
Title:	**Graph Coloring Cuts for All-Different Systems**
Abstract:	In this talk we investigate the relationship between the graph coloring problem and the system of all-different constraints from a polyhedral perspective. Specifically, we consider facets in the space of the all-different system and discuss their relative strength with classical 0-1 cuts for the graph coloring problem.
Coauthor(s):	**John Hooker** (`jh38@andrew.cmu.edu`)

Speaker:	**Elvin Coban** (Carnegie Mellon University, `ecoban@andrew.cmu.edu`)
Title:	**Flow-Based Combinatorial Chance Constraints**
Abstract:	We study stochastic variants of flow-based global constraints as combinatorial chance constraints. As a specific case study, we focus on the stochastic weighted alldifferent constraint. We first show that determining the consistency of this constraint is NP-hard. We then show how the combinatorial structure of the alldifferent constraint can be used to define chance-based filtering, and to compute a policy. Our propagation algorithm can be extended immediately to related flow-based constraints such as the weighted cardinality constraint. The main benefits of our approach are that our chance-constrained global constraints can be integrated naturally in classical deterministic CP systems, and are more scalable than existing approaches for stochastic constraint programming.
Coauthor(s):	**Andre A. Cire** (`acire@andrew.cmu.edu`) , **Willem-Jan van Hoeve** (`vanhoeve@andrew.cmu.edu`)

Speaker:	**Willem-Jan van Hoeve** (Carnegie Mellon University, `vanhoeve@andrew.cmu.edu`)
Title:	**MDD Propagation for Disjunctive Scheduling**
Abstract:	We present new propagation methods for disjunctive scheduling, based on limited-width Multivalued Decision Diagrams (MDDs). We show how our method can be integrated efficiently with existing propagation algorithms. Experimental results indicate that the MDD propagation can outperform state-of-the-art propagators especially when minimizing sequence-dependent setup times, in certain cases by several orders of magnitude.
Coauthor(s):	**Andre Cire** (`acire@andrew.cmu.edu`)

9:45am-11:15pm	Parallel session (Track 3 of 3)	B013 (1st floor)
Session title:	MATHEMATICAL OPTIMIZATION	
Session chair:	Getachew Befekadu	

Speaker:	**Lijian Chen** (University of Louisville, `lijian.chen@louisville.edu`)
Title:	**Polynomial Approximation Scheme for the Chance Constraint Imposed on Affine Inequalities with Joint Logarithmically Concave Continuous Random Vector in the Right-hand Side**
Abstract:	We establish a Bernstein polynomial based approximation scheme for a specific type of chance constrained optimization in which the chance constraint is imposed on quasi-concave constraints with logarithmically concave (log-concave in short) continuous random vector on the right hand side. Although the model is indeed convex, it is still computationally demanding due to the costs of calculating the chance constraint's value and gradient. More importantly, we only assume the log-concave and continuous joint distribution for the random vector without further assuming any close-form expression. We address the following computational issues. (1) We choose the initial solution by the Boolean bounding technique. (2) We showed that our approximation scheme will require smaller sample in comparison to the crude Monte Carlo. (3) The method is polynomial. And (4) We showed that obtained optimal solution is converging to the original through the epigraph convergence analysis. Numerical results on logistics and air traffic control are presented.

Speaker: **Susan Margulies** (Pennsylvania State University, `margulies@math.psu.edu`)
Title: **0/1 Constraint-Satisfaction Problems and Tensor Contraction Networks**
Abstract: In a series of papers dating from 2007, J. Cai and V. Choudhary developed tensor contraction networks as an alternative description of L. Valiant's "holographic algorithms". In this paper, we apply algebraic methods to design very specific tensor contraction networks under a change of basis that are meant to simulate 0/1 constraint-satisfaction problems. Using algebraic methods, we capture the combinatorial notion of a "Pfaffian" tensor contraction network under a change of basis, and construct particular partial tensor contraction network pieces meant to simulate 0/1 variables and a "swap" gates or wire crossings. Finally, we show that these planar, Pfaffian tensor contraction network pieces can be algebraically linked with another explicitly codified set of gates, and thus, we illustrate a class of 0/1 constraint-satisfaction problems that are solvable in polynomial-time.
Coauthor(s): **Jason Morton** (`morton@math.psu.edu`)

Speaker: **Getachew K. Befekadu** (University of Notre Dame, `gbefekadu1@nd.edu`)
Title: **Characterization of reliable stabilization using self-bounded controlled invariant subspaces**
Abstract: In this talk, we consider the problem of reliable stabilization for generalized multi-channel systems. We specifically link the problem of stabilization of the multi-channel system to certain properties of self-bounded controlled invariant subspaces that are associated with the problem of disturbance decoupling, where the structure induced from this family of invariant subspaces is used for characterizing the problem of reliable stabilization. We also provide conditions for the existence of a set of state feedback controllers that maintain the stability of the system under possible single-channel controller failure as well as in the presence of unknown disturbances in the system.
Coauthor(s): **Vijay Gupta** (`vgupta2@nd.edu`), **Panos J. Antsaklis** (`antsaklis.1@nd.edu`)

11:15am-11:30am Coffee break — Wood Dining Room (2nd floor)

11:30am-12:30pm Plenary presentation — Wood Dining Room (2nd floor)
Chair: Luis F. Zuluaga

Speaker: **Kurt Anstreicher** (University of Iowa, `kurt-anstreicher@uiowa.edu`)
Title: **Optimization with Copositive and Completely Positive Matrices**
Abstract: An $n \times n$ real symmetric matrix X is called copositive (COP) if $a'Xa \geq 0$ for every nonnegative vector a, and completely positive (CP) if $X = NN'$ for some nonnegative matrix N. The cones of copositive and completely positive matrices are dual to one another. In recent years it has been shown that a variety of NP-hard optimization problems can be formulated as conic linear programs over the COP and CP cones. We describe these formulation results, as well as different algorithmic approaches for problems posed over these cones. One approach is based on computable matrix hierarchies that give better and better approximations of the CP and COP cones, and another is based on generating a COP cut matrix that separates a given non-CP matrix from the CP cone, or a CP cut matrix that separates a non-COP matrix from the COP cone. Computational results show that these algorithmic approaches generate improved bounds on some difficult instances.

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

1:30pm-3:00pm Parallel session (Track 1 of 3) Wood Dining Room (2nd floor)
Session title: INTEGER/COMBINATORIAL OPTIMIZATION
Session chair: Yanjun Li

Speaker: **Oktay Günlük** (IBM Research, gunluk@us.ibm.com)
Title: **Multi-branch split cuts for mixed-integer polyhedra**
Abstract: In this paper we study the t-branch split cuts introduced by Li and Richard (2008). They presented a family of mixed-integer programs with n integer variables and a single continuous variable and conjectured that the convex hull of integer solutions for any n has unbounded rank with respect to $(n-1)$-branch split cuts. It was shown earlier by Cook, Kannan and Schrijver (1990) that this conjecture is true when $n = 2$, and Li and Richard proved the conjecture when $n = 3$. In this paper we show that this conjecture is also true for all $n > 3$.
Coauthor(s): **Sanjeeb Dash** (sanjeebd@us.ibm.com)

Speaker: **Selvaprabu Nadarajah** (Carnegie Mellon University, snadaraj@andrew.cmu.edu)
Title: **A procedure for generating a polynomial size collection of points for a cut generating set**
Abstract: We study the new cut generating paradigm recently introduced in Balas and Margot (2011). A major component of this paradigm involves intersecting edges of a non-conic polyhedron with the boundary of a lattice-free convex set to obtain a collection of intersection points. We call this collection a cut generating set, since it can be used to generate valid cuts in a non-recursive fashion. The method of hyperplane activation used for obtaining the intersection points, in its original form produces exponentially many points and is thus computationally too expensive. We introduce a polynomial time algorithm to produce a valid cut generating set of a size linear in the number of variables and quadratic in the number of hyperplanes activated. We also discuss a procedure for generating the cuts in a subspace and lifting them to inequalities that are valid for the original problem. Computational results will be presented.
Coauthor(s): **Egon Balas** (eb17@andrew.cmu.edu) , **Francois Margot** (fmargot@andrew.cmu.edu)

Speaker: **Yanjun Li** (Purdue University, li14@purdue.edu)
Title: **A Class of Rank 2 Facets for the 1-Restricted Simple 2-Matching Polytope**
Abstract: A simple 2-matching in a simple undirected graph is a subgraph all of whose nodes have degree 1 or 2. A simple 2-matching is called 1-restricted if each of its connected components has at least two edges. As a continuation of the study of 1-restricted simple 2-matchings in a published paper, we introduce a new class of valid inequalities for the 1-restricted simple 2-matching polytope, called the r-2 blossom inequalities. Using the concept of hypomatchable graph (from classical matching theory), we define a subclass of the r-2 blossom inequalities. We show that these inequalities are facet inducing and that they can have Chvatal rank 2, which illustrates the complexity of this polytope. We give a simple condition that characterizes the rank 2 inequalities in this subclass. A complete description of this polytope for general graphs is still open.
Coauthor(s): **David Hartvigsen** (dhartvig@nd.edu)

1:30pm-3:00pm Parallel session (Track 2 of 3) Governor's Suite (2nd floor)
Session title: INTERIOR-POINT METHODS AND APPLICATIONS
Session chair: Hande Y. Benson

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

Speaker: **Pramod Abichandani** (Drexel University, `pva23@drexel.edu`)
Title: **Mathematical Programming for Multi-Vehicle Motion Planning**
Abstract: Real world Multi-Vehicle Motion Planning (MVMP) problems require the optimization of suitable performance measures under an array of complex and challenging constraints involving kinematics, dynamics, communication connectivity, target tracking, and collision avoidance. The general MVMP problem can thus be formulated as a mathematical program (MP). In this paper we present a mathematical programming (MP) framework that captures the salient features of the general MVMP problem. To demonstrate the use of this framework for the formulation and solution of MVMP problems, we examine in detail four representative works and summarize several other related works. As MP solution algorithms and associated numerical solvers continue to develop, we anticipate that MP solution techniques will be applied to an increasing number of MVMP problems and that the framework and formulations presented in this paper may serve as a guide for future MVMP research.
Coauthor(s): **Dr. Hande Benson** , **Dr. Moshe Kam**

Speaker: **Hande Y. Benson** (Drexel University, `benson@drexel.edu`)
Title: **Interior-Point Methods for Nonconvex Nonlinear Programming: Primal-Dual Methods and Cubic Regularization**
Abstract: We present a primal-dual interior-point method for solving nonlinear programming problems. It employs a Levenberg-Marquardt (LM) perturbation to the Karush-Kuhn-Tucker (KKT) matrix to handle indefinite Hessians and a line search to obtain sufficient descent at each iteration. We show that the LM perturbation is equivalent to replacing the Newton step by a cubic regularization step with an appropriately chosen regularization parameter. This equivalence allows us to use the favorable theoretical results of Griewank (1981), Nesterov and Polyak (2006), and Cartis et.al. (2011), but its application at every iteration of the algorithm, as proposed by these papers, is computationally expensive. We propose a hybrid method: use a Newton direction with a line search on iterations with positive definite Hessians and a cubic step, found using a sufficiently large LM perturbation to guarantee a steplength of 1 otherwise. Numerical results are provided on a large library of problems to illustrate the robustness and efficiency of the proposed approach on both unconstrained and constrained problems.

1:30pm-3:00pm Parallel session (Track 3 of 3) B013 (1st floor)
Session title: MATHEMATICAL AND APPLIED OPTIMIZATION
Session chair: Jason Hicken

Speaker: **Francis J. Vasko** (Kutztown University, `vasko@kutztown.edu`) , **Eric Landquist** (Kutztown University, `elandqui@kutztown.edu`)
Title: **Efficiently Solving Large Cable-Trench and Steiner Cable-Trench Problems with applications in Vascular Image Analysis**
Abstract: In 2002, Vasko et. al. defined the Cable-Trench Problem (CTP) as the combination of the shortest path problem and the minimum spanning tree problem. They showed that this combination of two easy problems is difficult to solve, i.e., the CTP is NP-complete. Recently, vascular imaging problems have been modeled as large CTPs. In this paper, we will define the Steiner CTP and discuss heuristic solution approaches for solving CTPs and Steiner CTPs. Empirical results from graphs with up to 25,000 vertices and 30 million edges will be given.
Coauthor(s): **Adam Tal** (`atal822@live.kutztown.edu`) , **Yifeng Jiang** (`jiang1feng@gmail.com`)

Speaker:	**Delphine Sinoquet** (IFPEN, `delphine.sinoquet@ifpen.fr`)
Title:	**A comparison of non linear constrained derivative free optimization methods applied on a reservoir characterization inverse problem**
Abstract:	Reservoir characterization inverse problem in petroleum industry aims at building consistent reservoir models with available production and seismic data for a better forecast of the hydrocarbon production. Observed data (pressures, oil/water/gas rates at the wells and 4D seismic data) are compared with simulated data to determine unknown petrophysical properties of the reservoir. The underlying optimization problem is usually formulated as the minimization of a least-squares objective function composed of two terms : the production data and the seismic data mismatch. In practice, this problem is often solved by nonlinear optimization methods, such as Sequential Quadratic Programming (SQP) methods with derivatives approximated by finite differences. In applications involving 4D seismic data, the use of the classical Gauss-Newton algorithm is often infeasible because the computation of the Jacobian matrix is CPU time consuming and its storage is impossible for large datasets like seismic-related ones. Consequently, we develop an adapted derivative free optimization method, called SQA (Sequential Quadratic Approximation), based on a trust region method with quadratic interpolation models. Both derivative based and derivative free non linear constraints are taken into account, thanks to a SQP solver used to solve internal optimization problems and by defining quadratic models of the derivative free constraints. Moreover, the least-square property of the objective function is handled by modelling individually (or by physically coherent groups) the residuals. This method is applied on a reservoir characterization application with the joint inversion of production data and 4D seismic data with different methodologies: constrained formulation to handle the two data types and bi-objective optimization. SQA method is compared with other methods as a classical SQP method, evolutionary algorithms (CMAES and its multi-objective version MO-CMAES) coupled with surrogate models (based on kriging).
Speaker:	**Jason Hicken** (Rensselaer Polytechnic Institute, `jason.hicken@gmail.com`)
Title:	**Reduced-space inexact-Newton-Krylov methods for PDE-constrained optimization**
Abstract:	In the context of PDE-constrained optimization, reduced-space inexact-Newton-Krylov (iNK) methods offer a potential compromise between full-space Newton-Krylov methods (e.g. LNKS) and reduced-space quasi-Newton methods; however, previous work suggests that the Hessian-vector products used in reduced-space iNK methods must be computed with high precision to maintain orthogonally between the Krylov subspace vectors. We will show how this accuracy requirement can be relaxed, so that the Hessian-vector products can be computed approximately (or inexactly). These inexact Hessian-vector products are essential to the efficient performance of iNK methods applied in the reduced-space. Indeed, numerical examples illustrate that iNK in the reduced-space can be competitive with the full-space approach on some problems. The examples also confirm that, like their full-space counterparts, reduced space iNK methods retain superior algorithmic scaling relative to quasi-Newton reduce d-space approaches.

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:	Katya Scheinberg	

Speaker:	**Afonso S. Bandeira** (Princeton University, `ajsb@math.princeton.edu`)
Title:	**On Sparse Hessian Recovery and Trust-Region Methods based on Probabilistic Models**
Abstract:	In many application problems in optimization, one has little or no correlation between problem variables, and such (sparsity) structure is unknown in advance when optimizing without derivatives. We will show that quadratic interpolation models computed by l1-minimization recover the Hessian sparsity of the function being modeled, when using random sample sets. Given a considerable level of sparsity in the unknown Hessian of the function, such models can achieve the accuracy of second order Taylor ones with a number of sample points (or observations) significantly lower than $O(n^2)$. The use of such modeling techniques in derivative-free optimization led us to the consideration of trust-region methods where the accuracy of the models is given with some positive probability. We will show that as long as such probability of model accuracy is over 1/2, one can ensure, almost surely, some form of convergence to first and second order stationary points.
Coauthor(s):	**Katya Scheinberg** (`katyas@lehigh.edu`) , **Luis Nunes Vicente** (`lnv@mat.uc.pt`)

Speaker: **Xiaocheng Tang** (Lehigh University, `xct@lehigh.edu`)
Title: **Using Second Order Information in Large Scale ℓ_1 Convex Optimization**
Abstract: Recently, a variety of first-order methods have emerged for large scale machine learning problems where traditional state-of-the-art second-order methods like interior point methods fail. In this work, we present a novel coordinate descent type two phase algorithm for sparse logistic regression, requiring only function and gradient evaluations. Particularly, we show that a two-level active-set phase can quickly identify the nonzero subspace in the solution, and that the use of a compact form of limited-memory BFGS will greatly accelerate the soft-thresholding steps in coordinate descent, thus facilitating the minimization of that subspace.
Coauthor(s): **Katya Scheinberg** (`katyas@lehigh.edu`)

Speaker: **Aida Khajavirad** (IBM Research, `aida@cmu.edu`)
Title: **Convex envelopes generated from finitely many compact convex sets**
Abstract: We consider the problem of constructing the convex envelope of a lower semi-continuous function defined over a compact convex set. We formulate the envelope representation problem as a convex optimization problem for functions whose generating sets consist of finitely many compact convex sets. Our development unifies all prior results in the convexification of functions with non-polyhedral envelopes and extends to many additional classes of functions that appear frequently in nonconvex NLPs and MINLPs. We focus on functions that are products of convex and component-wise concave functions and derive closed-form expressions for the convex envelopes of a wide class of such functions. Several examples demonstrate that these envelopes reduce significantly the relaxation gaps of widely used factorable relaxation techniques.
Coauthor(s): **Nick Sahinidis** (`sahinidis@cmu.edu`)

3:15pm-4:45pm Parallel session (Track 2 of 3) Governor's Suite (2nd floor)
Session title: HYBRID OPTIMIZATION
Session chair: Michael R. Bartolacci

Speaker: **Sadan Kulturel-Konak** (Penn State University - Berks, `sadan@psu.edu`)
Title: **A Probabilistic Tabu Search Approach for the Unequal Area Facility Layout Problem**
Abstract: In this study, the facility layout problem (FLP) with unequal area departments is solved using the flexible bay structure (FBS), which is a very common layout in many manufacturing and retail facilities. In addition, the FBS is relaxed by allowing empty spaces within bays, which results in more flexibility in assigning departments into bays. Moreover, departments are allowed to be located more freely within the bays, and they can have different side lengths as long as they are within the bay boundaries and do not overlap. To achieve these goals, department shapes and their locations within bays are determined by linear programming (LP). A Probabilistic Tabu Search (PTS) approach is developed to search an overall layout structure that describes relative positions of departments for the relaxed?FBS. The comparative results show that the proposed approach is very promising and able to find new best solutions for several test problems.

Speaker: **Abdullah Konak** (Penn State University - Berks, `konak@psu.edu`)
Title: **A Hybrid Genetic Algorithm and Lagrangian Heuristic Approach to Survivable Network Design Problem with Relays**
Abstract: This paper presents the network design problem with relays considering the two-edge network connectivity. The problem arises in telecommunication and logistic networks where a constraint is imposed on the distance that a commodity can travel on a route without being processed by a relay, and the survivability of the network is critical in case of a component failure. The network design problem involves selecting two edge-disjoint paths between source and destination node pairs and determining the location of the relays to minimize the network design cost. The formulated problem is solved by a hybrid genetic algorithm (GA) and a Lagrangian heuristic. The GA searches for two-edge disjoint paths for each commodity, and the Lagrangian heuristic is used to determine relays on these paths. The performance of the proposed hybrid approach is compared to the previous approaches from the literature with promising results.

Speaker:	**Michael R. Bartolacci** (Penn State University - Berks, `mbartolacc@aol.com`)
Title:	**Optimization of Wireless Connectivity for Disaster Planning and Management**
Abstract:	In light of recent disasters in Haiti, Japan, and New Orleans, the need for coordinated disaster planning and response in times of crisis has come to the forefront. As seen in particular in the Japanese earthquake and resulting tsunami, telecommunication systems that emergency responders and the general population have come to rely on and assume will always be available fail in times of crisis necessitating alternate means of communication. Planning for the deployment of portable wireless base stations and other similar mobile communications infrastructure is an important step to ensure coordinated disaster response. This work examines the development of an optimization model for the deployment of such an infrastructure.

3:15pm-4:45pm	Parallel session (Track 3 of 3) — B013 (1st floor)
Session title:	QUEUING AND LINEAR PROGRAMMING
Session chair:	Yuriy Zinchenko

Speaker:	**Ho Woo Lee** (Sungkyunkwan University (Korea), `hwlee@skku.edu`)
Title:	**Analysis of M/M/1 queueing system with power supply and consumption**
Abstract:	This talk analyzes the performance of an M/M/1 queueing system with power-supplied server and power-consuming customers. Power requirements of customers follow the exponential distribution. If the server runs out of its energy(power), it enters a charging period and is charged up to S. The mean level of energy and the mean number of customers are computed.
Coauthor(s):	**Feng, Liyan** , **Se Won Lee** , and **Jung Woo Baek**

Speaker:	**Marco Serpa Molinaro** (Carnegie Mellon University, `molinaro@cmu.edu`)
Title:	**Geometry of Online Packing Linear Programs**
Abstract:	We consider packing LP's with m rows where all constraint coefficients are normalized to be in the unit interval. The n columns arrive in random order and the goal is to set the corresponding decision variables irrevocably when they arrive so as to obtain a feasible solution maximizing the expected reward. Previous $(1-\epsilon)$-competitive algorithms require the right-hand side of the LP to be $\Omega((m/\epsilon^2) log(n/\epsilon))$, a bound that worsens with the number of columns and rows. However, the dependence on the number of columns is not required in the single-row case and known lower bounds for the general case are also independent of n. Our goal is to understand whether the dependence on n is required in the multi-row case, making it fundamentally harder than the single-row version. We refute this by exhibiting an algorithm which is $(1-\epsilon)$-competitive as long as the right-hand sides are $\Omega((m^2/\epsilon^2)\log(m/\epsilon))$. Our techniques refine previous PAC-learning based approaches which interpret the online decisions as linear classifications of the columns based on sampled dual prices. The key ingredient of our improvement comes from a non-standard covering argument together with the realization that only when the columns of the LP belong to few 1-d subspaces we can obtain small such covers; bounding the size of the cover constructed also relies on the geometry of linear classifiers. General packing LP's are handled by perturbing the input columns, which can be seen as making the learning problem more robust.
Coauthor(s):	**R. Ravi** (`ravi@cmu.edu`)

Speaker:	**Yuriy Zinchenko** (University of Calgary, `yzinchen@ucalgary.ca`)
Title:	**Shrink-Wrapping trajectories for Linear Programming**
Abstract:	Hyperbolic Programming (HP) – minimizing a linear functional over an affine subspace of a finite-dimensional real vector space intersected with the so-called hyperbolicity cone – is a class of convex optimization problems that contains well-known Linear Programming (LP). In particular, for any LP one can readily provide a sequence of HP relaxations. Based on these hyperbolic relaxations, a new Shrink-Wrapping approach to solve LP has been proposed by Renegar. The resulting Shrink-Wrapping trajectories, in a sense, generalize the notion of central path in interior-point methods. We study the geometry of Shrink-Wrapping trajectories for Linear Programming. In particular, we analyze the geometry of these trajectories in the proximity of the so-called central line, and contrast the behavior of these trajectories with that of the central path for some pathological LP instances.

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

5:00pm-6:00pm	Plenary presentation	Wood Dining Room (2nd floor)
Chair:	Luis F. Zuluaga	
Speaker:	**Edgar Blanco** (Massachusetts Institute of Technology, `eblanco@mit.edu`)	
Title:	**Mega-City Logistics**	
Abstract:	The field of Supply Chain and Logistics Management has evolved over the last 15 years from practices and experiences from Europe and the United States. As academic and practitioners try to apply the same approaches and techniques to emerging economies in Asia and Latin America, they quickly realize that the unique environment characteristics, creates challenges that are usually not addressed in traditional approaches. Through a series of of real-life examples, this presentation will illustrate why academics and practitioners should re-evaluate their approach to urban logistics in "megacities", specially in the context of emerging markets. Megacities Ð cities with a population of at least 10 million people Ð are increasing in both number and size, and their share of world GDP is expected to grow from about 14% to over 20% in a decade. Most of the 23 megacities that currently exist are located in emerging markets. The discussion will include initial results of on-going field research in Latin-American.	
6:30pm-9:30pm	Graduate Student Social	Graduate Student Center

Detailed Program and Abstracts

Tuesday, July 31

8:00am-8:30am	Breakfast	Wood Dining Room (2nd floor)

8:30am-9:30am — Plenary presentation — Wood Dining Room (2nd floor)

Chair: Aurélie Thiele

Speaker: **Reha Tütüncü** (Goldman Sachs Asset Management, reha.tutuncu@gs.com)

Title: **New Optimization Problems in Quantitative Portfolio Construction**

Abstract: Classical quantitative portfolio construction models evolved around the single-period, single-portfolio mean-variance optimization formulation of Markowitz. More recent studies focused on variations addressing multi-period or multi-portfolio instances as well as formulations with different objectives. For example, "risk parity" portfolios seek better diversification through more balanced risk allocations across asset classes. We survey some of these recent approaches and the challenging optimization problems that result from them.

9:30am-9:45am	Coffee break	Wood Dining Room (2nd floor)

9:45am-11:15am — AIMMS-MOPTA Modeling Competition Finalist Presentations — Wood Dining Room (2nd floor)

Session chair: Peter Nieuwesteeg

Finalist: Team SMART
Institution: University of Twente, Enschede, The Netherlands
Members: **Irana Denissen** (i.f.c.denissen@student.utwente.nl), **Dorien Meijer Cluwen** (f.t.f.meijercluwen@student.utwente.nl)
Advisor: **Bodo Manthey** (B.Manthey@utwente.nl)

Finalist: Smart Power Engineers
Institution: Berlin University of Technology, Berlin, Germany
Members: **Soner Emec** (emec@mf.tu-berlin.de), **Florian Huber** (huber@mf.tu-berlin.de)
Advisor: **Rüdiger Stephan** (stephan@math.tu-berlin.de)

Finalist: Yie Galindo
Institution: State University of New York at Buffalo, Buffalo, United States
Members: **Ruben D. Yie-Pinedo** (rubenyie@buffalo.edu), **Gina M. Galindo-Pacheco** (ggalindo@buffalo.edu)
Advisor: **Rajan Batta** (batta@buffalo.edu)

11:15am-11:30am	Coffee break	Wood Dining Room (2nd floor)

11:30am-12:30pm — Plenary presentation — Wood Dining Room (2nd floor)

Chair: Tamás Terlaky

Speaker: **Henry Wolkowiscz** (University of Waterloo, hwolkowi@uwaterloo.ca)

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

Abstract: The elegant theoretical results for strong duality and strict complementarity for linear programming, LP, lie behind the success of current algorithms. However, the theory and preprocessing techniques that are successful for LP can fail for cone programming over nonpolyhedral cones. Surprisingly, many instances of semidefinite programming, SDP, problems that arise from relaxations of hard combinatorial problems are degenerate. (Slater's constraint qualification fails.) Rather than being a disadvantage, we show that this degeneracy can be exploited. In particular, several huge instances of SDP completion problems can be solved quickly and to extremely high accuracy. In particular, we illustrate this on the sensor network localization and Molecular conformation problems.

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

1:30pm-3:00pm	Parallel session (Track 1 of 3)	Wood Dining Room (2nd floor)
Session title:	OPTIMIZATION FOR THE SMART GRID	
Session chair:	Miguel F. Anjos	

Speaker: **Bala Venkatesh** (Ryerson University, `bala@ryerson.ca`)

Title: **Unit Commitment Challenges**

Abstract: Unit commitment is a challenging problem to solve. Its key attributes include: (1) A set of nonlinear power balance equations that are hourly. The number of sets equal 24 for the day-ahead challenge. The number of equations in each set equals 2N where N is the number of buses in the system. (2) A set of intertemporal constraints that bind the 24 hourly solutions together. These include generator status and ramping limits on generator outputs. (3) A whole host of operating limits such as generator output limits, line flow limits, bus voltage limits, etc. The objective for the problem is to minimize the total generation cost. This paper outlines the challenges and discusses a possible solution process using sequential mixed integer linear programming algorithm.

Coauthor(s): **Peng Yu** (`peng.yu@ryerson.ca`)

Speaker: **Jim Ostrowski** (University of Tennessee, `jostrows@utk.edu`)

Title: **Symmetry in the Unit Commitment Problem**

Abstract: Adding symmetry-breaking to a highly symmetric instance of a MILP problem can reduce the size of the problem's feasible region considerably. The same can be said for good dominance constraints. In this talk we will examine the impact of using dominance arguments to strengthen symmetry breaking constraints for the Unit Commitment (UC) problem. Symmetry is present in (traditional formulations of) the UC problem when there are several generators of the same type. We show that by adding dominance strengthened cuts, the number of feasible solutions that need to be considered only grows polynomially as the number of generators increases (so long as the number of unique generators is fixed).

Coauthor(s): **Jianhui Wang** (`jianhui.wang@anl.gov`)

Speaker: **Jiadong Wang** (Lehigh University, `jiw508@lehigh.edu`)

Title: **Impact of Sub-hourly Wind Power Forecasting on Unit Commitment and Dispatch**

Abstract: We propose a new unit commitment model that captures the sub-hourly variability of wind power. Scenarios are included in the stochastic unit commitment formulation to represent the uncertainty and intermittency of wind power output. A modified Benders decomposition method is used to improve the convergence of the algorithm. The numerical results show the benefit of the proposed model based on finer granularity compared with the conventional model of hourly resolution.

Coauthor(s): **Jianhui Wang** (`jianhui.wang@anl.gov`), **Cong Liu** (`liuc@anl.gov`), **Juan Ruiz** (`ziur.nauj@gmail.com`)

1:30pm-3:00pm	Parallel session (Track 2 of 3)	Governor's Suite (2nd floor)
Session title:	FINANCIAL OPTIMIZATION	
Session chair:	Miguel Lejeune	

Speaker: **Pavlo Krokhmal** (University of Iowa, `pavlo-krokhmal@uiowa.edu`)

Title: **Mixed integer portfolio optimization models with p-order cone constraints**

Abstract: We consider mixed integer p-order cone programming problems that arise from stochastic optimization models with higher moment coherent risk measures. Several approaches to solving mixed integer p-cone programming problems are considered, including branch and bound that uses polyhedral approximations of p-cones and branch-and-cut with MIR and lifted cuts for p-cone constraints. Numerical studies on several portfolio optimization problems illustrate the effectiveness of the proposed techniques.

Coauthor(s): **Alexander Vinel** (`alexander-vinel@uiowa.edu`)

Speaker: **Nan Xiong** (Carnegie Mellon University, `nxiong@andrew.cmu.edu`)
Title: **A New Framework for Portfolio Selection**
Abstract: The classical portfolio selection describes the task of asset allocation as having two-stages: estimation and optimization. In this paper, we propose a new framework for portfolio construction, which incorporates the estimation and optimization into a one-stage problem. That is, rather than estimate the parameters first and then compute the optimal portfolio, we realize both of these in one stage by computing the portfolio weights directly. We show that most existing portfolio strategies based on two-stage rules can be cast under our one-stage framework. We also propose a new portfolio allocation strategy based on our one-stage formulation. For the proposed portfolios, we analytically show that the resulting portfolio weights are more stable than those of portfolios based on two-stage rules. Moreover, the proposed portfolio, in some cases, can be better in the sense of expected loss function.

Speaker: **Miguel Lejeune** (George Washington University, `mlejeune@gwu.edu`)
Title: **Risk-Averse Enhanced Indexation**
Abstract: We propose a partial replication strategy to construct risk-averse enhanced index funds. Our model takes into account the parameter estimation risk by defining the asset returns and the return covariance terms as random variables. The variance of the index fund return is required to be below a low-risk threshold with a large probability, thereby limiting the market risk exposure. The resulting stochastic integer problem is reformulated through the derivation of a deterministic equivalent for the risk constraint and the use of a block decomposition technique. We develop an exact outer approximation method that provides a hierarchical organization of the computations with expanding sets of integer-restricted variables. The method scales well and can solve large (up to 1000 securities) instances.

1:30pm-3:00pm Parallel session (Track 3 of 3) B013 (1st floor)
Session title: DERIVATIVE-FREE/SURROGATE OPTIMIZATION
Session chair: Rommel Regis

Speaker: **Ahmad Almomani** (Clarkson University, `almomaar@clarkson.edu`)
Title: **Assessing Constraint Handling for Particle Swarm Optimization**
Abstract: We consider constraint handling for the Particle Swarm Optimization (PSO) algorithm for global optimization problems. We consider the filter method which treats linear and nonlinear constraints with a bi-objective approach. The filter method chooses points based on either decreasing the objective function value or improving a measure of feasibility and is incorporated within the PSO algorithm as opposed to aggregating the original objective function. We give a comparison of the new method (FPSO) to PSO with the classical penalty method on a suite of test problems that include smooth objectives and some with additional low amplitude noise to mimic simulation-based problems.
Coauthor(s): **Katie Fowler** (`kfowler@clarkson.edu`)

Speaker: **Ruobing Chen** (Lehigh University, `ruc310@lehigh.edu`)
Title: **Derivative Free Optimization for Noisy Functions**
Abstract: We apply a model-based trust-region derivative-free algorithm for optimizing the alignment of proteins. This problem arises in Structural Bio-informatics. The objective is computed via a noisy simulation, which causes the standard DFO approaches to fail. We design a special noise handling strategy within the trust region framework and produce a convergent method. Positive numerical results will be presented to show the effectiveness of our method.
Coauthor(s): **Katya Scheinberg** (`katyas@lehigh.edu`) , **Brian Chen** (`byc210@lehigh.edu`)

Speaker: **Rommel G. Regis** (Saint Joseph's University, `rregis@sju.edu`)
Title: **Pushing the Limits of High-Dimensional Surrogate-Based Black-Box Optimization**
Abstract: Some of the most challenging engineering optimization problems are those that involve black-box functions that are outcomes of computationally expensive simulations. Even more challenging are expensive black-box problems with large numbers of decision variables and constraints. Surrogates such as kriging, radial basis functions, and linear and quadratic models are widely used to solve these problems. However, surrogate-based methods tend to require considerably more computational overhead and memory than other optimization methods so their applicability to high-dimensional problems is somewhat limited. Moreover, the ability of surrogates to guide the selection of promising iterates tends to diminish as the problem dimension increases. For instance, kriging-based methods have mostly been applied to problems with less than 10 decision variables. This talk explores the limits of current surrogate-based methods in terms of the problem size that they can successfully handle. Two classes of problems are considered: bound constrained problems with an expensive objective function, and problems with expensive black-box constraints. This talk also presents preliminary comparisons of surrogate-based and other black-box optimization approaches on high-dimensional problems with 50 to over 1000 decision variables. The alternative approaches include direct search, derivative-free trust-region methods, evolutionary algorithms, particle swarm optimization, and traditional derivative-based optimization.

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: FIRST ORDER METHODS & COMPLEXITY
Session chair: Javier Peña

Speaker: **Javier Peña** (Carnegie Mellon University, `jfp@andrew.cmu.edu`)
Title: **A smooth perceptron algorithm**
Abstract: The perceptron algorithm is a simple greedy algorithm to solve the homogeneous system of linear inequalities $A^T y > 0$. The algorithm is popular due to its simple computational steps at each iteration and noise tolerance. However, it has slow convergence rate. We propose a smooth version of the perceptron algorithm that has a significantly better convergence rate while maintaining its simplicity. Our approach extends to the more general conic system $A^T y \in K$ provided a suitable smoothing oracle is available for the cone K. Such a smoothing oracle is readily available for cones of interest such as direct products of second-order and semidefinite cones.
Coauthor(s): **Negar Soheili** (`nsoheili@andrew.cmu.edu`)

Speaker: **Negar Soheili** (Carnegie Mellon University, `nsoheili@andrew.cmu.edu`)
Title: **A smooth von Neumann/perceptron algorithm**
Abstract: The von Neumann's algorithm, privately communicated by von Neumann to Dantzig in the late 40s, is a simple elementary algorithm to solve the homogeneous linear system $Ax = 0, x \geq 0, x \neq 0$. Von Neumann's algorithm can be seen as a dual version of the perceptron algorithm. As in the perceptron, the main drawback of von Neumann's algorithm is its slow rate of convergence. Building upon a smooth version of the perceptron algorithm, we develop a smooth version of von Neumann's algorithm that either solves the linear system $Ax = 0, x \geq 0, x \neq 0$ or its alternative $A^T y > 0$. Our algorithm retains the simplicity of the perceptron and von Neumann's algorithms while significantly improving their convergence rates.
Coauthor(s): **Javier Peña** (`jfp@andrew.cmu.edu`)

Speaker: **Dan Li** (Lehigh University, `dal207@lehigh.edu`)
Title: **The Duality between the Perceptron Algorithm and the von Neumann Algorithm**
Abstract: The perceptron and the von Neumann algorithms were developed to solve Linear Feasibility Problems. In this paper, we investigate and reveal the duality relationship between these two algorithms. The specific forms of Linear Feasibility Problems solved by the perceptron and the von Neumann algorithms are a pair of alternative systems by the Farkas Lemma. Based on this observation, we interpret variants of the perceptron algorithm as variants of the von Neumann algorithm, and vice-versa; as well as transit the complexity results from one family to the other. A solution of one problem serves as an infeasibility certificate of its alternative system. Further, an Approximate Farkas Lemma enables us to derive bounds for the distance to the feasibility or infeasibility from approximate solutions of the alternative systems.
Coauthor(s): **Tamás Terlaky** (`terlaky@lehigh.edu`)

3:15pm-4:45pm — Parallel session (Track 2 of 3) — Governor's Suite (2nd floor)

Session title: OPTIMIZATION MODELS FOR ELECTRICITY SYSTEMS

Session chair: Larry Snyder

Speaker: **MohammadMohsen Moarefdoost** (Lehigh University, `mom211@lehigh.edu`)

Title: **Generation and Storage Dispatch in Stochastic Electricity Networks**

Abstract: We present models for optimizing generation and storage decisions in an electricity network with multiple generators, each co-located with one storage unit, and multiple loads under power flow constraints. The system faces either stochastic loads or supply disruptions. We solve the problems heuristically by decomposing them into several single-generator, single-battery, multi-load systems and solving them optimally using dynamic programming, then obtaining a solution for the original problem by recombining. We discuss our heuristic's computational performance as well as insights gained from the models.

Coauthor(s): **Gengyang Sun** (`ges209@lehigh.edu`), **Larry Snyder** (`larry.snyder@Lehigh.edu`)

Speaker: **Yangfang Zhou** (Carnegie Mellon University, `yangfang@andrew.cmu.edu`)

Title: **Managing Wind-based Electricity Generation with Storage and Transmission Capacity**

Abstract: Managing power generation from wind is conceptually straightforward: generate and sell as much as possible when the price is positive, and do nothing otherwise. However, this leads to curtailment when wind energy exceeds the transmission capacity or prices are negative, and possible revenue dilution when current prices are low and are expected to increase in the future. Electricity storage is being considered as a means to alleviate these issues, and also enables buying electricity from the market for later resale. The presence of storage complicates the management of electricity generation from wind, and the value of storage for a wind-based generator is not entirely understood. We demonstrate that managing such a combined generation and storage system is nontrivial, and that mismanaging such a system can significantly reduce its value. We also show that storage can greatly increase the monetary value of the wind farm, and, while it typically increases the total energy sold to the market, in certain situations it may also — paradoxically — decrease the total wind energy sold to the market.

Coauthor(s): **Alan Scheller-Wolf** (`awolf@andrew.cmu.edu`), **Nicola Secomandi** (`ns7@andrew.cmu.edu`), **Stephen Smith** (`sfs@cs.cmu.edu`)

Speaker: **David W. Coit** (Rutgers University, `coit@rutgers.edu`)

Title: **Electric Power Grid Generation Expansion Optimization Considering Uncertainty and Risk**

Abstract: Power generation expansion planning of electric systems is described, and a formulation and solution approach is proposed considering uncertainty and risk. Mean-risk models are used with risk objective functions of maximum regret and conditional value at risk (CVaR). Generation expansion planning problem can be described as the determination of the number of new generating units, the capacity and location of these units. In this paper, we propose a new approach to find solutions for the generation expansion planning which explicitly consider uncertainty, risk and the availability of the system components over the planning horizon and operational dispatching decisions. Monte Carlo simulation is used to generate the components availabilities and demand scenarios and then the optimization problem is solved to find solutions. Several examples are presented.

Coauthor(s): **Hatice Tekiner-Mogulkoc** (`haticetekiner@sehir.edu.tr`), **Frank Felder** (`ffelder@rutgers.edu`)

3:15pm-4:45pm — Parallel session (Track 3 of 3) — B013 (1st floor)

Session title: FINANCIAL OPTIMIZATION

Session chair: Zhen Liu

Speaker: **Linwei Xin** (Georgia Institute of Technology, `lwxin@gatech.edu`)

Title: **Bounds for Nested Law Invariant Coherent Risk Measures**

Abstract: We provide a new upper bound for the nested (composite) formulation of Average Value-at-Risk. We test the tightness of the bound and compare it to existing bounds. Furthermore, we extend the result to law invariant coherent comonotonic risk measures

Coauthor(s): **Alexander Shapiro** (`ashapiro@isye.gatech.edu`)

Speaker:	**Elcin Cetinkaya** (Lehigh University, `elcin.cetinkaya@lehigh.edu`)	
Title:	**Robust and data-driven portfolio management with quantile constraints**	
Abstract:	We investigate an iterative, data-driven approximation to the problem where the investor seeks to maximize the expected return of her portfolio subject to a quantile constraint given historical realizations of the stock returns. Because our approach involves solving a series of linear programming problems, it can be solved quickly for problems of large scale. We compare its performance to that of methods commonly used in the finance literature, such as fitting a Gaussian distribution to the returns. We also analyze the resulting efficient frontier and extend our approach to the case where portfolio risk is measured by the interquantile range of its return.	
Coauthor(s):	**Aurélie Thiele** (`aurelie.thiele@gmail.com`)	
Speaker:	**Zhen Liu** (Missouri University of Science & Technology, `zliu@mst.edu`)	
Title:	**Large-scale Portfolio Optimization with Proportional Transaction Costs**	
Abstract:	We study the portfolio optimization problem with proportional transaction costs under Markov processes with multiple risky assets with infinite time horizon. The value function can be written as the solution to an infinite-dimensional linear program. We approximate the value function based upon simulation-based optimization methods, and solve for the optimal policy explicitly.	
4:45pm-5:00pm	Coffee break	Wood Dining Room (2nd floor)
5:00pm-6:00pm	Plenary presentation	Wood Dining Room (2nd floor)
Chair:	Ted Ralphs	
Speaker:	**Santosh Vempala** (Georgia Institute of Technology, `vempala@gatech.edu`)	
Title:	**On the Complexity of Integer Programming**	
Abstract:	We discuss three directions: 1. The status of the worst-case complexity of IP, with some recent improvements based on using M-ellipsoids. 2. A phase transition phenomenon for the feasibility of random IPs based on a connection to discrepancy theory. 3. A cutting-plane based algorithm for minimum-cost perfect matchings. We will highlight open questions for each of these.	
Coauthor(s):	**Karthekeyan Chandrasekaran** , **Daniel Dadush** , **Laszlo Vegh**	
6:00pm-7:00pm	Cocktail Reception	Sigel Gallery (Main Lobby)
7:00pm-9:30pm	Banquet, Patrick V. Farrell (Provost and VP for Academic Affairs, Lehigh U.)	Wood Dining Room (2nd floor)

Detailed Program and Abstracts
Wednesday, August 1

8:00am-8:30am	Breakfast	Wood Dining Room (2nd floor)

8:30am-9:30am — Plenary presentation — Wood Dining Room (2nd floor)
Chair: Luis F. Zuluaga

Speaker: **Michael Trick** (Carnegie Mellon University, `trick@cmu.edu`)
Title: **Optimization Methods in Sports Scheduling**
Abstract: In the last decade, sports scheduling has grown to be a robust, vibrant area of optimization. This is due to the economic impact of the work, with dozens of professional and amateur leagues now relying on optimization to create their schedules, as well as the inherent difficulty of creating good or optimal sports schedules. Despite this interest, there still exist small, well-defined sports scheduling problems that have defied exact solution. I cover some of the key models in sports scheduling, and show how innovative optimization approaches, including combinatorial Benders methods and optimization-based large scale local search, address these problems.

9:30am-9:45am — Coffee break — Wood Dining Room (2nd floor)

9:45am-11:15am — Parallel session (Track 1 of 3) — Wood Dining Room (2nd floor)
Session title: OPTIMIZATION FOR THE SMART GRID
Session chair: Miguel F. Anjos

Speaker: **Peter Nieuwesteeg** (AIMMS (Paragon Decision Technology), `Peter.Nieuwesteeg@aimms.com`)
Title: **OR in the Energy Market – Winning the Franz Edelman Award 2011**
Abstract: Our society has a great dependence on electricity. It is therefore essential that the energy market is operated efficiently and reliably. The Midwest Independent Transmission System Operator (ISO) used Operations Research to ensure reliable operation and equal access to high-voltage power lines in 13 U.S. states and the Canadian province of Manitoba, while minimizing the cost of electricity for their 40 million end customers. In this presentation, we will demonstrate how the Midwest ISO was able to realize between $2 and 3$ billion in cumulative savings between 2007 and 2010. In recognition of this achievement the Midwest ISO, together with Paragon Decision Technology (the developers of AIMMS) and Alstom Grid, was awarded the prestigious Franz Edelman Award at last year's INFORMS conference on business Analytics and Operations Research. Our presentation starts with an introduction to the design of the electricity market, both from a technical perspective as well as financial perspective and includes an overview of the different energy related products. This will be followed by an explanation of the optimization models that are solved as part of the grid operations, and the challenges related to model size and the tight performance requirements. We will then conclude the presentation with future challenges for the operations of the electric grid.

Speaker: **Lin He** (Lehigh University, `lih308@lehigh.edu`)
Title: **A Bilevel Model for Retail Electricity Pricing with Flexible Loads**
Abstract: We consider an electricity service provider that wishes to set prices for a large customer with flexible loads so that the resulting load profile matches a predetermined profile as closely as possible. Assuming the customer minimizes its electricity and delay costs, we model this as a bilevel problem in which the provider sets prices and the customer responds by shifting loads forward in time. We derive optimality conditions for the lower-level problem to obtain a single-level problem.
Coauthor(s): **Larry Snyder** (`larry.snyder@lehigh.edu`)

Speaker: **Kankar Bhattacharya** (University of Waterloo, `kankar@uwaterloo.ca`)
Title: **Optimal Operation of Distribution Feeders in Smart Grids**
Abstract: In this presentation a generic and comprehensive distribution optimal power flow (DOPF) model, that can be used by local distribution companies (LDCs) to integrate their distribution system feeders into a Smart Grid, is presented. The three-phase DOPF framework incorporates detailed modeling of distribution system components and considers various operating objectives. Phase specific and voltage dependent modeling of customer loads in the three-phase DOPF model allows LDC operators to determine realistic operating strategies that can improve the overall feeder efficiency. The distribution system operation objective is based on the minimization of the energy drawn from the substation while seeking to minimize the number of switching operations of load tap changers and capacitors. A novel method for solving the three-phase DOPF model by transforming the mixed-integer nonlinear programming problem to a nonlinear programming problem is proposed which reduces the computational burden and facilitates its practical implementation and application. Two practical case studies, including a real distribution feeder test case, are presented to demonstrate the features of the proposed methodology. The results illustrate the benefits of the proposed DOPF in terms of reducing energy losses while limiting the number of switching operations.
Coauthor(s): **Claudio Canizares** (`ccanizares@uwaterloo.ca`), **Sumit Paudyal** (`spaudyal@engmail.uwaterloo.ca`)

9:45am-11:15am Parallel session (Track 2 of 3) Governor's Suite (2nd floor)
Session title: ROBUST AND CONVEX OPTIMIZATION
Session chair: Fatma Kilinc-Karzan

Speaker: **Camilo Ortiz** (Georgia Institute of Technology, `camiort@gatech.edu`)
Title: **An accelerated proximal framework with a fast implementation for solving large-scale convex optimization problems**
Abstract: We describe a general framework for solving convex optimization problems that pinpoints some minimum requirements for convergence. This framework can be understood as a more general presentation of the A-HPE method recently introduced by Monteiro and Svaiter (2011). Moreover, various convex programming methods fit in this framework, including most variants of Nesterov's optimal methods. In this talk we review the main ideas behind this framework and the corresponding complexity bounds. Finally, we implemented an algorithm that pushes to the limit the main requirements of our framework. The performance of this algorithm on several large-scale conic quadratic programming problems is significantly faster in a benchmark that includes various accelerated optimal gradient methods.
Coauthor(s): **Renato D. C. Monteiro** (`monteiro@isye.gatech.edu`), **Benar F. Svaiter** (`benar@impa.br`)

Speaker: **Qihang Lin** (Carnegie Mellon University, `qihangl@andrew.cmu.edu`)
Title: **Optimal Trade Execution with Dynamic Risk Measures**
Abstract: We propose a model for optimal trade execution in an illiquid market that minimizes a coherent dynamic risk of the sequential transaction costs. The prices of the assets are modeled as a discrete random walk perturbed by both temporal and permanent impacts induced by the trading volume. We show that the optimal strategy is time-consistent and deterministic if the dynamic risk measure satisfies a Markovian property. We also show that our optimal execution problem can be formulated as a convex program, and propose an accelerated first-order method that computes its optimal solution. The efficiency and scalability of our approaches are illustrated via numerical experiments.
Coauthor(s): **Javier Peña** (`jfp@andrew.cmu.edu`)

Speaker: **Guanghui Lan** (University of Florida, `glan@ise.ufl.edu`)
Title: **Robust Stochastic First- and Zero-order Methods for Nonconvex Stochastic Programming**
Abstract: We present a new stochastic approximation (SA) type algorithm, namely the randomized stochastic gradient (RSG) method, for solving a class of nonlinear (possibly nonconvex) stochastic programming problems. We establish the rate of convergence of this method for computing an approximate stationary point of a nonlinear programming problem. We also show that this method can handle stochastic programming problems with endogenous uncertainty where the distribution of random variables depend on the decision variables. We discuss a variant of the algorithm which consists of applying a post-optimization phase to evaluate a short list of solutions generated by several independent runs of the RSG method, and show that such modification allows to improve significantly the large-deviation properties of the algorithm. These methods are then specialized for solving a class of simulation-based optimization problems in which only stochastic zero-order information is available.
Coauthor(s): **Saeed Ghadimi** (`sghadimi@ufl.edu`)

9:45am-11:15am Parallel session (Track 3 of 3) B013 (1st floor)
Session title: NONLINEAR PROGRAMMING
Session chair: Frank E. Curtis

Speaker: **Elena Khoroshilova** (Lomonosov Moscow State University, `khorelena@gmail.com`)
Title: **Optimal control of boundary-value problem**
Abstract: A method is proposed for solving the optimal control problem with free right end, and constraints in the form of a linear differential equation. The objective function of the terminal type is minimized on the attainability set under constraints such as a system of linear inequalities. We introduce an iterative process of extragradient type, formulated in a functional subspace of piecewise continuous controls. Original proof of its convergence to solution is given.

Speaker: **Zheng Han** (Lehigh University, `zhh210@lehigh.edu`)
Title: **A Primal-Dual Active Set Algorithm for Convex Quadratic Optimization**
Abstract: We present a novel active-set method for solving large-scale quadratic optimization problems. In contrast to classic active-set methods, ours allows for rapid changes in the active set estimates. By exploiting both primal and dual information in each iteration, it can identify the optimal active set much more rapidly, regardless of the initial estimate. The method is inspired by the primal-dual active-set method proposed by Hintermüller, Ito, and Kunisch [SIAM J. Optim., 13 (2003), pp. 865-888] for bound constrained quadratic optimization problems. It differs from that method, however, in its ability to solve general constrained quadratic optimization problems. Our method is generic and can be customized for certain specialized problems to achieve better performance. Global convergence guarantees are provided for two variants of the framework. Preliminary numerical results are also provided, illustrating that our method is efficient on general problems, and is superior for ill-conditioned problems. We attribute these latter benefits to the relationship between the framework and a semi-smooth Newton method.
Coauthor(s): **Frank E. Curtis** (`frank.e.curtis@lehigh.edu`), **Daniel P. Robinson** (`daniel.p.robinson@jhu.edu`)

Speaker: **Earl R. Barnes** (Morgan State University, `earl.barnes@morgan.edu`)
Title: **Matrix Inequalities and Combinatorial Optimization Problems**
Abstract: Let A and B be real symmetric $n \times n$ matrices. We would like to determine a permutation matrix P that maximizes the trace of the matrix product $APBP^T$. There are several combinatorial optimization problems that can be formulated in this way. These include the traveling salesman problem, the graph partitioning problem, and the maximum clique problem. Let $\alpha_1 \geq \alpha_2 \geq \cdots \geq \alpha_n$ and $\beta_1 \geq \beta_2 \geq \cdots \geq \beta_n$ denote the eigenvalues of A and B, respectively. The Hoffman-Wielandt inequality states that $\alpha_1\beta_n + \cdots + \alpha_n\beta_1 \leq \text{Trace}(AB) \leq \alpha_1\beta_1 + \cdots + \alpha_n\beta_n$. This inequality has been used to obtain bounds on the optimum values of several combinatorial optimization problems, including the ones mentioned above. In this talk we prove the stronger inequality $\frac{1}{2}\|AB - BA\|^2 \leq (\alpha_1\beta_1 + \cdots + \alpha_n\beta_n - \text{Trace}(AB))(\text{Trace}(AB) - \alpha_1\beta_n - \cdots - \alpha_n\beta_1)$, and show how it can be used to sharpen some of the bounds obtained earlier by the Hoffman-Wielandt inequality. We also point out that several classical inequalities are special cases of this one.

11:15am-11:30am Coffee break Wood Dining Room (2nd floor)

11:30am-12:30pm Plenary presentation Wood Dining Room (2nd floor)
Chair: Katya Scheinberg

Speaker: **Stephen Wright** (University of Wisconsin-Madison, swright@cs.wisc.edu)
Title: **Packing Ellipsoids and Circles: Algorithms and Application**
Abstract: Problems of packing shapes with maximal density, possibly into a container of restricted size, are classical in discrete mathematics. We describe here the problem of packing ellipsoids of given (varying) dimensions into a finite container, in a way that minimizes the maximum overlap between adjacent ellipsoids. A bilevel optimization algorithm is described for finding local solutions of this problem, both the general case and the easier special case in which the ellipsoids are spheres. Tools from conic optimization, especially semidefinite programming, are key to the approach. Theoretical and computational results will be summarized. We apply the method to the problem of chromosome arrangement in cell nuclei, and compare our results with the experimental observations reported in the biological literature.
Coauthor(s): **Caroline Uhler**

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

1:30pm-3:00pm Parallel session (Track 1 of 3) Wood Dining Room (2nd floor)
Session title: STOCHASTIC OPTIMIZATION / STATISTICAL LEARNING
Session chair: Peter Frazier

Speaker: **Raghu Pasupathy** (Virginia Polytechnic Institute and State University, pasupath@vt.edu)
Title: **On Approximating Optimal Sampling Laws for Simulation Optimization on Large Finite Sets**
Abstract: We consider the context of stochastically constrained simulation optimization on large finite sets. We demonstrate that in this context, the sampling laws characterizing an efficiently evolving algorithm are closed-form in a measure that we call "score." The score has the interpretation of a penalty for suboptimality and infeasibility of a candidate solution, and is easily estimated in many situations. The implications for implementation are substantial — our limited numerical experience suggests that we can solve problems with many thousands of systems within seconds on a laptop computer.
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Speaker: **Yuting Wang** (University of Virginia, hoperainstop@gmail.com)
Title: **Speeding Up the Cross Entropy Method for Global Optimization**
Abstract: We analyze a multi-start implementation of the CE method for global optimization in which sampled solutions are used as initial solutions or seeds for independent local searches. We provide a formal characterization for the speed of convergence (both worst-case and average) by developing a Markov chain model in which the state space is the set of all locally optimal solutions. The speed of convergence (worst-case) is determined by second largest eigenvalue associated with the transition probability matrix. This eigenvalue has a straightforward interpretation in terms of the "worst" possible state in which the process remains for a relatively large number of iterations. The average performance is characterized in terms of a classification of states into "clusters". The average performance of the single-thread CE methods deteriorates in problems with many clusters with relatively large basins of attraction. These results motivate a new parallel implementation of the method that is guaranteed to speed up convergence by means of an acceptance-rejection test aimed to prevent duplication in search effort.
Coauthor(s): **Alfredo Garcia** (agarcia@virginia.edu)

Speaker: **Peter Frazier** (Cornell University, `pf98@cornell.edu`)
Title: **Parallel Global Optimization with Expensive Function Evaluations: A One-Step Bayes-Optimal Method**
Abstract: We consider the problem of parallel derivative-free global optimization with expensive function evaluations. A natural decision-theoretic approach for solving such problems is to combine Bayesian statistics and the value of information, placing a Gaussian process prior on the objective function, and choosing sets of points to evaluate based on the value of the information they provide. Ginsbourger, Le Riche, and Carraro (2008) proposed such an algorithm, called the multi-points expected improvement algorithm, but this algorithm was deemed too difficult to actually implement in practice. Using stochastic approximation, we show how this conceptual algorithm can be implemented efficiently, and demonstrate that the resulting practical algorithm provides a speedup over the single-threaded expected improvement algorithm.
Coauthor(s): **Scott C. Clark** (`sc932@cornell.edu`)

1:30pm-3:00pm Parallel session (Track 2 of 3) Governor's Suite (2nd floor)
Session title: OPTIMIZATION MODELS FOR ELECTRICITY SYSTEMS
Session chair: Larry Snyder

Speaker: **Jhi-Young Joo** (Carnegie Mellon University, `jjoo@ece.cmu.edu`)
Title: **Multi-Layered Optimization Of Demand Resources Using Lagrange Dual Decomposition**
Abstract: In this work we attempt to find the mathematical relations of the optima of the global system and of each system/market component. Especially, we attempt to show the implications of the objectives of demand resources within the context of the system optimum in the time scale of economic dispatch and in the near real-time scale. We start from defining the optimization problem of the system that includes the subobjectives of many different players, both supply and demand entities in the system, and decompose the problem into each playerÕs optimization problem, using Lagrange dual decomposition. A demand entityÕs, or a load serving entityÕs problem is further decomposed into problems of the many different endusers that the load serving entity serves. By examining the relationships between the global objectives and the local/individual objectives in these multiple layers and the optimality conditions of these decomposable problems, we define the requirements of these different objectives to converge. We illustrate the ideas by simulating simple examples with different conditions and objectives of each entity in the system.
Coauthor(s): **Marija Ilic** (`milic@ece.cmu.edu`)

Speaker: **Fang Chen** (Lehigh University, `fac210@lehigh.edu`)
Title: **Efficient Algorithms and Policies for Demand Response Scheduling**
Abstract: We consider efficient mechanisms to optimize the power consumption within a home, industrial facility, college campus, or other facility or set of facilities. The system is controlled centrally by an Energy Management Controller (EMC),which determines the timing of the operation of some of the devices within the facilities. We introduce an Approximate Dynamic Programming (ADP) algorithm for this problem and show that the ADP outperforms an existing dynamic programming(DP) algorithm. However, even the ADP fails to solve sufficiently quickly when applied to larger instances. Therefore, we also propose several scheduling policies that provide accurate solutions in a fraction of the time required by the ADP. We discuss the computational performance of our ADP algorithm and scheduling policies, as well as insights gained from the models.
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Speaker: **Alberto J. Lamadrid** (Lehigh University, `ajl259@cornell.edu`)
Title: **On the Value of Better Models for the Electricity Sector**
Abstract: The electricity sector provides a platform for virtually all of the economic activity in developed economies. However, or maybe because of this, the reliability of the service has been a prime concern, often higher than economic efficiency, as System Operators (SOÕs) and Regional Transmission Organizations (RTOÕs) need to assure continuous delivery of energy according to often mandated reliability standards (NERC, 2011). As most of these economies aim to increase the share of renewable energy generated, and with expected demand increases around 25% (EIA, 2012), the operating reliability of the system is threatened by the variability in the output from these sources (Baldick, 2012). This paper measures the value of the stochastic solution for a system with high penetration of renewable energy sources (RES), by comparing it to a deterministic formulation with fixed locational reserves, as used by SOÕs in their daily operations. The performance analysis focuses on measures of the true economic costs of the system. Our suggested model for operations of the electricity network has a system planner seeking to minimize the cost of providing both energy and ancillary services using a security constrained Optimal Power Flow (SC-OPF) and explicitly reproducing the uncertainty in the system by using a Markovian transition probability matrix. Though there is a substantial body of research integrating economic dispatch and unit commitment and analyzing different policies, the relative advantages of each method are generally not quantified or discussed. Therefore, disentangling the different assumptions for each model makes more complicated the selection of methods for the next generation of models for the electric grid, and the evaluation of policies for the sector.
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1:30pm-3:00pm Parallel session (Track 3 of 3) B013 (1st floor)
Session title: OPTIMIZATION SOFTWARE
Session chair: Yunfei Song

Speaker: **Matthew Galati** (SAS, `Matthew.Galati@sas.com`)
Title: **Decomposition, Network Optimization, and Other New Features in SAS/OR® Software**
Abstract: This talk demonstrates several new and upcoming features in SAS/OR's, optimization modeling language procedure, PROC OPTMODEL . The new DECOMP algorithm provides an automated decomposition-based technique for solving LPs and MILPs. The interface enables a user to experiment easily with different decompositions simply by defining the partition of constraints in the original compact space. We will present results from several client applications where DECOMP has been successfully used, including results in both shared and distributed memory parallel environments.
Furthermore, we will demonstrate the upcoming NETWORK solver option, which provides access to a variety of network-based solvers using graph-based problem definitions instead of explicit formulations, thus greatly enhancing performance and scalability. We will also explore the new SUBMIT block feature, enabling execution of any SAS code within a PROC OPTMODEL invocation. Finally, we will present plans for future extensions and integration of these new features, which will be surfaced to the user directly through the modeling language.
Coauthor(s): **Leo Lopes**, **Rob Pratt**

Speaker: **John C. Nash** (University of Ottawa (retired), `nashjc@uottawa.ca`)
Title: **Optimization and nonlinear parameter estimation with R**
Abstract: At the MOPTA 2002 conference in Hamilton, the author presented a discussion of difficulties in estimating of uncertainty in parameters of optimization solutions. This presentation used R to draw graphs, and questions about R hijacked the talk. There was sufficient interest that this became an article in SIAG-Opt News and Views, vol. 15, no. 1, pages 2-5, 2003. Ten years later, R has acquired significant capability in optimization and related nonlinear parameter estimation. Indeed, R is believed to be the leading package for research with statistics, and the optimization capabilities tend to reflect the interests of its creators and users, since it is an open-source, user-developed system. This talk will provide an overview of R's optimization tools, both those that are stable and in development. Some attention will be paid to the way in which R packages are created that make R a convenient tool in which other computational and data management capabilities can be operated and analyzed.

Speaker: **Javier Trejos** (University of Costa Rica, `javier.trejos@ucr.ac.cr`)
Title: **A hyperbolic smoothing approach for fuzzy clustering**
Abstract: The hyperbolic smoothing clustering method is a new general strategy for solving problems in cluster analysis scope; verily it corresponds to a fuzzy way for clustering. We analyze these features and present a new fuzzy clustering algorithm. The approach has three main stages: relaxation of the allocation to the nearest centerÕs class, and smoothing the maximal and Euclidean norm functions. This leads to a continuous optimization problem which can be solved by Newton-Raphson iterations whose solution are the centroids of the classes. Then, allocation to the classes is made for each value of the relaxation step according to a simple rule, which is essentially a fuzzy clustering. Computational results obtained for solving a set of test problems of the literature show the efficiency and potentialities of the proposal. We show the possibility of obtaining a hard solution of the particular sum-of-squares clustering problem by a fuzzy strategy. The same methodology can be used for solving similar clustering problems. Moreover, we believe that the application of a sequence of fuzzy formulations that gradually approach the original one can be successfully used for solving a broad class of mathematical problems.
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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: OPTIMIZATION FOR THE SMART GRID
Session chair: Miguel F. Anjos

Speaker: **Claudio Canizares** (University of Waterloo, `ccanizar@uwaterloo.ca`)
Title: **The Energy Hub Management System (EHMS)**
Abstract: The EHMS project (www.energyhub.uwaterloo.ca) consists on the study and development of hardware and software to empower energy managers at manufacturing, agricultural, commercial, institutional and residential facilities such as mills, greenhouses, retail stores, arenas and detached houses to manage effectively their energy requirements through increased information and control. This presentation will mainly concentrate on describing the project, providing a general overview and discussing its main motivations, objectives and some preliminary results. The optimization models developed for residential customers, which are the main intelligence of the residential EHMS, will be described in some detail. These models consider the optimal control of all major residential energy loads and energy storage/generation devices, including heating/air-conditioning, lighting, fridge, dishwasher, washer and dryer, stove, water heater, hot tub, and pool pumps, as well as solar PV panels and battery storage systems, with the objective of minimizing demand, total cost of electricity and gas, emissions and peak load over the scheduling horizon while considering end-user preferences. The results of the application of this model to a real household will be presented, demonstrating significant reductions in energy costs and peak demand while maintaining the household owner's desired comfort levels.

Speaker: **Marc Beaudin** (University of Calgary, `mdbeaudi@ucalgary.ca`)
Title: **Residential power scheduling using multi-level moving window algorithm**
Abstract: Load control strategies have been explored as a partial solution to address the rising cost of energy and increasing concern over greenhouse gas emissions. Residential energy management is considered as an attractive research topic due to the opportunities offered by expected technological enhancements to the electricity grid. The present work proposes a multi-level moving window scheduling algorithm, used to improve energy consumption and production schedules for a single dwelling. The proposed algorithm is designed to allow for high time-resolution scheduling over an extended period without excessive computational burden. It is also designed to correct for errors in forecasts with every rescheduling interval. The optimization model in the present work uses mixed integer linear programming to schedule devices such as space heaters, water heaters, plug-in hybrid vehicles, and pool pumps. The variations in solve time and solution quality are compared and discussed due to changes in rescheduling intervals, scheduling window, and scheduling time-resolution. The proposed algorithm outperforms the baseline model in all cases, and is shown to be more robust against forecast errors and fluctuations beyond the scope of the scheduling period.
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Speaker: **Miguel F. Anjos** (École Polytechnique de Montréal, `miguel-f.anjos@polymtl.ca`)
Title: **A System Architecture for Autonomous Demand Side Load Management in Smart Buildings**
Abstract: We present a new system architecture for demand-side load management. The system is composed of modules for admission control, load balancing, and demand/response management that operate using online operation control, optimal scheduling, and dynamic pricing respectively. It can integrate different energy sources and handle autonomous systems with heterogeneous dynamics in multiple time-scales. Simulation results confirm the viability and efficiency of the proposed framework.

3:15pm-4:45pm Parallel session (Track 2 of 3) Governor's Suite (2nd floor)
Session title: HEALTHCARE MANAGEMENT
Session chair: Turgay Ayer

Speaker: **Osman Ozaltin** (University of Waterloo, `oozaltin@uwaterloo.ca`)
Title: **Optimal Design of the Annual Influenza Vaccine with Manufacturer Autonomy**
Abstract: Frequent updates to the flu shot strains are required, because the circulating strains mutate each season in response to antibody pressure. The World Health Organization recommends which flu strains to include in the annual vaccine based on international surveillance. These recommendations have to be made under uncertainty at least six months before the epidemic because the production has many time-sensitive steps. Furthermore, there is a decision hierarchy between the government agencies, who design the flu shot, and the manufacturers. This hierarchy results from the fact that the Committee optimizes the societal vaccination benefit by taking into account production decisions of the manufacturers, who maximize their own profits. We quantify the tradeoffs involved through a bilevel stochastic mixed-integer model. Calibrated over publicly available data, our model determines the optimal flu shot composition and production in a stochastic and dynamic environment.
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Speaker: **Murat Kurt** (State University of New York at Buffalo, muratkur@buffalo.edu)
Title: **Valuing Prearranged Paired Kidney Exchanges: A Stochastic Game Approach**
Abstract: End-stage renal disease (ESRD) is the ninth-leading cause of death in the U.S. Transplantation is the most viable therapy for ESRD patients, but there is a severe disparity between the demand for kidneys for transplantation and the supply. This shortage is further complicated by incompatibilities in blood-type and antigen matching between patient-donor pairs. Paired kidney exchange (PKE), a cross-exchange of kidneys among incompatible patient-donor pairs, overcomes many difficulties in matching patients with incompatible donors. In a PKE, transplantation surgeries take place simultaneously, so that no donor may renege after his/her intended recipient receives the organ. We consider a cyclic PKE with an arbitrary number of patients and construct life-expectancy-based edge weights under patient autonomy. Because the patients' health statuses are dynamic, and transplantation surgeries require compatibility between the patientsÕ willingnesses to exchange, we model the patientsÕ transplant timing decisions as a stochastic game in which each patient aims to maximize his/her life expectancy. We explore necessary and sufficient conditions for patients' decisions to be a Nash equilibrium to formulate a mixed-integer linear programming representation of equilibrium constraints. We calibrate our model using large-scale clinical data and empirically confirm that randomized strategies do not yield a social welfare gain over pure strategies. We also quantify the social welfare loss due to patient autonomy and highlight the importance of the disease severity on matching patient-donor pairs.
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Speaker: **Rubén A. Proaño** (Rochester Institute of Technology, rpmeie@rit.edu)
Title: **Automatic prioritization of vaccine initiatives: A multi-objective optimization group decision making approach**
Abstract: New vaccines are difficult to deploy in low- and middle-income countries due to multiple challenges that strain their immunization supply systems. If the importance of these challenges are factored in before these vaccines are developed, it will be possible for other easier-to-deploy vaccines to be considered as better alternatives for development. Ideally, the expert judgment of multiple stakeholders should be used to assess the quantitative and qualitative attributes associated with vaccine prioritization. This talk presents an optimization based approach to automatically rank a list of vaccine initiatives at different developmental stages by a group of decision-makers, who have conflicting priorities and face non-homogenous information.

Speaker: **Turgay Ayer** (Georgia Institute of Technology, `ayer@isye.gatech.edu`)
Title: **Heterogeneity in Women's Adherence and Its Role on Optimal Breast Cancer Screening Policies**
Abstract: Most major health institutions recommend women to undergo repeat mammography screening for early diagnosis of breast cancer, the leading cause of cancer deaths among women worldwide. Although the proportion of women who ever had a mammogram is increasing, there is significant heterogeneity in women's adherence to screening recommendations and a majority of women do not get repeat mammograms. This paper analyzes the role of heterogeneity in women's adherence on optimal mammography screening recommendations. We develop a dynamic modeling framework for breast cancer screening that simultaneously considers heterogeneity with respect to adherence and differences in women's breast cancer risks. We numerically solve this problem using real data based on two main data sources: a) a validated natural history model of breast cancer developed as part of the National Cancer Institute's Cancer Intervention and Surveillance Modeling Network (CISNET) program, and b) published experimental studies in medical and behavioral sciences. Unlike the existing breast cancer screening guidelines that recommend the same screening strategy for all women in the same age group, our results suggest that heterogeneity in women's adherence behaviors and breast cancer risks should be explicitly considered in clinical cancer screening recommendations. In particular, we find that for women who are less likely to adhere and in a higher risk group, more aggressive screening should be recommended; whereas for women who are highly likely to adhere and in a lower risk group, screening recommendations could be less frequent. Our results also shed light on the controversial mammography screening policies and provide managerial insights for the health policy-makers. In that regard, considering that about half of the eligible US women do not adhere to mammography screening recommendations, our findings support promoting aggressive screening recommendations for the general population, such as annual screening over age 40 as recommended by the American Cancer Society.
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3:15pm-4:45pm Parallel session (Track 3 of 3) B013 (1st floor)
Session title: OPTIMIZATION, INFORMATION & COMPLEXITY
Session chair: Eugene Perevalov

Speaker: **Brandon Pope** (Texas A&M University, `brandon_pope@tamu.edu`)
Title: **Decomposition Strategies for Network Management**
Abstract: As networks and their data become increasingly prevalent, opportunities to leverage the structure of networks to harness peer effects also increase. Using a diffusion model of peer influence, we model a network manager's intervention problem as a Markov decision process. Since this MDP is unsolvable for reasonably sized problems, we propose decomposition algorithms inspired by renormalization strategies from the statistical physics literature. In this presentation we study the solution quality and computational reduction of these algorithms.
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Speaker: **Alexander Nikolaev** (State University of New York at Buffalo, `anikolae@buffalo.edu`)
Title: **A Complex Activity Recognition Approach Using Random Graphs**
Abstract: This paper discusses methodologies for representing complex activity. It motivates and focuses on the use of template objects modeled as random graphs. An activity template can be formed by fusing multiple realizations of the activity of a given type; once identified, activity templates can be used as tools for activity recognition. Graph entropy is considered as an objective function in the problem of finding an optimal isomorphism of attributed graphs corresponding to activity realizations. Serving as a distance measure between random graph objects, the entropy can then be used to classify observed activity realization by type.
Coauthor(s): **Michael Stearns**

Speaker: **Soundar Kumara** (Pennsylvania State University, `skumara@psu.edu`)
Title: **Dealing with big data in online social networks' overlapping community detection algorithm**
Abstract: In today's world, social media networks capture interactions among people through comments on blogs, posts and feeds. People tend to have more than one preference making it difficult to put them in a single community and therefore detecting overlapping communities becomes an important issue. In this paper we discuss game theory based community detection algorithm and validate our implementation, by running experiments on some real world on-line social networks. We also focus on selecting the important attributes leading to communities by using entropy based methods.
Coauthor(s): **Yi-Shan Sung** , **Akshay Ghurye** , **Supreet Reddy Mandala**

Speaker: **Eugene Perevalov** (Lehigh University, `eup2@lehigh.edu`)
Title: **Information chain: the missing links**
Abstract: Classical Information Theory can be thought of as a description of the middle link of the full information chain – the link responsible for information transmission. That link is largely independent of the other two which effect the information acquisition and its utilization, respectively. If the acquired information is used for making decisions with a quantitative objective, the theory of the "end links" of the information chain can be developed. We sketch the main ideas and current results of such a development.
Coauthor(s): **David Grace**

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

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

Speaker: **Mark S. Roberts** (University of Pittsburgh, `mroberts@pitt.edu`)
Title: **Pushing the Envelope of Operations Research: Applying Management Science to Optimize Health Care Decisions**
Abstract: Historically, application of operations research in health care has been focused on the process and delivery of care. Viewing health care delivery as a production process, operations research and industrial engineering techniques have been use to optimize operating room and ambulance schedules, eliminate bottlenecks in emergency rooms, and re-organize the delivery of radiological services. There have been some applications in optimizing care; most notable perhaps is the development of algorithms to optimize the delivery of radiation therapy, but these remain rare. Over the past 15 years, we have been applying methods from operations research to optimize the treatment of disease. The preferred methodology in medicine for acquiring this type of knowledge is the randomized controlled trial. However, randomized trials are designed to answer simple questions such as "Is A better than B?" when, in fact, most clinical and policy questions are much more complex, and involve picking the best treatment out of a wide array of possibilities, or understanding under what conditions in A better than B. Answering these types of optimization questions is the purpose of operations research. This talk will describe our efforts to apply operations research techniques to patient care decision and policies, using examples from liver transplantation, HIV care and Cardiology.
