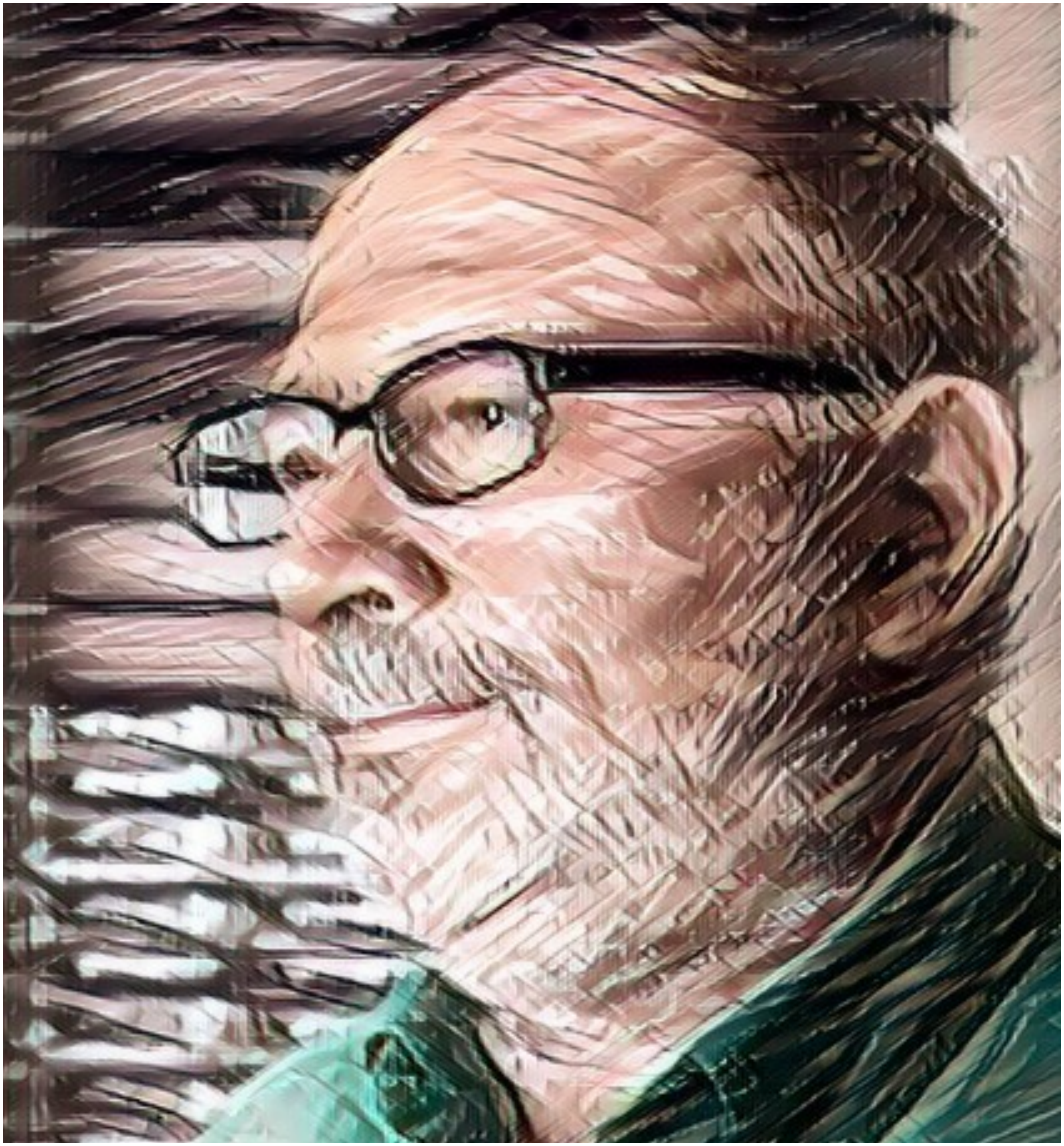

PanOptiC View on Global Optimization

University of Florida
Gainesville, FL
March 9 and 10, 2023

Welcome

Welcome to PanOptiC View of Global Optimization, a conference dedicated to the distinguished career of Professor Panos Pardalos. This workshop has been organized to celebrate the many contributions of Professor Pardalos to the field of global optimization and to recognize his significant impact on the research community, as well as decades of service to the Industrial and Systems Engineering Department at the University of Florida and to the Center for Applied Optimization (CAO).

Throughout his career, Professor Pardalos has made pioneering contributions to global optimization, network science, data science, and their numerous applications. His work has inspired countless researchers to pursue innovative approaches to optimization and data analysis. His contributions have been recognized with numerous awards.

During this workshop, we will have the opportunity to hear from leading experts in global optimization, network science, and related fields, who will present their latest research and share their perspectives on the future of the field.
Keynote talks are given by Professor John Birge, a pioneer in the mathematical modeling of systems under uncertainty and a speaker at the first CAO conference 30 years ago, and by Professor Nick Sahinidis, developer of the renowned BARON computational system for solving optimization problems to global optimality. We will also have the privilege of hearing from Professor Pardalos himself, who will share his insights and reflections on his career and the field in an informal setting.

We hope that this workshop will inspire new collaborations and discoveries in the field of global optimization and beyond, and that it will serve as a fitting tribute to the remarkable career of Professor Pardalos.

Welcome to PanOptiC!

Scientific and Organizing Committees

Scientific Committee

Dr. Sergiy Butenko (Co-Chair)
Professor, Department of Industrial & Systems Engineering, Texas A&M University

Dr. Oleg A. Prokopyev (Co-Chair)
Professor, Department of Industrial Engineering, University of Pittsburgh

Dr. Vladimir Boginski
Professor, Department of Industrial Engineering and Management Systems, University of Central Florida

Dr. Neng Fan
Associate Professor, Department of Systems and Industrial Engineering, University of Arizona

Dr. Qipeng Zheng
Associate Professor, Department of Industrial Engineering and Management Systems, University of Central Florida

Organizing Committee

Dr. Yongpei Guan (Co-Chair)
Professor and Associate Chair of Graduate Studies, Department of Industrial and Systems Engineering, University of Florida

Dr. William Hager (Co-Chair)
Professor, Department of Mathematics, University of Florida

Dr. Aleksandr Kazachkov
Assistant Professor, Department of Industrial and Systems Engineering, University of Florida

Dr. Hongcheng Liu
Assistant Professor, Department of Industrial and Systems Engineering, University of Florida

Dr. Jorge A. Sefair
Associate Professor, Department of Industrial and Systems Engineering, University of Florida

Dr. Alex Semenov
Assistant Research Professor, Department of Industrial and Systems Engineering, University of Florida

Dr. Yu Yang
Assistant Professor, Department of Industrial and Systems Engineering, University of Florida

Anil Kumar Kondapalli
Webmaster, Department of Industrial and Systems Engineering, University of Florida

PanOptiC View on Global Optimization
University of Florida, Gainesville, FL USA
https://www.ise.ufl.edu/panoptic/

Day 1: March 9, 2023

9:00 - 9:10	Opening Remarks	*Reitz Union 2335*
9:10 - 10:00	Keynote 1: John Birge	*Reitz Union 2335*
10:00 - 10:15	Break	

10:15 - 11:45 — Day 1 Session 1

Track 1: Discrete Optimization 1 *Reitz Union 2335* Session Chair: Sergiy Butenko

Authors	*Title*
Sergiy Butenko, Mykyta Makovenko, and Miltiades Pardalos	A Hierarchy of Nonconvex Continuous Reformulations for Discrete Optimization
Vladimir Boginski	Motzkin-Straus Formulation for Maximum Clique Problem: Minimum Potential Energy Interpretation and Extensions
Yu Yang	An Exact Price-Cut-and-Enumerate Method for the Capacitated Multitrip Vehicle Routing Problem with Time Windows

Track 2: Energy Systems 1 *Reitz Union 2325* Session Chair: Qipeng Phil Zheng

Authors	*Title*
Anestis G. Anastasiadis, Alexios Lekidis, Ioannis Pierros, and **Kostas Hrissagis**	Energy cost optimization for multi-carrier systems with energy hubs
Ang Li, Jiming Peng, and **Lei Fan**	Enhanced Optimization Modelling, Theory, and Algorithms for Battery Energy Storage System in Electricity Market
Qipeng Phil Zheng	A Nested Cross Decomposition Algorithm for Power System Capacity Expansion with Multiscale Uncertainties

11:45 - 1:30	Lunch (on your own)

1:30 - 3:00 — Day 1 Session 2

Track 1: Machine Learning *Reitz Union 2335* Session Chair: Hongcheng Liu

Authors	*Title*
Hongcheng Liu	Training generalizable quantized deep neural nets
Petros Xanthopoulos	One class relaxed support vector machine for novelty detection
George Lan	Policy optimization over general state and action spaces

Track 2: Environment and Policy *Reitz Union 2325* Session Chair: Neng Fan

Authors	*Title*
Anna Nagurney, Dana Hassani, Oleg Nivievskyi, and Pavlo Martyshev	Exchange Rates and Multicommodity International Trade: Insights from Spatial Price Equilibrium Modeling with Policy Instruments via Variational Inequalities
Neng Fan	Integrating economic, environmental, and social impacts into optimal design of a biomass supply chain for semi-arid areas
Shiping Mao, Marios Dominikos Kremantzis, **Leonidas Sotirios Kyrgiakos**, and George Vlontzos	R&D Performance Evaluation in the Chinese Food Manufacturing Industry Based on Dynamic DEA in the COVID-19 Era

3:00 - 3:30	Break

3:30 - 5:00 — Day 1 Session 3

Track 1: Optimizing Risk and Uncertainty *Reitz Union 2335* Session Chair: Yu Yang

Authors	*Title*
Pavlo Krokhmal and Masoud Eshghali	Risk Optimization in Networks and Discrete Systems
Haoming Shen and **Ruiwei Jiang**	Value of Stochastic Solution with Right-Hand Side Uncertainty
Yiling Zhang	Integer programming approach for distributionally robust chance constraints with adjustable risk

Track 2: Networks *Reitz Union 2325* Session Chair: Vladimir Boginski

Authors	*Title*
Clayton Commander, Arsenios Tsokas, and Panos Pardalos	Modeling Practice Efficiency Using Social Network Analysis
Faraz Khoshbakhtian, Hamidreza Validi, Mario Ventresca, **Dionne Aleman**, Randy Giffen, and Proton Rahman	Distance-based critical node detection for effective vaccine policies
Yajun Lu, Zhuqi Miao, Parisa Sahraeian, and **Baski Balasundaram**	On Atomic Cliques in Temporal Graphs

5:00 - 5:15	Group Photo	*Reitz Union 2335*
5:15 - 6:15	Posters	*Arredondo Café*
6:30 - 8:30	**Conference Dinner**	*Arredondo Café*

Day 2: March 10, 2023

9:00 - 10:30 — Day 2 Session 1

Track 1: Discrete Optimization 2 *Reitz Union 2335* Session Chair: Bill Hager

Authors	*Title*
Alla Kammerdiner, Alexander Semenov, and Eduardo Pasiliao	The variable neighborhood search algorithms for the multidimensional assignment problem
Ilias Kotsireas	Optimization and metaheuristic perspectives in hard combinatorial problems
Yi Zhang and Nick Sahinidis	Solving Continuous and Discrete Nonlinear Programs with BARON

Track 2: Scheduling and Supply Chain *Reitz Union 2325* Session Chair: Jorge Sefair

Authors	*Title*
Erhun Kundakcioglu	Select, Schedule, and Route Foster Care Visitation
Chrysafis Vogiatzis	Identifying interface points in illicit supply chains
Juan Manuel Restrepo-Florez, Christos Maravelias, and David Rothamer	A superstructure based optimization framework for the design of advanced biofuels

10:30 - 10:45	Break
10:45 - 11:35	Keynote 2: Nick Sahinidis *Reitz Union 2335*
11:35 - 1:30	Lunch (on your own)

1:30 - 3:00 — Day 2 Session 2

Track 1: Multilevel Optimization *Reitz Union 2335* Session Chair: Oleg Prokopyev

Authors	*Title*
Oleg Prokopyev, Jourdain Lamperski, and Luca Wrabetz	Min-max-min Optimization with Smooth and Strongly Convex Objectives
Evren Mert Turan, Johannes Jaeschke, and **Rohit Kannan**	Improved discretization based lower bounding methods for semi-infinite programming
Maude Josee Blondin	Decentralized optimization algorithm for multiagent systems with weighted priorities

Track 2: Energy Systems 2 *Reitz Union 2325* Session Chair: Yongpei Guan

Authors	*Title*
Burak Eksioglu	Energy Savings through Platooning in Connected and Autonomous Vehicles
Mariana Resener	Optimization in Electric Power Distribution Systems: Challenges and Opportunities
Nomanullah Nomanullah and **Mujahid Syed**	Multi-Objective Optimization of District Cooling System

3:00 - 3:30	Break

3:30- 5:00 — Day 2 Session 3

Track 1: Global Optimization *Reitz Union 2335* Session Chair: Bill Hager

Authors	*Title*
William Trevena, **Alexander Semenov**, Michael Hirsch, Panos Pardalos, and Ilias Kotsireas	Solving Large Systems of Nonlinear Equations with Global Optimization in the Cloud
Rohit Kannan, **Harsha Nagarajan**, and Deepjyoti Deka	Learning to Accelerate Partitioning Algorithms for the Global Optimization of Nonconvex Quadratically-Constrained Quadratic Programs
Steve Huntsman	Parallel black-box optimization of expensive high-dimensional multimodal functions via magnitude

Track 2: Applied Optimization *Reitz Union 2325* Session Chair: Aleksandr Kazachkov

Authors	*Title*
Andrew Murray, **Ashwin Arulselvan**, Michael Cashmore, and Swarup Mohalik	Datacenter Optimisation for 5G Slicing via Column Generation
Mohammed Al Saafin, Mujahid Syed, Uthman Baroudi, and Anas Al-Ghazi	Location Privacy Preservation Mathematical Model for the Sink Node Anonymity in Wireless Sensor Networks
Stan Uryasev and Cheng Peng	Estimation of Conditional Distributions with Factor Model of Mixtures

Keynote Speakers

<u>Keynote (March 9):</u> *9:10 – 10:00 (Reitz Union 2335)*

Dr. John R. Birge, Hobart W. Williams Distinguished Service Professor of Operations Management, Booth School of Business, University of Chicago.

Title: Optimization and Estimation in High Dimensions

Abstract: Many decision models involve both parameter estimation and optimization over a set of decision variables. Asymptotic properties of the estimators are often used to justify a model's validity, but these results may not be applicable in high dimensions. This talk will discuss the potential bias that arises in these optimization settings and potential approaches to remove this bias in high-dimensional models.

<u>Keynote (March 10):</u> *10:45 – 11:35 (Reitz Union 2335)*

Dr. Nick Sahinidis, Gary C. Butler Family Chair and Professor, The H. Milton Stewart School of Industrial and Systems Engineering, Georgia Tech

Title: Global black-box optimization.

Abstract: This talk presents a new optimization algorithm for black-box optimization problems for which optimization must be performed in the absence of an algebraic formulation, i.e., by utilizing only data originating from simulations or experiments. Our approach combines model-based search with a dynamic domain partition strategy that guarantees convergence to a global optimum. Equipped with a clustering algorithm for balancing global and local search, the proposed approach outperforms existing derivative-free optimization algorithms on a large collection of problems.

Day 1: March 9, 2023

Session	Track 1 (Reitz Union 2335)	Track 2 (Reitz Union 2325)
Session 1 (10:15 – 11:45)	Discrete Optimization 1	Energy Systems 1
Session 2 (1:30 – 3:00)	Machine Learning	Environment and Policy
Session 3 (3:30 – 5:00)	Optimizing Risk and Uncertainty	Networks

Opening Remarks: *9:00 – 9:10 (Reitz Union 2335)*

Keynote: *9:10 – 10:00 (Reitz Union 2335)*

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Break: *10:00-10:15*

Day 1: March 9, 2023

Session 1: *10:15 – 11:45*

Track 1: Discrete Optimization 1 (Reitz Union 2335)

Session Chair: Sergiy Butenko

Sergiy Butenko, Mykyta Makovenko, and Miltiades Pardalos	**Title**: A Hierarchy of Nonconvex Continuous Reformulations for Discrete Optimization **Abstract**: In this talk we discuss risk-averse stochastic optimization in discrete systems, such as networks or graphs. In particular, we consider identification of minimum-risk structures in graphs with random vertex or edge weights. The risk aversity is facilitated by employing a family of certainty equivalent coherent/convex measures of risk, resulting in mixed-integer conic programming with nonsymmetric cones. A connection of this framework to determining the systemic risk of a networked system is discussed. In addition, the discrete setting allows us to obtain new insights into the interplay of risk reduction and diversification, the staple strategy in risk management. A graph-based combinatorial branch-and-bound solution scheme is proposed, where the bounding step is performed using polyhedral approximations. Numerical experiments and case studies are presented.
Vladimir Boginski	**Title**: Motzkin-Straus Formulation for Maximum Clique Problem: Minimum Potential Energy Interpretation and Extensions **Abstract**: The Motzkin-Straus formulation for the maximum clique problem provides a nontrivial characterization of the clique number of a graph in terms of the maximum value of a nonconvex quadratic function over a standard simplex. It was originally developed as a way of proving Turán's theorem in graph theory but was later used to develop competitive algorithms for the maximum clique problem based on continuous optimization. It is widely regarded as a very important albeit somewhat non-intuitive result. In this presentation, we introduce the concept of "gravitational" potential energy in the context of networks and investigate its implications for interpreting maximum cliques and Motzkin-Straus formulation from a physics perspective. We treat the nodes of a graph as "particles" with masses and consider the Newtonian potential energy of gravitational interactions between them. We prove that the maximum clique in a graph represents the minimum gravitational potential energy structure. This yields an intuitive physics-based interpretation of the Motzkin-Strauss formulation as the problem of minimizing the Newtonian gravitational potential energy in a graph under certain assumptions. At the end of the presentation, we also mention recent results on extending the Motzkin-Straus formulation to optimization problems on clique relaxations (namely, maximum s-defective clique and maximum s-plex), which relax the concept of a clique by allowing missing edges.
Yu Yang	**Title**: An Exact Price-Cut-and-Enumerate Method for the Capacitated Multitrip Vehicle Routing Problem with Time Windows **Abstract**: We consider the capacitated multitrip vehicle routing problem with time windows (CMTVRPTW), where vehicles are allowed to make multiple trips. The ability to perform multiple trips is necessary for some real-world applications where the vehicle capacity, the trip duration, or the number of drivers or vehicles is limited. However, it substantially increases the solution difficulty in view of the additional trip scheduling aspect. We propose an exact price-cut-and-enumerate method (EPCEM) that solves a novel superstructure-based formulation inspired by Paradiso et al. (2020). The EPCEM obtains a tight lower bound by an alternating column and row generation method and computes a valid upper bound in the early stage of the algorithm. It obtains an optimal solution and further proves its optimality by a new multiphase sift-and-cut method. Computationally, the EPCEM significantly outperforms the state-of-the-art exact method that only proves optimality for 9 of the 27 test instances with 50 customers. In particular, the EPCEM solves all test instances with up to 70 customers to optimality for the first time and obtains near-optimal solutions with an average optimality gap of no more than 0.3% for instances with 80 to 100 customers. From a practical point of view, solving the CMTVRPTW by the EPCEM yields a solution that, on average, uses at least 45% fewer vehicles and increases the travel cost by no more than 7% compared with the solution to the standard CVRPTW.

Day 1: March 9, 2023

<u>Session 1:</u> *10:15 – 11:45*

Track 2: Energy Systems 1 (Reitz Union 2325)

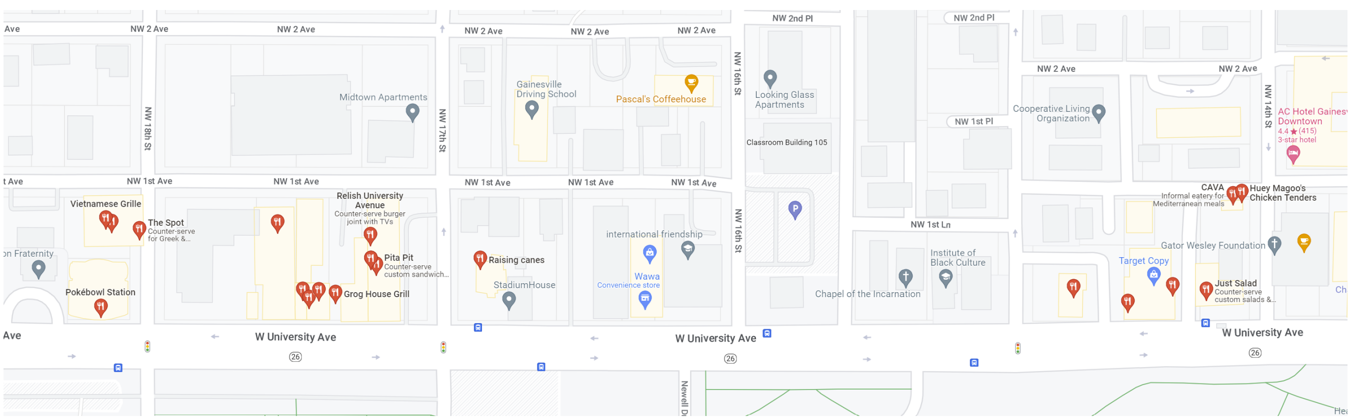
Session Chair: Qipeng Phil Zheng

Anestis G. Anastasiadis, Alexios Lekidis, Ioannis Pierros and Kostas Hrissagis	**Title**: Energy cost optimization for multi-carrier systems with energy hubs **Abstract**: For many decades energy carrier infrastructures, such as the electricity and natural gas networks, were developed and operated separately. However, recent research directions shifted the focus towards the analysis of an integrated multi-carrier architecture for energy systems instead of separating the different energy carriers. Hence, a new approach coupling electrical, chemical, and heating carriers has emerged and fundamental entities that are contributing in it are the energy hubs. Energy hubs are interconnected systems which include the input and the output from different energy carriers as well as the conversion and storage from them. Moreover, they are equipped with Combined Heat and Power (CHP) units, which are much more efficient and adequately friendlier to the environment than the conventional thermic units. Furthermore, CHPs allow bigger flexibility in the use of electricity, natural gas as well as other energy carriers and thus offer comparative advantages in contrast to the traditional load supply methods. This paper analyses the steady-state model of energy hubs as well as all the underlying optimization problems, which concern the multi-carrier optimal dispatch, the optimal hub coupling and the optimal hub layout for an energy system. As an outcome, this work aims at the optimization of the overall energy cost of the system, whilst ensuring that all the system constraints remain satisfied. The experiments demonstrate that the introduction of an energy hub in an existing microgrid provides significant benefits in the current energy infrastructures as well as provide proof that the interconnected architecture of energy hubs can serve as the base for the development of future energy systems.
Ang Li, Jiming Peng and Lei Fan	**Title**: Enhanced Optimization Modelling, Theory, and Algorithms for Battery Energy Storage System in Electricity Market **Abstract**: Due to its decreasing capital cost, high flexibility and short response time, the BESS has been playing a more and more important role in maintaining the balance between electricity production and consumption in the operations of modern power grids. However, most existing BESS optimization models have highly nonlinear and non-convex objective function/constraints that are difficult to handle. In a recent work, we proposed a novel voltage (V) current (I) arbitrage model (VIAM) for BESS control where we use some linear function to approximate the dependency function between the open circuit voltage and the battery status (OCVDF). This leads to the so-called linearly constrained exponential optimization model (LCEO). Though an effective algorithm is proposed for the LCEO model, it is unclear whether the obtained solution is a global optimal solution to the underlying LCEO model. Moreover, we also observe in experiments that, the usage of an linearized OCVDF in the VIAM usually incurs certain profit loss. In this paper, we discuss how to address the above two issues. For this, we first introduce a new reformulation to recast the VIAM as a biconvex optimization problem (BCO). Then, we show that the BCO with linear OCVDF and linear constraints (LCBCO) can be reduced to convex optimization under certain conditions on the OCVDF and the price dynamics, and thus the global optimal solutions to both the LCEO and the LCBCO models can be located effectively. We also introduce a new scheme to approximate the original nonlinear OCVDF using piece-wise linear and quadratic functions, and the new scheme does not involve integer variables. This leads to a quadratically constrained biconvex optimization model (QCBCO). A novel sequential dynamic linear/quadratic approximation algorithm (SDLQP) is developed for the QCBCO model and its convergence is established. Preliminary experiments are conducted to demonstrate the efficacy of the new model and the efficiency of the proposed algorithm.

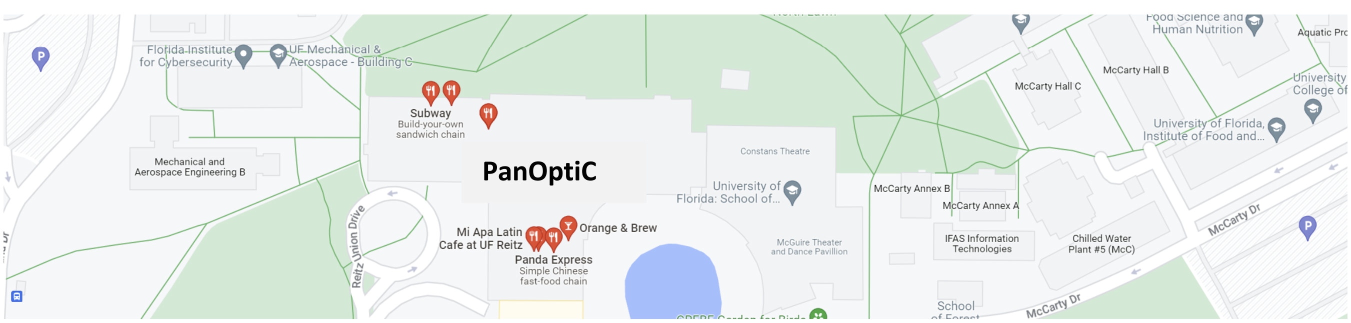
Qipeng Phil Zheng	**Title**: A Nested Cross Decomposition Algorithm for Power System Capacity Expansion with Multiscale Uncertainties **Abstract**: Modern electric power systems have witnessed rapidly increasing penetration of renewable energy, storage, electrical vehicles, and various demand response resources. The electric infrastructure planning is thus facingmore challenges as a result of the variability and uncertainties arising from the diverse new resources. This study aims to develop a multistage and multiscale stochastic mixed integer programming (MM-SMIP) model to capture both the coarse-temporal-scale uncertainties, such as investment cost and long-run demand stochasticity, and fine-temporal-scale uncertainties, such as hourly renewable energy output and electricity demand uncertainties, for the power system capacity expansion problem. To be applied to a real power system, the resulting model will lead to extremely large-scale mixed integer programming problems, which suffer not only the well-known curse of dimensionality but also computational difficulties with a vast number of integer variables at each stage. In addressing such challenges associated with the MM-SMIP model, we propose a nested cross decomposition algorithm that consists of two layers of decomposition—that is, the Dantzig–Wolfe decomposition and L-shaped decomposition. The algorithm exhibits promising computational performance under our numerical study and is especially amenable to parallel computing, which will also be demonstrated through the computational results.

<u>Lunch break:</u> *11:45 – 1:30*

- Dining Options on University Av. (~15min walk)



- Dining Options on Campus.



Day 1: March 9, 2023

Session 2: *1:30 – 3:00*

Track 1: Machine Learning (Reitz Union 2335)

Session Chair: Hongcheng Liu

Hongcheng Liu	**Title**: Training generalizable quantized deep neural nets **Abstract**: While a number of practical methods for training quantized DL models have been presented in the literature, there exists a critical gap in the theoretical generalizability results for such approaches. Although empirical evidence often suggests a high tolerance of DL architectures to variations of training procedures, existing theoretical generalization analyses are often contingent on the specific designs of training algorithms, e.g., in stochastic gradient descent (SGD). This specialization makes such generalizability results inapplicable to the case of quantized DL models. In view of this critical vacuum, this paper provides several almost-algorithm-independent results to ensure the generalizability of a quantized neural network at different levels of optimality. These results include the characterizations of a computable, quantized local solution that ensures the generalization performance and an algorithm that is provably convergent to such a local solution.
Petros Xanthopoulos	**Title**: One class relaxed support vector machine for novelty detection **Abstract**: One class classification or novelty detection is the special case of classification problems where the classifier is trained exclusively with examples from one class. This has application for classification of rare events such as catastrophic damages where collection of minority class data is pretty much impossible. One of the most common approaches for this problem is support vector one class classification. In this talk, along these lines, we present a support vector approach with constraint relaxation aimed to alleviate the effect of outliers in the training data. This approach has been used before for imbalanced class classification and support vector regression with promising results especially in the presence of data anomalies.
George Lan	**Title**: Policy optimization over general state and action spaces **Abstract**: Reinforcement learning (RL) problems over general state and action spaces are notoriously challenging. In contrast to the tableau setting, one can not enumerate all the states and then iteratively update the policies for each state. This prevents the application of many well-studied RL methods especially those with provable convergence guarantees. In this talk, we first present a substantial generalization of the recently developed policy mirror descent method to deal with general state and action spaces. We introduce new approaches to incorporate function approximation into this method, so that we do not need to use explicit policy parameterization at all. Moreover, we present a novel policy dual averaging method for which possibly simpler function approximation techniques can be applied. We establish linear convergence rate to global optimality or sublinear convergence to stationarity for these methods applied to solve different classes of RL problems under exact policy evaluation. We then define proper notions of the approximation errors for policy evaluation and investigate their impact on the convergence of these methods applied to general-state RL problems with either finite-action or continuous-action spaces. To the best of our knowledge, the development of these algorithmic frameworks as well as their convergence analysis appear to be new in the literature.

Day 1: March 9, 2023

<u>Session 2:</u> *1:30 – 3:00*

Track 2: Environment and Policy (Reitz Union 2325)

Session Chair: Neng Fan

Anna Nagurney, Dana Hassani, Oleg Nivievskyi and Pavlo Martyshev	**Title**: Exchange Rates and Multicommodity International Trade: Insights from Spatial Price Equilibrium Modeling with Policy Instruments via Variational Inequalities **Abstract**: In this paper, we construct a multicommodity international trade spatial price equilibrium model of special relevance to agriculture in which exchange rates are included along with policy instruments in the form of tariffs, subsidies as well as quotas. The model allows for multiple trade routes between country origin nodes and country destination nodes and these trade routes can include different modes of transportation and transport through distinct countries. We capture the impacts of exchange rates through the definition of effective path costs and identify the governing multicommodity international trade spatial price equilibrium conditions, which are then formulated as a variational inequality problem in product path flows. Existence results are established and a computational procedure presented. The illustrative numerical examples and a case study are inspired by the impacts of the war against Ukraine on agricultural trade flows and product prices. The modeling and algorithmic framework allows for the quantification of the impacts of exchange rates and various trade policies, as well as the addition or deletion of supply markets, demand markets and/or routes, on supply and demand market prices in local currencies, and on the volume of product trade flows with implications for food security.
Neng Fan	**Title**: Integrating economic, environmental, and social impacts into optimal design of a biomass supply chain for semi-arid areas **Abstract**: Scarce water resources have made crop production as a key management decision in the agriculture sector, especially in arid and semi-arid regions. In this talk, optimization approaches are applied to design sustainable biomass supply chains, from field production planning, harvesting scheduling, process facility location, transportation, to machinery scheduling, with the consideration of economic benefits, environmental and social impacts. The whole supply chain involves of three major decision support modules, and each of them is modeled through an advanced optimization model through stochastic, multi-objective or large-scale optimization. The proposed methods are studied for two low-water-use crops which have great potential for the agricultural economy of the Southwestern America, with the analysis on their economic, environmental, and social impacts of the semi-arid areas.
Shiping Mao, Marios Dominikos Kremantzis, Leonidas Sotirios Kyrgiakos and George Vlontzos	**Title**: R&D Performance Evaluation in the Chinese Food Manufacturing Industry Based on Dynamic DEA in the COVID-19 Era **Abstract**: Nowadays, China's food consumption structure is shifting from being survival-oriented to health-oriented. However, the food industry is still facing a research and development (R&D) dilemma. Scientific evaluation of an enterprise's R&D performance can help to reduce the investment risk of R&D and promote economic benefits. This study implements the dynamic data envelopment analysis (DDEA) technique to measure and evaluate the level of R&D performance in the Chinese food manufacturing industry. Twenty-eight listed companies were selected for the study, considering the time period from 2019 to 2021. After constructing a system of inputs, outputs and carry-over indicators, overall and period efficiency scores were obtained. The results reveal that the overall level of R&D in the industry is relatively low (0.332). Average efficiency scores across years were estimated as 0.447, 0.460, 0.430 for 2019, 2020, and 2021, respectively. Lastly, this study considers the actual business situation of the industry and makes suggestions for improvement from the perspective of enterprises and the government; these anticipate aiding the food manufacturing industry to improve the performance management of R&D activities.

Day 1: March 9, 2023

<u>Break:</u> *3:00 – 3:30*

<u>Session 3:</u> 3*:30 – 5:00*

Track 1: Optimizing Risk and Uncertainty (Reitz Union 2335)

Session Chair: Yu Yang

Pavlo Krokhmal and Masoud Eshghali	**Title**: Risk Optimization in Networks and Discrete Systems **Abstract**: In this talk we discuss risk-averse stochastic optimization in discrete systems, such as networks or graphs. In particular, we consider identification of minimum-risk structures in graphs with random vertex or edge weights. The risk aversity is facilitated by employing a family of certainty equivalent coherent/convex measures of risk, resulting in mixed-integer conic programming with nonsymmetric cones. A connection of this framework to determining the systemic risk of a networked system is discussed. In addition, the discrete setting allows us to obtain new insights into the interplay of risk reduction and diversification, the staple strategy in risk management. A graph-based combinatorial branch-and-bound solution scheme is proposed, where the bounding step is performed using polyhedral approximations. Numerical experiments and case studies are presented.
Haoming Shen and Ruiwei Jiang	**Title**: Value of Stochastic Solution with Right-Hand Side Uncertainty **Abstract**: We revisit the value of stochastic solution (VSS) in the context of distributional ambiguity. When the uncertainty arises from the right-hand side of a two-stage stochastic program, we consider upper and lower bounds of VSS using distributionally robust and optimistic optimization. We discuss the computation of these bounds and demonstrate them through numerical examples.
Yiling Zhang	**Title**: Integer Programming Approaches for Distributionally Robust Chance Constraints with Adjustable Risk **Abstract**: We study distributionally robust chance constrained programs (DRCCPs) with individual chance constraints and random right-hand sides. The DRCCPs treat the risk tolerances/reliability level associated with the distributionally robust chance constraints (DRCCs) as decision variables to trade off between the (operational) cost and risk of violations by penalizing the risk tolerances in the objective function. We consider two types of Wasserstein ambiguity sets: with finite distributions and with continuous distributions. By exploring the hidden discrete structures, we develop mixed integer programming reformulations for the two types of ambiguity sets to determine an optimal risk tolerance for each chance constraint. Valid inequalities are derived to strengthen the formulations. We test instances with diverse sizes of transportation problems and a demand management problem with real-world data.

Day 1: March 9, 2023

Break: *3:00 – 3:30*

Session 3: 3*:30 – 5:00*

Track 2: Networks (Reitz Union 2325)

Session Chair: Vladimir Boginski

Clayton Commander, Arsenios Tsokas and Panos Pardalos	**Title**: Modeling Practice Efficiency Using Social Network Analysis **Abstract**: PURPOSE: To review concepts from social network analysis with a case study modelling a prototypical hospital-based vascular and interventional radiology (VIR) practice and examine various efficiency metrics and complexity measures. MATERIALS AND METHODS: A graph representing a snapshot of a VIR service at a large academic medical center was constructed where healthcare workers and patients were represented as nodes and flow of information as links between the nodes. Measures of connectivity, "node importance" and vulnerability were calculated using techniques from social network analysis. RESULTS: The network consisted of 47 nodes including 23 VIR staff including physicians, fellows, residents, nurses, and technologists. The remaining nodes represented patients, consulting physicians, inpatient nurses, anesthesia staff, and the patient transport service. There were 215 edges (links) in the graph. The longest line of communication between any two nodes was 4 edges. Across multiple measures, the most important nodes in the graph included the VIR procedure coordinator who assigns cases to rooms, the hospital transport service, the attending VIR in charge for the day as well as the inpatient consultant and outpatient IR provider. CONCLUSION: Organizational vulnerabilities, redundancies, and complexity can be identified using mathematical modelling techniques and social network analysis. This allows for efficient operations and the ability to simulate and plan for unexpected changes to the network infrastructure.
Faraz Khoshbakhtian, Hamidreza Validi, Mario Ventresca, Dionne Aleman, Randy Giffen and Proton Rahman	**Title**: Distance-based critical node detection for effective vaccine policies **Abstract**: Vaccinations are one of the most effective mitigation tools for a long-term solution to infectious disease control. We study the formulation of effective vaccination policies under budget constraints as a distance-based critical node detection (DCNDP) problem. DCNDP involves the selection of a subset of nodes in a network whose removal maximally degrades a pre-defined distance-based metric of connectivity. We implement a novel framework that combines state-of-the-art pandemic modeling and mathematical optimization to derive actionable vaccination policies. Our novel DCNDP optimization approach combines degree-based heuristics and exact integer programming formulations to find near-optimal solutions to networks with hundreds of thousands of nodes. We specifically examine networks of the entire population of Newfoundland & Labrador (Canada) to control COVID spread.
Yajun Lu, Zhuqi Miao, Parisa Sahraeian and Baski Balasundaram	**Title**: On Atomic Cliques in Temporal Graphs **Abstract**: Atomic cliques were introduced recently to analyze comorbidity graphs that vary over time. We consider the atomic counterpart of the classical maximum clique problem in this paper. Our main contribution is a polynomial-time algorithm that transforms the maximum atomic clique problem to the maximum clique problem on an auxiliary graph. We report results from our computational studies that demonstrate the effectiveness of this transformation in solving the maximum atomic clique problem in comparison to direct integer programming based approaches.

Day 1: March 9, 2023

<u>Group Photo</u>: 5:00 – 5:15 (Reitz Union 2335)

<u>Poster Session</u>: 5:15 – 6:15 (Arredondo Café – Reitz Union Level 4)

Parisa Vaghfi Mohebbi, Yajun Lu, Zhuqi Miao and Baski Balasundaram	**Title**: Maximum Mortality Rate Clique in Disease Comorbidity Networks **Abstract**: This poster presents our ongoing work on finding a fixed-size clique representing a cluster of diseases with a high incidence of comorbidity that corresponds to the maximum mortality rate (MMR) among a given patient population. The MMR is defined as the fraction of expired patients correlating to the cluster of diseases among patients who had all diseases represented by the clique. The mathematical optimization formulation of this problem involves maximizing a single fractional objective function subject to linear constraints in binary variables. We describe our current linearization and reformulation approaches to solve this problem using mixed-integer programming techniques. We present our preliminary results on large-scale patient electronic health records.
Weihang Ren and Yongpei Guan	**Title:** Battery Bidding Strategy under Uncertainty Considering Market Practical Situations **Abstract:** Storing off-peak electricity and supplying for peak demand is advantageous in terms of energy production, social impact, and environmental preservation. The potential gain from the bidding spread for the battery owner motivates multiple methods of energy storage. Furthermore, different market conditions will result in unpredictable energy allocation based on energy production level. In this paper, we use stochastic programming to investigate optimized bidding methods under market uncertainty. From the standpoint of a battery owner, we create efficient algorithms to generate strategies for three common energy market settings. We present one-time validation for our proposed strategies in each market setting, as well as an analysis of the structural feature of each strategy that reveals the underlying logic. The numerical experiments demonstrate the empirical performance of our solutions and provide context for our findings.
Marwen Elkamel and Luis Rabelo	**Title**: Agent Based Simulation, Supply Chain Optimization, and Micro-Grid Electricity Generation of Collaborating Urban Farms: Towards Increasing Food Security, Minimizing Food Wastage, and Reducing CO2 emissions **Abstract**: An agent-based modeling framework is developed and employed to replicate the interactions that occur among urban farms. The objectives are to efficiently manage food, energy and water resources at urban farms, decrease food waste and increase food availability for the local community. A case study of eleven farms is investigated in the city of Vancouver, Canada, to study the linkages that occur between resources in the urban food, energy, water nexus. Each urban farm in the simulation belongs to a community microgrid generating electricity from solar and wind. Local farms have a goal of providing fresh produce for their respective local communities, however at some points, they may lack supply, and at other points, there is excess supply, leading to food waste. Food waste can be converted into fertilizers or bioenergy, however due to the natural resources required for production, the objective of efficiently managing resources, and adhering to sustainability guidelines, an alternative solution needs to be employed. In this paper, an optimization framework is integrated within the agent-based model to create a micro supply chain. The micro supply chain directly links producers with consumers, by severing the links involved in a traditional food supply. Each urban farm in the study collaborates in order to reduce food wastage and meet consumer demands, establishing farmer to farmer exchange, or transitional agriculture. The optimization based micro supply chains aims to minimize costs and looks to meet equilibrium between food supply and demand. Through regular communication between farms, food wastage is reduced across the farms by 96.9% over a 16-week period, and fresh food availability is increased for the local community as exemplified by consumer purchases over the same period. Moreover, the simulation results indicate that renewable energy generation at the community microgrids was beneficial by avoiding 17,542 tonnes of CO2 based on the electricity profile of Vancouver, trough the generation of 22,774 Mwh from solar and 2,568 Mwh from wind.

Hongcheng Liu and Jindong Tong	**Title**: Traffic network design mechanism based on sparsity-inducing zeroth-order methods **Abstract**: This research presents a novel traffic network design mechanism based on sparsity-inducing zeroth-order methods. The mechanism employs an optimization algorithm that utilizes sparsity-inducing regularization to select a small number of the most effective control variables in the traffic network model to maximally promote the performance of the network. The algorithm is a combination of zeroth-order optimization and sparsity-encouraging variation of the Euclidean projection. The zeroth-order nature of the approach allows the proposed mechanism to be completely free from potential misspecifications in the chosen underlying traffic model. The proposed mechanism is evaluated using several case studies of a realistically sized traffic networks and the results demonstrate the effectiveness in enhancing traffic management approaches such as congestion tolls. The proposed mechanism has the potential to significantly improve traffic flow and reduce congestion in real-world traffic networks while also being more computationally efficient and scalable.
Tan Yu, Xiang Zhong and Yongpei Guan	**Title**: Visiting Nurses Assignment and Routing for Hybrid Telehealth Service Networks **Abstract**: As telehealth utilization for office visits and home-based care skyrockets, there has been a paradigm shift to a decentralized care delivery modality integrating both in-person and telehealth services provided at different layers of the care delivery network, i.e., a central hospital, satellite clinics, and patient homes. The operations of such decentralized care delivery need to take into consideration patients' preferences and satisfaction and rely on multiple types of nurses who can support and facilitate telehealth with physicians in clinics and patient homes. Precise decisions regarding the type of care delivered, the location of care delivered, and the scheduling of all kinds of healthcare nurses have a significant impact on the efficiency and effectiveness of this hybrid telehealth system. Therefore, we formulate an optimization problem to simultaneously satisfy patients' care needs and reduce operating costs. We propose a bi-level approximation that exploits the structure of the hybrid telehealth system and develops column generation-based approaches to identify the decision rules for clinic selection and nurse scheduling. We compare the performance and overall solution efficiency of traditional branch-and-price, global heuristic, and bi-level approximation algorithms. Our numerical study results demonstrate that there exist opportunities for the healthcare provider to significantly reduce the total operating cost of their services by integrating scheduling and routing decisions while reducing patients' travel time and burden, and the proposed bi-level approximation is applicable to provide good performance even with a large patient instance.

Conference Dinner: 6:30 – 8:30 (Arredondo Café – Reitz Union Level 4)

Day 2: March 10, 2023

Session	Track 1 (Reitz Union 2335)	Track 2 (Reitz Union 2325)
Session 1 (9:00 – 10:30)	Discrete Optimization 2	Scheduling and Supply Chain
Session 2 (1:30 – 3:00)	Multilevel Optimization	Energy Systems 2
Session 3 (3:30 – 5:00)	Global Optimization	Applied Optimization

Session 1: *9:00 – 10:30*

Track 1: Discrete Optimization 2 (Reitz Union 2335)

Session Chair: Bill Hager

Alla Kammerdiner, Alexander Semenov and Eduardo Pasiliao	**Title**: The variable neighborhood search algorithms for the multidimensional assignment problem **Abstract**: Variable neighborhood search (VNS) is a powerful metaheuristic method for solving global optimization and combinatorial optimization problems. We apply this metaheuristic to randomly generated instances of the multidimensional assignment problem (MAP). This computationally challenging problem has numerous important applications, including target tracking, particle physics, multipartite entity resolution, and fall detection. We formulate and investigate several novel VNS variants for the MAP. We perform a battery of numerical experiments on the problem instances of various sizes to systematically compare new VNS schemes to the only two other existing VNS algorithms for the MAP, to the Greedy algorithm for the large-scale MAP, and to the state-of-the-art genetic algorithms for the MAP. Our results show that the new VNS can outperform the existing heuristic approaches for solving this NP-hard problem.
Ilias Kotsireas	**Title**: Optimization and metaheuristic perspectives in hard combinatorial problems **Abstract**: We will survey a wide spectrum of optimization and metaheuristic perspectives that we contributed in a series of joint publications and a book co-authored with Panos M. Pardalos, in the context of exceedingly hard combinatorial problems. The cross-fertilization of these research areas, allowed us to solve some long-standing combinatorial conjectures and also pave the way for next generations of researchers to continue to produce new results. Some of our perspectives and associated formulations of combinatorial problems, can be used in the context of quantum computing, which is another future promising avenue/direction of investigation.
Yi Zhang and Nick Sahinidis	**Title**: Solving Continuous and Discrete Nonlinear Programs with BARON **Abstract**: Under development since the early 1990s, BARON has become a highly robust and efficient computational system for solving nonconvex optimization problems to global optimality. This work discusses key features that were introduced to BARON recently, including continuous and discrete relaxations, linear and nonlinear presolve methods, enhanced branching algorithms and heuristics, and various robustness enhancements. A systematic computational comparison on benchmark libraries is presented among various global codes for nonlinear and mixed-integer nonlinear programs. The results demonstrate the benefits from the newly added algorithmic facilities.

Day 2: March 10, 2023

Session 1: *9:00 – 10:30*

Track 2: Scheduling and Supply Chains (Reitz Union 2325)

Session Chair: Jorge A. Sefair

Erhun Kundakcioglu	**Title**: Select, Schedule, and Route Foster Care Visitation **Abstract**: Agencies charged with ensuring foster children regularly visit biological parents can be challenging to accommodate given fixed workforce levels and fluctuating caseloads. We introduce the Foster Care Visitation Scheduling Problem to assign, schedule, and route workers to foster children. We develop a two-phased network-based optimization approach, that 1) preprocesses and pre-computes a time-space network structure, and 2) solves a large-scale integer optimization problem over this network. Our approach improves the consistency of visits and quality of life for foster children, while assisting foster care organizations to better operationalize their resources. We discuss computational experiments on a variety of instances inspired by real data from New York State that reveal encouraging computational performance.
Chrysafis Vogiatzis	**Title**: Identifying interface points in illicit supply chains **Abstract**: In this talk, we present a novel network optimization problem in the context of illicit supply chains. The rapid market growth of illicit trade in the last years can be attributed to their hidden, yet effective, structure. This work proposes a network analytic approach for investigating the composition of illicit supply networks using limited information. First, we propose the construction of a large, broad network of entities that could potentially participate in the illicit supply chain through the unification of alternate bills-of-materials, leading to a network representation. Then, we propose a new optimization problem (a variant to the well-known Steiner Tree Problem, referred to as the Generalized Group Steiner Tree Problem) to identify effective supply chain structures that illicit traders are likely to employ. Dissimilarity is another key contribution; focusing only on the most effective structures produces supply chains that disproportionally choose cheaper producers/suppliers. On the other hand, a set of effective and dissimilar structures proves more useful in identifying key producers/suppliers that illicit traders may use. We finish this talk with a semi-real case study using openly available data for footwear.
Juan Manuel Restrepo-Florez, Christos Maravelias and David Rothamer	**Title**: A Superstructure based optimization framework for the design of advanced biofuels **Abstract**: The consumption of liquid transportation fuels in the U.S. is close to 16 billion gallons per year, accounting for 28% of the country's greenhouse gas emissions. The development of sustainable biofuels, particularly those derived from lignocellulosic materials has been identified as an alternative for the mitigation of the negative impacts of uncontrolled fossil fuel consumption. However, most available biofuels have limited fungibility. This limitation has prompted the search for alternative biofuels with better fungibility. A promising platform to achieve this goal relies on the upgrading of ethanol. This platform offers three main advantages: (1) it can use the existing infrastructure for ethanol manufacture; (2) it can produce fuels in the whole distillation spectrum, from gasoline to diesel; and (3) it offers the possibility of using the advances in ethanol chemistry to produce fuels with superior properties. However, the identification of optimal strategies for ethanol upgrading remains challenging. On the one hand, the search space, characterized by the chemistries and catalysts that are used in a biorefinery for ethanol upgrading, is very large. Additionally, the multidisciplinary nature of the problem calls for the simultaneous design of processes and products integrating information of different areas (catalysis, process engineering, and fuel property modeling). Accordingly, we present a superstructure-based framework that enables the design of biorefineries for ethanol upgrading. This framework relies on correlations and targeting methods to estimate capital and operating costs, enabling the identification of optimal upgrading strategies and the exploration of a large number of alternatives, without requiring extensive simulations. The proposed framework is used to design optimal ethanol upgrading

	biorefineries for the production of gasoline, diesel, and jet fuel. We identify trade-offs between biorefinery complexity (measured as the number of chemical transformations) and profit. In general, we observe that increasing the number of chemical transformations improves the economic viability of the process due to an increase in the fuel yield. The possibility and the economic impact of producing fuels of superior quality (e.g., diesel with high cetane number, and gasoline with high octane number) is also studied. Specifically, we discuss how changing product specifications impacts fuel composition, process characteristics, and profit. The use of a system-level analysis allows us to identify non-intuitive processes for ethanol upgrading, both toward drop-in biofuels with properties similar to their fossil counterparts as well as toward biofuels with superior properties.

Break: *10:30 – 10:45*

Keynote: *10:45 – 11:35 (Reitz Union 2335)*

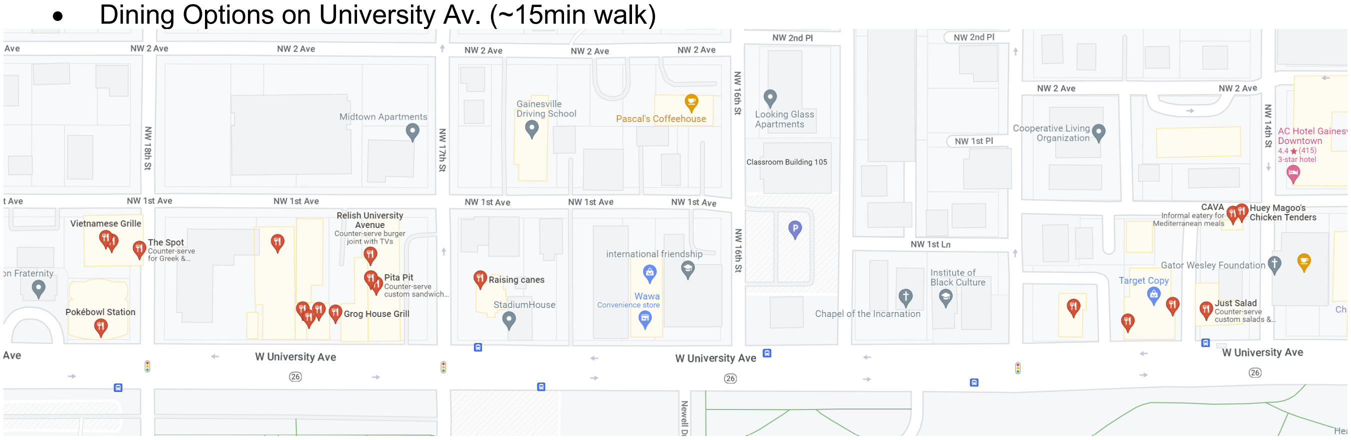
Dr. Nick Sahinidis, Gary C. Butler Family Chair and Professor, The H. Milton Stewart School of Industrial and Systems Engineering, Georgia Tech

Title: Global black-box optimization.

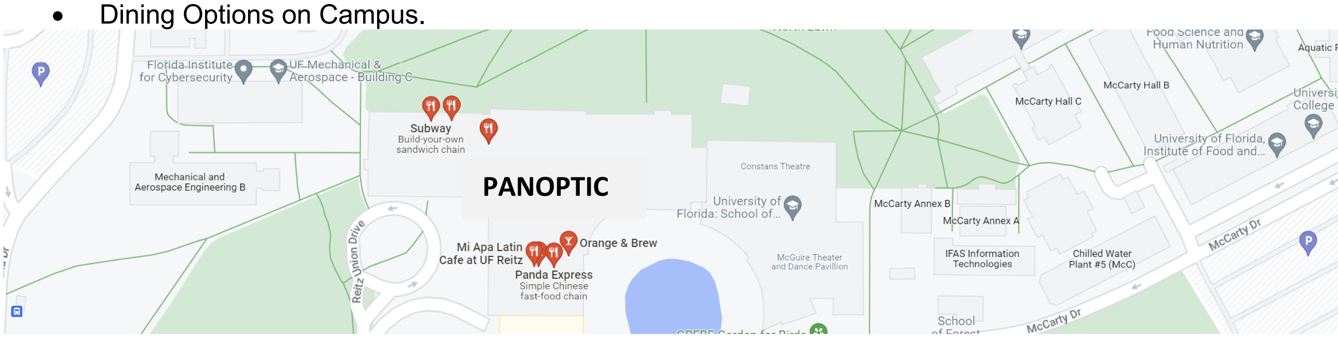
Abstract: This talk presents a new optimization algorithm for black-box optimization problems for which optimization must be performed in the absence of an algebraic formulation, i.e., by utilizing only data originating from simulations or experiments. Our approach combines model-based search with a dynamic domain partition strategy that guarantees convergence to a global optimum. Equipped with a clustering algorithm for balancing global and local search, the proposed approach outperforms existing derivative-free optimization algorithms on a large collection of problems.

Lunch break: *11:35 – 1:30*

- Dining Options on University Av. (~15min walk)



- Dining Options on Campus.



Day 2: March 10, 2023

Session 2: *1:30 – 3:00*

Track 1: Multilevel Optimization (Reitz Union 2335)

Session Chair: Oleg Prokopyev

Oleg Prokopyev, Jourdain Lamperski and Luca Wrabetz	**Title**: Min-max-min Optimization with Smooth and Strongly Convex Objectives **Abstract**: We consider min-max-min optimization with smooth and strongly convex objectives. Our motivation for studying this class of problems stems from its connection to the k-center problem and the growing literature on min-max-min robust optimization. In particular, the considered class of problems non-trivially generalizes the Euclidean k-center problem in the sense that distances in this more general setting do not necessarily satisfy metric properties. We present a 9κ-approximation algorithm (where κ is the maximum condition number of the functions involved) that generalizes a simple greedy 2-approximation algorithm for the classical k-center problem.
Evren Mert Turan, Johannes Jaeschke and Rohit Kannan	**Title**: Improved discretization based lower bounding methods for semi-infinite programming **Abstract**: Semi-infinite programs (SIPs) are optimization problems with a finite number of decision variables and an infinite number of constraints (typically parameterized by a finite-dimensional parameter), that appear in various engineering and science applications such as design centering and robust optimization. Most methods for the global minimization of SIPs use an iterative lower bounding method in which the parameter space is discretized with values that correspond to the largest constraint violation at the incumbent solution. In this work we demonstrate a newly proposed lower bounding method in which the parameter space is discretized with the parameter values that yield the highest lower bound at the incumbent solution. This is formulated as a max-min problem which we solve to local optimality using parametric sensitivity results. Numerical results show that the proposed approach can significantly reduce the number of iterations for the lower bound to converge compared to the standard approach.
Maude Josee Blondin	**Title**: Integer Programming Approaches for Distributionally Robust Chance Constraints with Adjustable Risk **Abstract**: During the past few decades, multiagent systems (MAS) have drawn increased attention from the research community. MAS concern collaborative problems, in which multiple agents accomplish an individual task that might influence the behavior of the other agents. A solution or behavior emerges from agents' interaction. For problems where multiple objective functions are present among agents, many works optimize the sum of these objective functions. This formulation implies that each objective has the same priority. In other words, optimizing the sum of objective functions is a specific case of a multiobjective problem in which all objectives matter equally, limiting agents' possibilities. Indeed, it is easy to envision situations where agents' objectives may have different priorities. For instance, agents, such as ground robots or drones, mapping a region, performing a rescue mission, or sensing an area may have different priorities between travel time, precision, and energy usage. And these priorities may be time-varying, influenced by agents' own internal states or external states, such as the remaining battery power or an obstacle on the agent's path, respectively. A large body of work on multiobjective optimization methods exists for centralized problems; however, such techniques remain primarily unexplored in a multiagent system context. The limited number of distributed multiobjective optimization methods with different priorities is due to the mathematical assumptions; having agents with equal priorities simplifies the analysis of agents' computations. This presentation will present recent distributed multiobjective optimization algorithms, in which agents can have different priorities. Theoretical analyses will also be presented, including proof of convergence to solutions and convergence rates of a distributed multiobjective optimization algorithm. Future research direction will also be discussed.

Day 2: March 10, 2023

Session 2: *1:30 – 3:00*

Track 2: Energy Sytems 2 (Reitz Union 2325)

Session Chair: Yongpei Guan

Burak Eksioglu	**Title**: Energy Savings through Platooning in Connected and Autonomous Vehicles **Abstract**: We investigate the energy savings potential of platooning in the context of Connected and Autonomous Vehicles (CAVs). Platoons are groups of vehicles traveling closely together, reducing air drag and thus energy consumption. However, the formation and maintenance of platoons also result in increased energy use due to acceleration. To investigate the potential savings from platooning we develop a centralized and a decentralized approach. Our centralized approach determines vehicle-to-platoon assignments given the current location, speed, and destination of all the vehicles and platoons on the freeway. The decentralized approach eliminates the need for sharing large sets of data and information. We test these two approaches in a simulation study model that captures the energy expended by each vehicle in realistic traffic conditions. Our results indicate that, through individual decision-making, a system-wide energy saving of 2.2% to 2.6% can be achieved, compared to 3% with prescribed platoon formation by a central authority.
Mariana Resener	**Title**: Optimization in Electric Power Distribution Systems: Challenges and Opportunities **Abstract**: The uptake of distributed energy resources (DERs) transforms the traditional distribution grid that supplies power in only one direction. With DERs, distribution systems become active with bidirectional power flows, bringing technical concerns and several opportunities to optimize operations. In this context, optimization models and computational tools that provide relevant information for distribution system operators become essential. This presentation will discuss optimization models applied to power distribution systems. Moreover, a mixed-integer linear programming model for the distribution system scheduling under uncertainty will be introduced. This model aims to minimize operation costs related to energy losses, voltage violations, power curtailment and power flow commitment at interfaces with transmission system operators. A method to estimate uncertainties in the power flow commitment is also proposed. Finally, this presentation will discuss challenges and future research trends in a scenario with large-scale adoption of DERs.
Nomanullah Nomanullah and Mujahid Syed	**Title**: Multi-Objective Optimization of District Cooling System **Abstract**: Efficiently managing heating and cooling systems centrally in the novel smart cities like Neom (in KSA) is a challenging task. In this work, an application of operations research in managing and planning of central District Cooling System (DCS) is considered. Different objectives that are critical for effective functioning of DCS are considered. Specifically, the objectives related to investment & operation costs, power consumption, and environmental emissions will be considered. A stochastic multi-objective formulation for DCS is proposed, which incorporates stochastic demand during multiple time periods. Relevant data of DCS elements from literature and market is gathered. A numerical case study that illustrates the applicability of the proposed approach is presented.

Break: *3:00 – 3:30*

Day 2: March 10, 2023

Session 3: *3:30 – 5:00*

Track 1: Global Optimization (Reitz Union 2335)

Session Chair: Bill Hager

William Trevena, Alexander Semenov, Michael Hirsch, Panos Pardalos and Ilias Kotsireas	**Title**: Solving Large Systems of Nonlinear Equations with Global Optimization in the Cloud **Abstract**: Systems of nonlinear equations are prevalent in numerous theoretical and applied mathematical problems. Approaches to solve these systems, making use of special properties of the specific systems, has been studied extensively. Recent research has been performed transforming these systems into global optimization problems in order to find solutions, without taking into account any special properties exhibited by the systems. However, problem size and complexity still limit finding solutions to these systems. In this research, we will give an overview of global optimization techniques to solve systems of nonlinear equations, and then discuss how to make use of cloud resources to truly solve large problems.
Rohit Kannan, Harsha Nagarajan and Deepjyoti Deka	**Title**: Learning to Accelerate Partitioning Algorithms for the Global Optimization of Nonconvex Quadratically-Constrained Quadratic Programs **Abstract**: We learn optimal instance-specific heuristics to accelerate partitioning algorithms for solving nonconvex quadratically-constrained quadratic programs (QCQPs) to global optimality. Specifically, we propose the novel problem of strong partitioning to optimally partition the domains of variables participating in nonconvex terms within a QCQP without sacrificing global optimality guarantees. We then design a local optimization method for solving this challenging max-min strong partitioning problem. Because solving this max-min problem to local optimality may still be time consuming, we propose to use machine learning (ML) to learn this strategy on homogeneous families of QCQPs. We present a detailed computational study on randomly generated families of QCQPs, including instances of the pooling problem, using the open-source global solver Alpine. Our numerical experiments demonstrate that strong partitioning and its ML approximation significantly reduce Alpine's solution time by factors of 3.5 – 16.5 and 2 – 4.5 on average and by maximum factors of 15 – 700 and 10 – 200, respectively, over different QCQP families.
Steve Huntsman	**Title**: Parallel black-box optimization of expensive high-dimensional multimodal functions via magnitude **Abstract**: Building on the recently developed theory of magnitude, we introduce the optimization algorithm EXPLO2 and carefully benchmark it. EXPLO2 advances the state of the art for optimizing high-dimensional ($D \gtrapprox 40$) multimodal functions that are expensive to compute and for which derivatives are not available, such as arise in hyperparameter optimization or via simulations.

Day 2: March 10, 2023

Session 3: *3:30 – 5:00*

Track 2: Applied Optimization (Reitz Union 2325)

Session Chair: Aleksandr Kazachkov

Andrew Murray, Ashwin Arulselvan, Michael Cashmore and Swarup Mohalik	**Title**: Datacenter Optimisation for 5G Slicing via Column Generation **Abstract**: In a 5G network, internet service providers (ISP) face the challenge of delivering network services (NS) to satisfy diverse use cases such as mobile broadband, VR/AR, autonomous driving, IoT devices and industrial automation. These services are characterised by varying key performance indicators (KPI) such as latency, data rate and reliability. Each NS is composed of an ordered sequence of Virtual Network Functions (VNF) through which packets must be routed. The VNF's can be deployed and instantiated in different servers with ease, enabling ISPs to dynamically reconfigure the network and scale the services according to traffic intensity, resource usage and changes to the SLA conditions. However, finding a suitable placement of the VNFs within the datacenter is a complicated problem. We can pose this as a location and routing problem. We first formulate a mixed integer program and propose column generation to solve the mixed integer program. Using a network transformation, we can solve the routing subproblem efficiently using any shortest path algorithm. In addition, we consider various other settings within this framework such as maintenance scheduling, reliability optimisation and robust network design.
Mohammed Al Saafin, Mujahid Syed, Uthman Baroudi and Anas Al-Ghazi	**Title**: Location Privacy Preservation Mathematical Model for the Sink Node Anonymity in Wireless Sensor Networks **Abstract**: Wireless Sensor Networks (WSNs) have attracted significant interest from research community due to its wide array of applications including: border defense, security surveillance, disaster warning and health care. WSN operates frequently in unattended environment and the network is vulnerable to attacks. This study focuses on protecting the sink node from attackers. We propose and develop a novel Mixed Integer Programming (MIP) model that can protect the sink node in a WSN with several source nodes. Specifically, the model incorporates phantom routing and random walk mechanisms along with the evidence theory measure to generate routing schedule that results in location privacy protection for the sink node. Moreover, trade-off between the routing energy consumption and the location privacy protection of the sink node is studied. Different instances of the data are tested to check the validity of the proposed model.
Stan Uryasev and Cheng Peng	**Title**: Estimation of Conditional Distributions with Factor Model of Mixtures **Abstract**: This paper estimates distribution of a response variable conditioned on observing factors (features). We propose a model possessing important properties: flexibility, interpretability, tractability, and extendability. We estimate the conditional quantile of the distribution as a mixture (weighted sum) of basis quantile functions with weights depending on factors. The suggested factor model has a closed-form expression. The calibration problem is reduced to optimization conducting quantile regressions for all confidence levels simultaneously. However, the model does not suffer from ``quantile crossing'' by design. The calibration is equivalent to minimization of Continuous Probability Ranked Score (CRPS). We prove asymptotic normality of the estimator. Additionally, based on Risk Quadrangle framework, we generalize the approach to conditional distributions defined by Conditional Value-at-Risk (CVaR), Expectile and other risk functions. Based on CP decomposition of tensors, we reduce the rank of the parameter tensor and propose an alternating algorithm for estimating the parameter tensor. Numerical experiments demonstrated efficiency of the approach. The approach allows for applications of neural networks for calibration.

Sponsors

Acknowledgement

We express our heartfelt gratitude to all the participants of the PanOptiC workshop, who came together to support Panos' retirement and celebrate the 30th anniversary of the Center for Applied Optimization (CAO). Your presence and contributions have made this event a memorable and special one.

We are deeply grateful to our keynote speakers John Birge and Nick Sahinidis for supporting this event during your busy schedules. Your expertise and knowledge in the field will undoubtedly enrich our understanding of optimization research.

We would also like to take this chance to thank our sponsors, including the University of Florida Office of Research for their support in bringing in the keynote speakers, Springer for their cash donation and book donations to CAO, and the Department of Industrial and Systems Engineering for their direct financial support and indirect service support.

We thank the scientific committee for providing the workshop name and reaching out to invite fellow colleagues. We also thank the organizing committee members for their hard work and dedication in putting this event together. Special thanks go to Aleks Kazachkov for communicating with Springer and helping maintain the conference website, Hongcheng Liu and Yu Yang for their work in preparing IT devices, conference room reservations, coffee break, and banquet/reception preparations, Jorge Sefair for helping maintain the website and creating the program booklet, and Alex Semenov for managing the EasyChair system and communicating with participants.

Last but not the least, we would like to thank Barbara Martin and Will Gibson for handling the logistics and finances for this workshop, and Anil Kumar Kondapalli for creating and maintaining the conference website. Your tireless efforts and professionalism have been instrumental in making this event a success.

We hope this workshop serves as a bridge to bring us closer to support each other in our collective pursuit of success in optimization research.

Yongpei Guan and William Hager

Reitz Union

LEVEL 2

Auditorium
Center for Inclusion and Multicultural Engagement
David and Wanda Brown Center for Leadership and Service
The Gallery
Grand Ballroom
Meeting Rooms 2101-2108
Meeting Rooms 2315-2365
Student Activities and Involvement Info Desk
SG Graphics and Copy Center

- Orange Elevator
- Blue Elevator
- Meeting Rooms
- Restrooms

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Petroleum and Minerals
Saudi Arabia

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Professor and Associate Dean
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Canada

Amzad, Razia
Springer Nature
United States

Arulselvan, Ashwin
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Business School
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WORKSHOP: PANOPTIC VIEW ON GLOBAL OPTIMIZATION

DATE & LOCATION
March 9 and 10, 2023
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