Progress on Nonconvex Quadratic Optimization

by

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Abstract

Quadratic optimization is a major step toward global optimization. The indefiniteness of a quadratic form may lead to NP-Hardness. Variants of quadratic optimization are often seen in applications such as the linearly constrained quadratic programming problem, trust region method, max-cut problem, binary quadratic programming problem, box constrained quadratic programming problem, and quadratically constrained quadratic programming problem. In this talk, we report the research progress on quadratic optimization made by integrating the Lagrangian-based methods, semi-definite programming techniques, conic programming theory, and canonical duality approach.

Optimal Control - Practical Motivation and Problem Formulations

by

K.L. Teo

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Abstract:

In this seminar, we will discuss some fascinating and diverse theory and applications in optimal control. We will begin by describing the standard optimal control problem with two practical applications. We will then proceed to discuss the following interesting optimal control problems:

(i) Optimal control problems with cost on changing control;

(ii) Optimal control problems with multiple characteristic time constraints;

(iii) Optimal impulsive control problems;

(iv) Minimax optimal control problems;

(v) Optimal control problems with free terminal time;

(vi) Optimal synchronization motion control problems;

(vii) Optimal discrete valued control problems; and

(viii) State-delay identification problems.

The focus will be on the practical motivation underlying these problems and their formulations. It is hoped that this seminar will stimulate research interests in optimal control and its multidisciplinary applications.

On Numerical Solution of Free Boundary Problems Arising From Option Valuation

by

Song Wang

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Abstract

In this talk I will present some of our latest advances in the numerical solution of free boundary problems arising from pricing various options tradable in financial markets. These include penalty methods for complementarity problems and HJB equations, and some discretization techniques for solving the penalized problems. Both theoretical and numerical aspects of the methods will be addressed.

On Local Minimizers and Maximizers of the Double Well Potential Problem

by

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Abstract

The double well potential problem is to optimise a special type of multi-variate polynomial of degree 4. It appears in many applications such as in solid mechanics, in Landau-Ginzburg theory of the second order ferroelectric transformations, and in the model describing hydrogen dynamics in carboxylic acids, etc. In this talk, we characterize the local minimizers and maximizers of the double-well potential problem. It is proven that for the nonsingular case there exists at most one local-nonglobal minimizer and at most one local maximizer. The local maximizer is "surrounded" by local minimizers in the sense that its weighted norm is strictly smaller than that of any local minimizer. We establish necessary and sufficient conditions for the global minimizer, reveal the hidden convex nature of the problem, and develop an efficient algorithm for solving it.

On the objectivity, canonical duality and triality in global optimization

by

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Abstract

The terminologies of cost, objective, and target functions have been used extensively in mathematical programming and global optimization, but a few people really pay attention on their differences and physical meanings. It turns out that any Lipschitz function is considered as the objective function in their optimization problems.

In this talk, the speaker will tell certain fundamental principles that mathematical models should obey, and each mathematical problem should be independent with the choice of their coordinate systems. Based on the physical definition of the objectivity, a unified framework is presented for general complex systems, which provides a theoretical foundation for the canonical duality theory. The speaker will show that this potentially powerful theory can be used for solving a large class of nonconvex/nonsmooth/discrete problems and the associated triality theory is proved to be true for complex systems governed by general objective functions. Complete sets of solutions for a large class of challenging problems will be presented, including some well-known NP-hard problems in integer programming.

This talk should bring some fundamentally new insights to global optimization and the canonical duality theory will bridge certain existing gap between mathematics and physics.

A Nonlinear Cone Separation Theorem and Applications in Nonconvex Optimization

by

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Balcova, Izmir, Turkey

Abstract

In this lecture, a special separation property for two closed cones in Banach spaces is introduced, and a nonlinear separation theorem for the cones possessing this property is proposed. We introduce new concepts for weak subdifferentials and radial epiderivatives, and with their help the necessary and sufficient optimality conditions in nonconvex optimization are presented and a derivative-free solution algorithm is proposed.

On Tractable Approximations of Copositive Optimization: Theory and Practice

by

Emre Alper Yıldırım

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Abstract

Copositive optimization deals with the optimization of a linear functional over an affine subspace of the cone of copositive matrices. Recently, it has been shown that every quadratic optimization problem with binary variables can be formulated as an instance of a copositive optimization problem. Therefore, despite the convex nature of this class of optimization problems, the cone of copositive matrices is computationally intractable. We discuss various tractable approximations of copositive optimization problems. We report results from our computational experience using polyhedral approximations.

Convex Optimization on Time Scales

by

Murat Adıvar

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Abstract

This paper aims to study convex analysis on some "generalized domains," in particular, the domain of the product of time scales. We introduce the basic concepts and derive analytic properties regarding convex sets of a time scale and convex functions defined on the product of time scales. The results obtained may open an avenue for modeling and solving a new type of optimization problems that involve both discrete and continuous variables at the same time.

An Agent-Based Environment for Solving Global Optimization Problems Cooperatively

by

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Abstract

This study introduces a new multiagent environment, MANGO, developed for solving global optimization problems. The strength of the environment is its flexible structure based on communicating software agents that try to solve a problem cooperatively. This structure allows the execution of a wide range of global optimization algorithms described as a set of interacting operations. In one extreme, MANGO welcomes an individual noncooperating agent, which is basically the traditional way of solving a global optimization problem. In the other extreme, autonomous agents existing in the environment cooperate as they see fit during run time. We explain the development and communication tools provided in the environment, and give examples of agent realizations and cooperation scenarios. We also show how the multiagent structure is more effective than having a single nonlinear optimization algorithm with randomly selected initial points.