Mini Workshop on Optimization

Department of Mathematics
National Taiwan Normal University

October 18, 2007

Sponsored by

Division of Mathematics, National Center for Theoretical Sciences, Taipei Office
Office of International Affairs, National Taiwan Normal University

Organized by

Jein-Shan Chen

Schedule of Programs
Place : M210, Mathematics Building

October 18 (Thursday)	Speakers/Events	Title
09:50 - 10:10	Registration	
10:10 - 11:00	Yu-Jye Lee	Nonlinear dimension reduction with kernel sliced inverse regression
11:00 - 11:50	Ruey-Lin Sheu	Dualities and algorithms in fractional programs
12:00 - 14:00	*LUNCH*	
14:00 - 14:50	YungYen Chiang	Merit functions on Hilbert space
14:50 - 15:40	Shaohua Pan	A damped Guass-Newton method for the SOCCP
15:40 - 16:00	*BREAK*	
16:00 - 16:50	Jein-Yen Lin	Approximating term structure of interest rates using cubic-splines
16:50 - 17:40	Chun-Hsu Ko	Recurrent neural networks for solving nonlinear complemetarity problems and nonlinear SOCP
18:00	*DINNER*	

Merit Functions on Hilbert Space

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Abstract. Let H denote a real Hilbert space with the inner product $\langle \cdot, \cdot \rangle$. We fix an arbitrary unit vector $e \in H$, and consider the closed convex cone

$$\mathbb{K} = \left\{ x \in H : \langle x, e \rangle \geq \frac{1}{\sqrt{2}} \|x\| \right\}.$$

Moreover, $\mathbb{K}$ is pointed, solid and self-dual. Note that $\mathbb{K}$ becomes the usual Lorentz cone when $H = \mathbb{R}^n$ and $e = (1, 0) \in \mathbb{R} \times \mathbb{R}^{n-1}$.

In this talk, by introducing the Jordan product to H associated with $\mathbb{K}$, we define a class of functions Φ_t on $H \times H$ analogously to the NCP-functions introduced by Kanzow and Kleinmichel. Every Φ_t will play the role of an NCP-function associated with $\mathbb{K}$. The Fréchet differentiability of Φ_t are investigated. We also prove that the merit functions corresponding to Φ_t are continuously Fréchet differentiable. Stationary points of these merit functions are discussed.

Recurrent Neural Networks for solving Nonlinear Complementarity Problems and Nonlinear Second-Order Cone Programs

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Abstract. The recurrent neural networks for solving optimization problems are hardware-implementable by designated integrated circuits. It can produce real-time solution which is desired in many scientific and engineering applications. We firstly consider the neural network model for solving the nonlinear complementarity problems (NCP). The neural network for NCP is derived from an equivalent unconstrained minimization reformulation, which is based on the generalized Fischer-Burmeister function. Next, we extend the well-known projection neural network model commonly used for solving nonlinear problems to solve nonlinear second-order cone programs (NSOCP). We show that the neural networks are Lyapunov stable and asymptotically stable. Moreover, the existence and convergence of the trajectory of the neural networks are proved. Simulation results indicating the effectiveness of the proposed neural networks are also reported.

Nonlinear Dimension Reduction with Kernel Sliced Inverse Regression

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Abstract. Dimension reduction is an important topic in machine learning and data mining. The most popular dimension reduction method is probably the principal component analysis (PCA), which is an unsupervised method. In the contrast, the sliced inverse regression (SIR) extracts the dimension reduction subspace based on the covariance matrix of input attributes inversely regressed on the responses. SIR can be viewed as a supervised companion to PCA for linear dimension reduction. Like other linear methods, SIR can extends to nonlinear setting via the "kernel trick". In this article we focus on the problem of fast implementation of kernel SIR and study its numerical behavior and performance in classification and regression. Numerical experiments show that kernel SIR is an effective dimension reduction technique and it can be combined with other linear algorithms to form a powerful toolkit for massive data analysis.

Approximating Term Structure of Interest Rates Using Cubic-Splines

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Abstract. Classical spline fitting methods for estimating the term structure of interest rates have been criticized for generating highly fluctuating fitting curves for bond price and discount function. In addition, the performance of these methods usually relies heavily on parameter tuning involving human judgment. To overcome these drawbacks, a recently developed cubic-spline model is proposed for term structure analysis. Cubic-splines preserve the shape of the data, exhibit no extraneous oscillation and have small fitting errors. Cubic-splines are tested using a set of real financial data and compared with the widely used B-splines.

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A damped Guass-Newton method for the SOCCP

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Abstract. In this talk, we investigate some properties related to the generalized Newton method for the Fischer-Burmeister (FB) SOC complementarity function, which allows us to reduce the second-order cone complementarity problem (SOCCP) to a semismooth system of equations. We characterize the B-subdifferential of the FB function at any point and study the nonsingularity condition of the B-subdifferential at a solution of the SOCCP. Furthermore, for the corresponding FB merit function, we first establish the boundedness of the level sets by using the uniform Cartesian P-property, and provide a weaker condition to guarantee that each stationary point is an optimal solution of the SOCCP. By this, we propose a damped Guass-Newton method for the SOCCP and obtain the corresponding global and superlinear convergence results. Numerical results are also reported for some convex second-order cone programs, which verify the good theoretical properties of the method proposed.

Dualities and Algorithms in Fractional Program

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Abstract. In this talk, I will introduce the fractional program. In particular, we emphasize on (1) why the fractional program is important? (2) what type of mathematical problems are faced in fractional program? and (3) algorithms for solving the fractional program. To this end, several examples for real applications are given; different types of duality theorems are compared; and a new unified solution method is proposed.