3RD NUS GRADUATE SYMPOSIUM IN MATHEMATICS

21 April 2015 (Tuesday)
Department of Mathematics
S17 #04-06 and #04-04

PROGRAMME

Venue: S17-04-06 (Seminar Room 1)

08:50 - 09:00 Opening Address by *Prof TOH Kim Chuan*

09:00 - 09:45 **Introduction to Pluripotential Theory and Applications**
Prof DINH Tien Cuong

09:45 - 10:30 **How to Do Research in Quantitative Finance?**
Prof Steven KOU

10:30 - 11:00 Tea break @ Mathematics Department Lounge

Time/Venue	S17-04-06	S17-04-04
11:00 - 11:20	CHEN Weiqiang	HU Fei
11:20 - 11:40	CUI Ying	LIU Yong
11:40 - 12:00	XIE Peichu	LU Hengfei
12:00 - 14:00	***Lunch @ Mathematics Department Lounge***	
14:00 - 14:20	GUO Jiancang	GUO Han
14:20 - 14:40	LI Yunzhi	QIAO Lei
14:40 - 15:00	RUAN Xinran	WEI Ran
15:00 - 15:20	WANG Yan	YANG Chen
15:20 - 15:50	***Tea break @ Mathematics Department Lounge***	
15:50 - 16:10	TENG Dan	YANG Yu
16:10 - 16:30	YANG Liuqin	YU Jinjiong
16:30 - 16:50	ZHAO Yufei	ZENG Yishu

ABSTRACTS

TIME	TALK	VENUE
08:50 – 09:00	**Opening Address by *Prof TOH Kim Chuan***	S17-04-06
09:00 – 09:45	***Prof DINH Tien Cuong*** **Introduction to Pluripotential Theory and Applications** The theory of pluripotential is a branch in complex analysis and was founded in '40 by Lelong and Oka. Since then, it progresses continuously thanks to the fundamental contributions of several mathematicians: Berndtsson, Bombieri, Demailly, Hörmander, Sibony, Siu, Skoda, among others. Nowadays, it is a quite powerful tool. The theory of pluripotential leads to many applications in Complex Analysis, Complex Geometry, Differential Geometry, Algebraic Geometry, Dynamics, Foliations. In this talk, I will try to introduce this theory together with some ideas of applications.	S17-04-06
09:45 – 10:30	***Prof Steven KOU*** **How to Do Research in Quantitative Finance?** In this talk we shall introduce 3th and 4th year Ph.D. students to potential research in quantitative finance, by discussing the following issues: (1) What is a good research topic in quantitative finance? (2) How to proceed with research questions in quantitative finance? (3) How to publish papers in the journals of quantitative finance?	S17-04-06

TIME	TALK	VENUE
11:00 – 11:20	***CHEN Weiqiang*** **An Augmented Lagrangian Method for l_1-Regularized Optimization Problems with Orthogonality Constraints** A class of l_1-regularized optimization problems with orthogonality constraints has been used to model various applications arising from physics and information sciences, e.g., compressed modes for variational problems. Such optimization problems are difficult to solve due to the non-smooth objective function and non-convex constraints. Existing methods either are not applicable to such problems, or lack convergence analysis e.g., the SOC method. In this paper, we propose a proximal alternating minimized augmented Lagrangian (PAMAL) method that hybridizes the augmented Lagrangian method and the proximal alternating minimization scheme. It is shown that the proposed method has the so-called sub-sequence convergence property, i.e., there exists at least one convergent subsequence and any convergent sub-sequence converges to a Karush-Kuhn Tucker (KKT) point of an equivalent minimization problem. Experiments on the problem of compressed modes illustrate that the proposed method is noticeably faster than the SOC method. This talk is based on a joint article with Associate Professor Ji Hui and Miss You Yanfei.	S17-04-06
	HU Fei **On the birational maps of projective surfaces** In this talk, I will explain why birational maps of projective plane is the most interesting case when we talk about the dynamics of birational maps of projective surfaces.	S17-04-04

TIME	TALK	VENUE
11:20 – 11:40	***CUI Ying*** **Solving linearly constrained convex optimization problems with coupled objective functions** In this talk, we present an augmented Lagrangian framework for solving large scale linearly constrained convex optimization problems with coupled objective functions. In order to achieve a fast convergence rate of the augmented Lagrangian method, we introduce an inexact accelerated block coordinate descent algorithm to deal with the inner subproblems. Numerical results show that our proposed algorithm is efficient and robust.	S17-04-06
	LIU Yong **Computable Trees and their Paths** We begin with the concepts of computable trees and $\prod_1^0$ −class, then discuss the computability of their paths and various basis theorems for the $\prod_1^0$ −class.	S17-04-04

TIME	TALK	VENUE
11:40 – 12:00	***XIE Peichu*** **Some aspects of wavelet theory** Wavelet theory was historically motivated by the fourier analysis in the localized sense and later served as powerful instrument both in the field of analysis and that of applications. In this talk I will introduce the history of MRA (multi-resolution analysis) -based wavelet frames and talk about the basic properties of the objects, with a view of their applications.	S17-04-06
	LU Hengfei **Representations of p-adic groups** We will give an introduction to the irreducible representations of p-adic groups over local fields and present several examples about the period problems. Here we mainly talk about the situations in the classical reductive groups, especially in the GL(2) case.	S17-04-04

TIME	TALK	VENUE
14:00 – 14:20	***GUO Jiancang*** **An Introduction of Climbing String Method** A brief introduction of climbing string method, which was proposed to compute saddle points for a given minimum of the potential or free energy of complex systems. These saddle points act as transition states for the barrier-crossing event. Application to 2D Muller potential and 7 atoms cluster will be presented.	S17-04-06
	GUO Han **An Introduction of Spectral Operators of Matrices** In order to overcome limitations of the Lowner operators of matrices in solving matrix optimization problems (MOPs), we will introduce a thorough study on a more powerful class of matrix valued functions, named as spectral operators of matrices. The following several fundamental properties of spectral operators will be introduced: the well-definedness, continuity, directional differentiability, Frechet-differentiability, locally Lipschitzian continuity, ρ-order B-differentiability ($0<\rho\leq 1$), ρ-order G-semismooth ($0<\rho\leq 1$) and the characterization of Clarke's generalized Jacobian. These are some necessary theoretical foundations for designing numerical methods for solving the MOP.	S17-04-04

TIME	TALK	VENUE
14:20 – 14:40	***LI Yunzhi*** **Numerical Study of Vapor Condensation on Patterned Hydrophobic Surfaces Using the String Method** Vapor condensation on solid surfaces plays a crucial role across a wide range of industrial applications. Recent advances of nanotechnology have made possible the manipulation of the condensation process through the control of surface structures. In this work, we study vapor condensation on hydrophobic surfaces patterned with microscale pillars. The critical nuclei, the activation barriers, and the minimum energy paths are computed using the climbing string method. The effects of pillar height, interpillar spacing, the level of supersaturation, and the intrinsic wettability of the solid surface on the nucleation process are investigated. Two nucleation scenarios are obtained from the computation. In the case of high pillar, narrow interpillar spacing, low supersaturation, and/or low surface wettability, the critical nucleus prefers the suspended Cassie state; otherwise, it prefers the impaled Wenzel state. A comparison of the nucleation barrier with that on a flat surface of the same material reveals that vapor condensation is inhibited by the microstructures in the former case, while enhanced in the latter case. The critical values of the pillar height, the interpillar spacing, and the supersaturation at which the critical nucleus changes from the Cassie state to the Wenzel state are identified from the phase diagram of the critical nucleus. It is found that the dependence of the critical interpillar spacing on the supersaturation follows closely the curve of the critical radii in a homogeneous nucleation. The relaxation dynamics of the condensate after the critical nucleus is formed is computed by solving the steepest descent equation. It is observed that when the pillar is low and/or the interpillar spacing is wide, a condensate initially in the Cassie state may evolve into the Wenzel state during the relaxation.	S17-04-06
	QIAO Lei **Dynamic Directed Random Matching** We demonstrate the existence of a continuum of agents conducting dynamic directed random searches for counterparties, and characterize the implications. Agents' types are shown to be independent discrete-time Markov processes that incorporate the effects of random matching, with the potential for enduring partnerships that may have randomly timed break-ups. Agents' types also randomly mutate over time. The random match-induced type changes for paired agents are potentially correlated. The multi-period cross- sectional distribution of types in such a discrete-time dynamic system is deterministic, because of the exact	S17-04-04

	law of large numbers. The results provide a mathematical foundation for many previously studied search-based models of labor markets, money, and financial markets.	

TIME	TALK	VENUE
14:40 – 15:00	***RUAN Xinran*** **Dimension Reduction Problem for Modified GP Equation** With strong confinement in one or two directions, the 3D ground solution can be approximated well by the 2D or 1D solution, which requires much less computational cost. In my talk, I will first review the problem for GP equation, and then show some results for the modified GP equation (only consider the stationary solution): \mu\phi=-\frac{1}{2}\Delta\phi+V\phi+\beta\phi^3-\delta(\Delta(|\phi|^2))\phi	S17-04-06
	WEI Ran **Characterization of long-range directed polymer** In this talk, we will generalize the results of nearest-neighbor directed polymer to the long-range case. We will define the polymer measures for long-range case and then introduce the strong disorder and weak disorder, etc. We will show the existence of free energy and state the central limit theorem and classify strong disorder and weak disorder.	S17-04-04

TIME	TALK	VENUE
15:00 – 15:20	***WANG Yan*** **Sharp interface model for strongly anisotropic solid state dewetting problems** For simulating strongly anisotropic solid-state dewetting of thin films with sharp interface model, we propose two kinds of regularization methods due to two different anisotropic surface energy densities. One is to smooth the cusp points in the strongly anisotropic surface energy. This kind of regularization is applicable for the energy density which is not differentiable at several points, and the problem collapses to weakly anisotropic problem. The other is to add a regularizing term in the total free energy of the system. It is suitable for the smooth, strongly anisotropic energy densities. This kind of regularization preserves the strong anisotropy and leads to a higher order equation. For both cases, we simulate the evolution of the film/vapor interface by the front tracking method, and we present a series of simulation results.	S17-04-06
	YANG Chen **The Level of Risk-free Rate in China: Evidence from the Classification Fund Market** One-month SHIBOR rate, three-month fixed deposit rate, and ten-year treasury yield are often employed as a proxy for the risk-free rate in China's market. However, empirical studies show that these rates are too low to reflect the actual level of risk-free rate demanded by China's market. Using the Black-Scholes option pricing theory, we develop an approach of estimating the level of China's risk-free rate in terms of the classification fund, an innovative structured product that is capable of capturing the characteristics of both the bond market and the equity market. We find that the level of the risk-free rate implied from the classification fund market is uniformly higher than the commonly used risk free rates, which confirms the presence of a downward bias in the level of risk-free rate. Authors: Min DAI, Steven KOU, Chen YANG, Zhenfei YE	S17-04-04

TIME	TALK	VENUE
15:50 – 16:10	***TENG Dan*** **Randomized Algorithms for Large Scale Matrices** Traditional methods for solving matrix problems now become insufficient due to the large size a matrix may have. In recent years, mathematicians have employed randomization in solving these problems as it can lead to faster algorithms with more interpretable output. In this talk, we will focus on random sampling and random projection algorithms to see how they perform in least-squares approximation and low-rank matrix approximation.	S17-04-06
	YANG Yu **A sufficient condition on exposed maps between matrix algebras and concrete constructions.** In order to analyze the facial structure of the cone consisting all positive maps between two matrix algebras, exposed maps are to be investigated. Lacking of a necessary and sufficient condition for a positive map to be exposed, there are only a few concrete examples of exposed map in literature (Choi's map in $3 \otimes 3$, Woronowicz's map in $2 \otimes 4$, Robertson's map in $4 \otimes 4$). In this talk, we will introduce a sufficient condition on exposeness (by Woronowicz) as well as three related examples.	S17-04-04

TIME	TALK	VENUE
16:10 – 16:30	***YANG Liuqin*** **An Inexact Accelerated Block Coordinate Descent Method for Least Squares Semidefinite Programming** We consider least squares semidefinite programming (LSSDP) where the primal matrix variable must satisfy given linear equality and inequality constraints, and must also lie in the intersection of the cone of positive semidefinite matrices and a simple polyhedral set. We propose an inexact accelerated block coordinate descent (ABCD) method for solving the problem via its dual, which can be reformulated as a convex composite minimization problem whose objective is the sum of a coupled quadratic function involving four blocks of variables and two separable non-smooth functions involving only the first and second block, respectively. Our ABCD method has $O(\frac{1}{k^2})$ iteration complexity if the subproblems are solved progressively more accurately. The design of our ABCD method relied on recent advances in the symmetric Gauss-Seidel technique for solving a convex minimization problem whose objective is the sum of a multi-block quadratic function and a non-smooth function involving only the first block. Extensive numerical experiments on various class of over 600 large scale LSSDP problems demonstrate that our ABCD method not only can solve the problems to high accuracy, but it is also far more efficient than (a) the well-known BCGD (block coordinate gradient descent) method, (b) the ARBCGD (an enhanced version of the accelerated randomized BCGD) method, and (c) the APG (accelerated proximal gradient) method.	S17-04-06
	YU Jinjiong **Characterization of the Brownian web** The Brownian web (BW) is the random network formally consisting of the paths of coalescing one-dimensional Brownian motions starting from every space-time point in \mathbb{R}\times\mathbb{R}. Fontes, Isopi, Newman and Ravishankar give a rigorous definition of the Brownian web in a special probability space, whose element is a collection of paths with specified starting points. Heuristically, the Brownian web can be regarded as a coalescing Brownian motions system.	S17-04-04

TIME	TALK	VENUE
16:30 – 16:50	***ZHAO Yufei*** **l1 norm recovery under sufficient separation** One of the fundamental conclusions in compressed sensing is that the Null-space Property holds if and only if the l1 recovery for the sparse signals is unique and exact. People give various conditions to ensure the Null-space Property. In the recent paper by Candes, by establishing the dual polynomial, the authors obtain the elegant conclusion: if the signal satisfies the sufficient separation condition, the Null-space Property is fulfilled. In this talk, I will give a review of Candes's and related work. And the stability result for the noisy case will also be mentioned.	S17-04-06
	ZENG Yishu **Perfect equilibrium in large game** We prove the existence of perfect equilibrium in large game with infinite actions. Under some condition we show the validity of the closed graph theory for perfect equilibria.	S17-04-04