香港數學學會
The Hong Kong Mathematical Society

(Founded in 1979)

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THE HONG KONG MATHEMATICAL SOCIETY
ANNUAL GENERAL MEETING 2014

6 June 2014 (Friday)
9:00am- 5:20pm

N001, N112-116, Block N
The Hong Kong Polytechnic University

Schedule of Events

Venue: N001

Chair: Zhou-Ping Xin

9:00am - 10:00am **HKMS Distinguished Lecture by Horng-Tzer Yau (Harvard University)**

Title: Random Matrices and Partial Differential Equations

Abstract: It was known that Dyson Brownian motion is closely related to the local statistics of random matrices. In this lecture, I'll explain that Dyson Brownian motion can be studied by a partial differential equation with random coefficients. From the regularity theory of this PDE, many important properties of local spectral statistics of random matrices can be derived.

10:00am – 10:30am **Tea Break**

10:30am - 10:50am **HKMS Best Thesis Award Presentation Ceremony**

Chair: Conan Leung

10:50am - 11:40am **Plenary Lecture by Stephen S. T. Yau (Tsinghua University)**

Title: Non-constant CR morphisms between compact strongly pseudo-convex CR manifolds and Etale covering between resolutions of isolated singularities

Abstract: Strongly pseudoconvex CR manifolds are boundaries of Stein varieties with isolated normal singularities. We prove that any non-constant CR morphism between two (2n-1)-dimensional strongly pseudoconvex CR manifolds lying in an n-dimensional Stein variety with isolated singularities are necessarily a CR biholomorphism. As a corollary, we prove that any non-constant self map of (2n-1)-dimensional strongly pseudoconvex

CR manifold is a CR automorphism. We also prove that a finite etale covering map between two resolutions of isolated normal singularities must be an isomorphism. This is a joint work with Yu-Chao Tu and Huai Qing Zuo.

11:40pm - 1:45pm **Lunch**

Venue: Room N001

Chair: Zhou-Ping Xin

1:45pm - 2:30pm **HKMS Annual General Meeting**

Invited talks (Parallel Sessions):

Venue: Room N112
Parallel Session 1: Geometry
Chair: Kwok Wai Chan

2:30pm - 3:00pm **1. Huai-Liang Chang (HKUST)**

Title: Landau Ginzburg type theories from algebraic geometry

Abstract: The Landau Ginzburg model unifies different moduli spaces and their counting in A side of mirror symmetry. Algebra-geometric approach to define it via p-fields and cosection localization unifies these different theories, as like Gromov-Witten theory, FJRW theory, and also others. We will brief on their constructions, comparisons, and also relations which is work under progress.

3:00pm - 3:30pm **2. Rong Du (HKU)**

Title: Canonical maps of algebraic varieties and abelian covers

Abstract: I will talk about canonical maps of nonsingular algebraic surfaces of general type and Gorenstein minimal projective 3-folds of general type with locally factorial terminal singularities. Moreover, we study those varieties whose canonical maps are abelian covers over projective spaces. It is a joint work with Yun Gao.

3:30pm - 3:50pm **Tea Break**

3:50pm - 4:20pm **3. Paul Lee (CUHK)**

Title: Ricci curvature type lower bounds for sub-Riemannian structures on Sasakian manifolds

Abstract: In this talk, we introduce a type of Ricci curvature lower bound for a natural sub-Riemannian structure on Sasakian manifolds and discuss various consequences under this condition.

4:20pm - 4:50pm **4. Yat-Hin Suen (CUHK)**

Title: A Frolicher-type inequality generalized complex manifolds

Abstract: I will talk about a Frolicher-type inequality for generalized complex manifolds, whose equality gives a characterization of the generalized ddbar-lemma. This result unifies analogous results in the complex and symplectic cases.

Venue: Room N113

Parallel Session 2: Analysis and Application of PDES

Chair: Zhi-An Wang

2:30pm - 3:00pm **1. Lihe Wang (University of Iowa)**

Title: Global solutions for elliptic and parabolic equations

Abstract: We will discuss classification problems for positive solutions of elliptic equations on unbounded domains. The question is a natural generalization of the classical Liouville type theorems.

3:00pm - 3:30pm **2. Shangbing Cui (Sun Yat-sen University)**

Title: Linearized eigenvalues for a free boundary problem modeling two-phase tumor growth

Abstract: In this talk we study a linearized eigenvalue problem derived from a free boundary problem modeling the growth of a tumor containing two species of cells: proliferating cells and quiescent cells. The reduced form of this eigenvalue problem is a 2-system of a first-order nonlocal singular differential-integral equation in a ball coupled by a third-order elliptic pseudo-differential equation in the unit sphere. The singularity joined with non-localness of the first-order equation causes the main difficulty of this problem. By using Fourier expansion via a basis of spherical harmonic functions and some techniques for solving singular differential integral equations developed in some previous literature, we prove that there exists a null sequence for the surface tension coefficient, with each of them being an eigenvalue of the linearized problem, i.e., if the surface tension coefficient is equal to one of them then the linearized problem has extra nontrivial solutions besides the standard nontrivial solutions, and otherwise the linearized problem does not have other nontrivial solutions than the standard nontrivial solutions. Invertibility of some linear operators related to the linearized problem in suitable function spaces is also studied.

3:30pm - 3:50pm **Tea Break**

3:50pm - 4:20pm **3. Tong Li (University of Iowa)**

Title: Global Wellposedness and Traveling Wave Solutions of PDE Models of Chemotaxis

Abstract: We investigate local and global existence, blowup criterion and long time behavior of classical solutions for a system of PDEs derived from the Keller-Segel model describing chemotaxis. Moreover, we establish the existence and the nonlinear stability of large-amplitude traveling wave solutions to the system of nonlinear conservation laws derived from Keller-Segel model.

4:20pm - 4:50pm **4. Renjun Duan (CUHK)**

Title: Global stability of the rarefaction wave of the Vlasov-Poisson-Boltzmann system

Abstract: This talk is devoted to a study of the nonlinear stability of the rarefaction waves of the Vlasov-Poisson-Boltzmann system with slab symmetry in the case where the electron background density satisfies an analogue of the Boltzmann relation. We allow that the electric potential may take distinct constant states at both far-fields. The rarefaction wave whose strength is not necessarily small is constructed through the quasineutral Euler equations coming from the zero-order fluid dynamic approximation of the kinetic system. We prove that the local Maxwellian with macroscopic quantities determined by

the quasineutral rarefaction wave is time-asymptotically stable under small perturbations for the corresponding Cauchy problem on the Vlasov-Poisson-Boltzmann system. This is a joint work with Shuangqian Liu.

4:50pm - 5:20pm **5. Yijun Lou (PolyU)**

Title: Spatio-Temporal Epidemiology: A Case Study of Malaria Modelling

Abstract: To show the challenges and opportunities in spatio-temporal epidemiology study, this talk formulates a malaria transmission model with an appropriate consideration of spatial heterogeneity and time lag, with the former due to the human and mosquito movement and the latter as a result of the disease latency. The resultant nonlocal and time-delayed reaction-diffusion model is analyzed through a dynamical system point of view. The long term behavior of the solutions can be determined by a threshold parameter, the basic reproduction ratio, which is defined as the spectral radius of an operator. Furthermore, a sufficient condition is obtained to guarantee that all nontrivial solutions will stabilize at a positive steady state eventually in the case where all the parameters are spatially independent. Moreover, the numerical scheme for the spectral radius computation of the operator is presented.

Venue: Room N114

Parallel Session 3: Numerical Optimization

Chair: Xiao-Jun Chen

2:30pm - 3:00pm **1. Ting Kei Pong (University of British Columbia)**

Title: Gauge optimization and duality

Abstract: Gauge optimization seeks the element of a convex set that is minimal with respect to a gauge function. It can be used to model a large class of useful problems, including a special case of conic optimization, and various problems that arise in machine learning and signal processing. In this talk, we explore the duality framework proposed by Freund, and discuss a particular form of the problem that exposes some useful properties of the gauge optimization framework.

3:00pm - 3:30pm **2. Wei Bian (Harbin Institute of Technology)**

Title: Feasible smoothing quadratic regularization method for box constrained non-Lipschitz optimization

Abstract: We propose a smoothing quadratic regularization (SQR) method for solving box constrained optimization problems with a non-Lipschitz regularization term that includes the lp norm ($0 < p < 1$) of the gradient of the underlying image in the l2-lp problem as a special case. At each iteration of the SQR algorithm, a new iterate is generated by solving a strongly convex quadratic problem with box constraints and the smoothing parameter is updated by a simple criterion. We definite an ε ($\varepsilon \geq 0$) scaled first order stationary point of the box constrained non-Lipschitz optimization problem. We prove that any cluster point of ε scaled first order stationary points with $\varepsilon > 0$ satisfies a first order necessary condition for a local minimizer as ε goes to 0, and the worst-case iteration complexity of the SQR algorithm for finding an ε scaled first order stationary point is $O(\varepsilon^{-2})$. Numerical examples are given to validate the worst-case complexity result and show good performance of the SQR algorithm for image restoration.

3:30pm - 3:50pm **Tea Break**

3:50pm - 4:20pm **3. Mingjie Guo (PolyU)**

Title: Design of distributed beamforming system using semi-definite programming and semi-infinite programming

Abstract: In this paper, the design of distributed broadband beamforming system is studied. In the configuration, we assume that each microphone is equipped with wireless communications capability. Once their mutual distance information is collected, localization techniques can be used to estimate the microphone locations. A broadband beamformer can then be designed such that the error between the actual response and the desired response is minimized. However, due to variations in the estimated microphone locations, robust design with uncertainties must be considered. This problem is formulated as a minimax optimization problem, which is then transformed into a semi-definite programming (SDP) problem so that interior point algorithms can be applied. We illustrate the proposed method by several designs and show that the algorithm is robust and efficient. The broadband beamforming design problem can also be formulated as a non-strictly convex semi-infinite programming (CSIP) problem. We add a small quadratic perturbation for the problem such that it becomes a strictly convex semi-infinite programming. We prove that the solution of the perturbation CSIP converges to the solution of the original CSIP when the perturbation goes to zero. The perturbation exchange algorithm provides an approximate optimal solution for the filter design problem in a finite number of iterations.

4:20pm - 4:50pm **4. Wenyi Tian (HKBU)**

Title: Convergence analysis of the primal-dual based method for total variation minimization with finite element approximation

Abstract: The total variation minimization is considered by using consistent finite element discretization. The problem can be regarded as a saddle-point formulation with an energy functional. Then we apply the primal-dual based iterative algorithms for solving the saddle-point problem and analyze their convergence.

Venue: Room N115

Parallel Session 4: Numerical analysis, Scientific computing and Mathematical Modeling (I)
Chair: Weifeng Frederick Qiu

2:30pm - 3:00pm **1. Xiantao Li (Penn State University)**

Title: A generalized diffusion model for the heat conduction in nanoscale materials

Abstract: Heat transport in solids has been traditionally modeled by Fourier's Law, which states simply that the heat flux is proportional to the local temperature gradient. However, in nanoscale devices, such a constitutive equation has been proven to fail. This is mainly due to the size and geometry of the system. In this talk, I will demonstrate the derivation of more general heat conduction models. The derivation starts from a moecular-level models, incorporating the detailed interactions of the atoms in the system. As a result, no empirical constitutive relation needs to be introduced. As examples, we will show some results for nano wires and nano tubes.

3:00pm - 3:30pm **2. Yang Xiang (HKUST)**

Title: Continuum framework for dislocation structure, energy and dynamics of dislocation arrays and low angle grain boundaries

Abstract: We present a continuum framework for dislocation structure, energy and dynamics of dislocation arrays and low angle grain boundaries that are allowed to be nonplanar or nonequilibrium. In our continuum framework, we define a dislocation density potential function on the dislocation array surface or grain boundary to describe the orientation dependent continuous distribution of dislocation in a very simple and accurate way. The continuum formulations incorporate both the long-range dislocation interaction and the local dislocation line energy, and are derived from the discrete dislocation model. The continuum framework recovers the classical Read-Shockley energy formula when the long-range elastic fields of the low angle grain boundaries are canceled out. Applications of our continuum framework are presented for dislocation structures on static nonplanar low angle grain boundaries and misfitting interfaces.

3:30pm - 3:50pm **Tea Break**

3:50pm - 4:20pm **3. Zhonghua Qiao (PolyU)**

Title: Large time-stepping methods for phase-field models

Abstract: We consider a class of phase-field models which have the dissipative mechanism in the energy law. Numerical simulations of these models require very long time computations to reach the steady state. In our recent work, some unconditionally energy stable schemes, which can preserve the discretized energy decay property for these phase-field models, has been developed and analyzed.

4:20pm - 4:50pm **4. Yat Tin Chow (CUHK)**

Title: Optimal Shape Design by Partial Spectral Data

Abstract: This talk will address a shape design problem in which our target is to design, up to rigid transformations and scaling, the shape of an object given either its polarization tensor at multiple contrasts or the partial eigenvalues of its Neumann-Poincare operator, which are known as the Fredholm eigenvalues. We propose to recover the eigenvalues of the Neumann-Poincare operator from the polarization tensor by means of the holomorphic functional calculus. Then we develop a regularized Gauss-Newton optimization method for the shape reconstruction process. We present numerical results to demonstrate the effectiveness of the proposed methods and to illustrate important properties of the Fredholm eigenvalues and their associated eigenfunctions. These results may have applications in the design of plasmon resonances in nanoparticles as well as pulsed imaging of small anomalies.

Venue: Room N116

Parallel Session 5: Numerical analysis, Scientific computing and Mathematical Modeling (II)
Chair: Zhonghua Qiao

2:30pm - 3:00pm **1. Eric Chung (CUHK)**

Title: Staggered discontinuous Galerkin methods

Abstract: In this talk, we will present the staggered discontinuous Galerkin methods.These methods are based on piecewise polynomial approximation on staggered grids. The

basis functions have to be carefully design, so that some compatibility conditions are satisfied. Moreover, the use of staggered grids brings some advantages, such as optimal convergence, conservation and super-convergence. We will discuss the basic methodologies and applications to wave propagation and fluid flows.

3:00pm - 3:30pm **2. Weifeng Qiu (CityU)**

Title: An HDG method for linear elasticity with strong symmetric stresses

Abstract: This paper presents a new hybridizable discontinuous Galerkin (HDG) method for linear elasticity, on tetrahedral meshes, based on a strong symmetric stress formulation. The key feature of this new HDG method is the use of a special form of the numerical trace of the stresses, which makes the error analysis different from the projection-based error analyzes used for most other HDG methods. On each element, we approximate the stress by using polynomials of degree k>=1 and the displacement by using polynomials of degree k+1. In contrast, to approximate the numerical trace of the displacement on the faces, we use polynomials of degree k only. This allows for a very efficient implementation of the method, since the numerical trace of the displacement is the only globally-coupled unknown, but does not degrade the convergence properties of the method. Indeed, we prove optimal orders of convergence for both the stresses and displacements on the elements. These optimal results are possible thanks to a special superconvergence property of the numerical traces of the displacement, and thanks to the use of a crucial elementwise Korn's inequality.

3:30pm - 3:50pm **Tea Break**

3:50pm - 4:20pm **3. Shun Zhang (CityU)**

Title: Proofs for Discontinuous Galerkin Methods with Low Regularity

Abstract: The convergence analysis for Discontinuous Galerkin methods of elliptic equations with H2 is well known. For equations with low regularity, the proof is not straightforward. In this talk, we will discuss several ways to prove the optimal convergence for Discontinuous Galerkin methods applied to elliptic equations with low regularity.

Location for Block N, The Hong Kong Polytechnic University

This event is co-organized with Department of Applied Mathematics, The Hong Kong Polytechnic University.