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 2016

21 May 2016 (Saturday)
9:00am- 5:15pm

The University of Hong Kong

Schedule of Events

Venue: P4, Chong Yuet Ming Physics Building

9:00am - 10:00am **HKMS Distinguished Lecture by Yum-Tong Siu (Harvard University)**

10:00am – 10:15am **Coffee Break**

10:15am - 10:30am **HKMS Best Thesis Award Presentation Ceremony**

10:30am - 11:20am **Plenary Lecture 1 by Tony F. Chan**
(Hong Kong University of Science & Technology)

11:25am - 12:00pm **HKMS Member Meeting**

Venue: Function Rooms A and B, Senior Common Room, 15th Floor, K. K. Leung Building

12:00pm - 2:00pm **Lunch (all faculty members and invited speakers are welcome to join)**

Venue: P4, Chong Yuet Ming Physics Building

2:00pm - 2:50pm **Plenary Lecture 2 by Tao Luo (City University of Hong Kong)**

2:50pm – 3:15pm **Coffee Break**

Venue: T3 – T7, Meng Wah Complex

3:15pm – 5:15pm **Invited talks (Parallel and Student Sessions)**

Titles and Abstracts:

Venue: P4, Chong Yuet Ming Physics Building
Distinguished Lecture
Chair: Zhouping Xin

9:00am – 10:00pm **Yum-Tong Siu (Harvard University)**

Title: The past, present and future of several complex variables

Abstract: For the study of analysis and function theory the most natural setting is several complex variables. Since its initial development more than a hundred years ago the theory of several complex variables has gone through several distinct stages of development with the use of very different techniques. One theme common throughout its development is the problem of constructing complex-analytic objects: functions, maps, coherent sheaves and their sections, etc. The talk will start with a survey from scratch, requiring minimal background knowledge. It will then progress to a discussion of current unsolved problems, available techniques, and approaches being developed for their solutions. Problems selected for discussion include hyperbolicity problems, the complex Neumann problem, effective results in algebraic geometry, the abundance conjecture and related questions.

Venue: P4, Chong Yuet Ming Physics Building
Plenary Lecture 1
Chair: Ngaiming Mok

10:30am – 11:20pm **Tony F. Chan (The Hong Kong University of Science and Technology)**

Title: A personal and historical view of computational mathematics

Abstract: In its modern incarnation, computational mathematics is a discipline that blossomed only after WWII. But even in its relatively brief history, there has been some major shifts in its methodology, emphasis, and applications. In this talk, I'll give a personal and historical view of this development, based on my own professional career and experience.

Venue: P4, Chong Yuet Ming Physics Building

Plenary Lecture 2

Chair: Xiaoping Wang

2:00pm – 2:50pm **Tao Luo (The City University of Hong Kong)**

Title: On the physical vacuum of compressible fluids

Abstract: Physical vacuum (also called physical vacuum singularity) that the sound speed is only $C^{1/2}$ -Lipschitzian continuous across the vacuum boundary appears in several important situations such as gaseous stars, compressible flows with damping and shallow waters. This low regularity of the sound speed near vacuum boundaries creates big obstacles in the analysis of the evolution of vacuum boundaries of compressible fluids due to the high degeneracy of compressible Euler and Navier-Stokes type equations near vacuum states so that the standard symmetrisation method developed by Friedrichs, Lax and Kato does not apply. In this lecture, I will first survey the progress in the local-in-time wellposedness theory, and then present the global-in-time regularity theory for the physical vacuum free boundary problems of compressible Euler equations with damping and Navier-Stokes-Possion equations of viscous gaseous stars. The key idea is on higher order regularity estimates both near vacuum boundaries and uniform in time by constructing higher order weighted functionals resolving the physical singularity near vacuum boundaries. The nonlinear asymptotic stability of the celebrated Barenblatt self-similar solution for Compressible Euler with damping and the Lane-Emden solution for viscous gaseous stars will be emphasized. The results presented here include those joint with Zhouping Xin and Huihui Zeng.

Venue: T3, Meng Wah Complex
Parallel Session 1: Numerical Analysis and Scientific Computation
Chair: Zhiwen Zhang (HKU)

3:15pm – 3:45pm **1. Weifeng Frederick Qiu (The City University of Hong Kong)**

Title: A superconvergent HDG method for the incompressible Navier-Stokes equations on general polyhedral meshes.

Abstract: We present a superconvergent hybridizable discontinuous Galerkin(HDG) method for the steady-state incompressible Navier-Stokes equations on general polyhedral meshes. For arbitrary conforming polyhedral mesh, we use polynomials of degree $k+1, k, k$ to approximate the velocity, velocity radient and pressure, respectively. In contrast, we only use polynomials of degree k to approximate the numerical trace of the velocity on the interfaces. Since the numerical trace of the velocity field is the only globally coupled unknown, this scheme allows a very efficient implementation of the method. For the stationary case, and under the usual smallness condition for the source term, we prove that the method is well defined and that the global L2-norm of the error in each of the above-mentioned variables and the discrete H1-norm of the error in the velocity converge with the order of $k+1$ for $k \geq 0$. We also show that for $k \geq 1$, the global L2-norm of the error in velocity converges with the order of k+2. From the point of view of degrees of freedom of the globally coupled unknown: numerical trace, this method achieves optimal convergence for all the above-mentioned variables in L2-norm for k>=0, super convergence for the velocity in the discrete H1-norm without postprocessing for $k \geq 0$, and superconvergence for the velocity in L2-norm without postprocessing for $k \geq 1$.

3:45pm – 4:15pm **2. De-Han Chen (The Chinese University of Hong Kong)**

Title: Well-posedness of an electric interface model and its finite element approximation

Abstract: This talk aims at providing a mathematical and numerical framework for the analysis on the effects of pulsed electric fields on the physical media that have a heterogeneous permittivity and a heterogeneous conductivity. Well-posedness of the model interface problem and the regularity of its solutions are established. A fully discrete finite element scheme is proposed for the numerical approximation of the potential distribution as a function of time and space simultaneously for an arbitrary shaped pulse, and it is demonstrated to enjoy the optimal convergence order in both space and time. The new results and numerical scheme have potential applications in the fields of electromagnetism, medicine, food sciences, and biotechnology.

4:15pm – 4:45pm **3. Houying Zhu (The City University of Hong Kong)**

Title: Construction of low-discrepancy point sets for non-uniform measures

Abstract: Quasi-Monte Carlo methods, which can be seen as a deterministic version of Monte Carlo methods, have been developed to improve the convergence rate to achieve greater accuracy, which partially depends on generating samples with small discrepancy. In this talk we focus on constructing low-discrepancy point sets with respect to non-uniform target measures. Discrepancy bounds and numerical results verify the effectiveness of the proposed constructions. This is a joint work with Josef Dick (UNSW, Australia).

4:45pm – 5:15pm **4. Jingrun Chen (Soochow University)**

Title: Towards a unified macroscopic description of exciton diffusion in organic semiconductors

Abstract: Exciton diffusion length is an important parameter to characterize the efficiency of organic solar cells. Diffusion model, Monte-Carlo method, Stern-Volmer formula, and exciton-exciton annihilation model have been used to calculate exciton diffusion lengths of different materials under photoluminescence and photocurrent measurements. In this talk, I will discuss the relations between different models from a
modeling viewpoint with mathematical justification and experimental verification.

Venue: T4, Meng Wah Complex
Parallel Session 2: Geometry
Chair: Martin Li (CUHK), Frederick Fong (HKUST)

3:15pm – 4:15pm **1. Kwok-kun Kwong (National Cheng Kung University)**

Title: Weighted Reilly's formula and a functional inequality on the boundary of static manifolds

Abstract: Static metrics have been widely studied in mathematical relativity. In this talk, I will discuss a functional inequality involving the static potential of a manifold with boundary possessing a static metric and the extrinsic geometry of the boundary. This is related to the second variation of the Wang-Yau quasi-local energy. I will also discuss other related inequalities when the metric is not static. This is joint work with Pengzi Miao.

4:15pm – 5:15pm **2. Chih-Wei Chen (National Taiwan University)**

Title: Shi-type estimates of the Ricci flow based on Ricci curvature

Abstract: We introduce a geometrical method to control the derivative of Ricci curvature by Ricci curvature and injectivity radius along the Ricci flow. As consequences, we derive compactness theorems for the Ricci flow and Ricci solitons.

Venue: T5, Meng Wah Complex
Parallel Session 3: Partial Differential Equations
Chair: Tao Luo (CityU)

3:15pm – 3:45pm **1. Chengjie Liu (Shanghai Jiaotong University)**

Title: On the linear ill-posedness of the Prandtl equations in the Sobolev framework

Abstract: In this paper, we will present some results on the linear ill-posedness of the Prandtl equations around shear flow in the Sobolev framework. Firstly, we give a linear instability criterion for the 3D Prandtl equations around the shear flow with exponential decay, which shows that the monotonicity condition of tangential velocity fields is not sufficient for the well-posedness of the 3D Prandtl equations, in contrast to the classical well-posedness theory of the 2D Prandtl equations under the Oleinik monotonicity assumption of the tangential velocity. Then, we will extend the result to the case when the shear flow has general decay, and the key observation is to construct approximate solutions capturing the initial layer to the linearized problem, motivated by the precise formulation of solutions to the inviscid Prandtl equations.

3:45pm – 4:15pm **2. Haiyang Jin (South China University of Technology)**

Title: Global stability of the predator-prey system with prey-taxis.

Abstract: We consider the global boundedness and stability to the predator-prey system with prey-taxis. By Moser iteration and L^p-estimates, we show that the intrinsic interaction between predators and preys in the predator-prey system is sufficient to prevent the population overcrowding without imposing any technical assumption on prey-taxis as done in the existing results. Furthermore, by constructing appropriate Lyapunoval functional, we show that prey-only steady state is globally asymptotically stable if the predation is weak, and the co-existence steady state is globally asymptotically stable under some conditions (like the prey-taxis is weak or prey diffuse fast) if the predation is strong. This is a joint work with Zhian Wang.

4:15pm – 4:45pm **3. Mingying Zhong (Guangxi University)**

Title: Spectrum structure and behaviors of the Vlasov-Maxwell-Boltzmann Systems

Abstract: The spectrum structures and behaviors of the Vlasov-Maxwell-Boltzmann (VMB) systems for both two species and one species are studied in this paper. The analysis shows the effect of the Lorentz force induced by the electro-magnetic field leads to some different structure of spectrum from the classical Boltzmann equation and the closely related Vlasov-Poisson- Boltzmann system. And the significant difference between the two-species VMB model and one-species VMB model are given. The structure in high frequency illustrates the hyperbolic structure of the Maxwell equation. Furthermore, the long time behaviors and the optimal convergence rates to the equilibrium of the Vlasov-Maxwell- Boltzmann systems for both two species and one species are established based on the spectrum analysis.

Venue: T6, Meng Wah Complex
Parallel Session 4: Analysis
Chair: Anthony Chun Kit Suen (HKIEd), Po Lam Yung (CUHK)

3:15pm – 3:45pm **1. Xiangyang Wang (Sun Yat-sen University)**

Title: On Hyperbolic graphs induced by iterated function systems

Abstract: For any contractive iterated function system (IFS, including the Moran systems), we show that there is a natural hyperbolic graph on the symbolic space, which yields the Hölder equivalence of the hyperbolic boundary and the invariant set of the IFS. We also show that the bounded degree property of the graph can be used to characterize certain separated properties of the IFS (open set condition, weak separation condition); the bounded degree property is particularly important when we consider random walks on such graphs. This application and the other application to Lipschitz equivalence of self-similar sets will be discussed.

3:45pm – 4:15pm **2. Jingang Xiong (Beijing Normal University)**

Title: Classification of positive solutions of a higher order boundary conformally invariant problem

Abstract: Recently there have been many studies of boundary GJMS operators and the Q-curvature in conformal geometry. Boundary GJMS operators can be viewed as boundary operators associated to linear (higher order) elliptic equations. In this talk, we consider the Euclidean space situation and classify constant Q-curvature metrics. A new phenomenon is the presence of polynomial part which is generated by the higher order linear effect. The idea of capturing those polynomials will be sketched. This is joint work with Liming Sun.

4:15pm – 4:45pm **3. Tak Kwong Wong (University of Pennsylvania)**

Title: Axisymmetric flow of ideal fluid in a narrow domain

Abstract: In applications in blood flow and pipeline transport, the radial length scale of the underlying flow is usually small compared to the horizontal length scale. In this talk, we will introduce a new model called the axisymmetric hydrostatic Euler equations, which describe the leading order behavior of an ideal and axisymmetric fluid moving in such narrow channel. After providing the formal derivation, we will discuss the mathematical analysis of this model under a new sign condition. This is a joint work with Robert M. Strain.

4:45pm – 5:15pm **4. Anthony Chun Kit Suen (Hong Kong Institute of Education)**

Title: Existence of intermediate weak solution to the equations of multi-dimensional Chemotaxis system

Abstract: We prove the global-in-time existence of intermediate weak solutions of the equations of chemotaxis system in a bounded domain of $\mathbb{R}^2$ or $\mathbb{R}^3$ with initial chemical concentration c_0 small in $\mathbb{H}^1$. No smallness assumption is imposed on the initial cell density n_0 which is in L2. We first show that when c_0 is small only in $\mathbb{H}^1$ and $(n_0 - n_\infty, c_0)$ is smooth, the classical solution exists for all time. Then we construct weak solutions as limits of smooth solutions corresponding to mollified initial data. Finally we determine the asymptotic behavior of the global solutions.

Venue: T7, Meng Wah Complex
Parallel Session 5: Student Session
Chair: Jeffery Ka Chun Lam (CUHK)

3:15pm – 3:30pm **1. Wang Dong (Hong Kong University of Science and Technology)**

Title: An efficient threshold dynamics method for wetting on rough surfaces

Abstract: The threshold dynamics method developed by Merriman, Bence and Osher (MBO) is an efficient method for simulating the motion by mean curvature flow when the interface is away from the solid boundary. Direct generalization of the MBO type method to the wetting problems with interface intersecting the solid boundary is not easy because solving heat equation on general domain with wetting boundary condition is not as efficient as that for the original MBO method. The dynamics of the contact point also follows a different dynamic law compared to interface dynamics away from the boundary. In this paper, we develop an efficient volume preserving threshold dynamics method for wetting on rough surfaces, which is based on minimization of the weighted surface area functional over a extended domain that includes the solid phase. The method is simple, stable with the complexity O(N log N) per time step and it is not sensitive to the inhomogeneity or roughness of the solid boundary.

3:30pm – 3:45pm **2. Yiqun Sun (The City University of Hong Kong)**

Title: An improvement of minimum action method for sharp corner

Abstract: Minimum action method has been efficient in finding minimum action path in both gradient and non-gradient systems. However, notice that the minimum action path may not be smooth at the critical points, this will cause problem in accuracy of the numerical solution. In this case, we make some implementation on geometric minimum action method, using Weighted Essentially non-oscillatory (WENO) interpolation method and moving mesh strategy, to get high order accurate solution.

3:45pm – 4:00pm **3. Shan Tai Chan (The University of Hong Kong)**

Title: On global rigidity of the p-th root embedding

Abstract: In 2008, Sui-Chung Ng proved in his PhD thesis that any holomorphic isometry from the (open) unit disk into the unit polydisk in $\mathbb{C}^p$ with respect to their Bergman metrics and with the global sheeting numebr equal to p is the p-th root embedding up to reparametrizations provided that $p \geq 2$ is an odd integer or $p = 2$. The problem that whether Ng's result holds true for any given even integer $p \geq 4$ remains unsolved. In this talk, I will show that Ng's result actually holds true for any integer $p \geq 2$ and explain the technique of resolving the problem.

4:00pm – 4:15pm **4. Lei Ge (The City University of Hong Kong)**

Title: Optimal portfolio and consumption problem under stochastic volatility

Abstract: We study optimal portfolio problem with consumption. We consider the volatility of stock is stochastic and follows Heston's model (1993) and the investor has a HARA (Hyperbolic absolute risk aversion) attitude towards risk. We develop a closed-form approximate solution of this problem and discuss the accuracy of our approximate solution.

4:15pm – 4:30pm **5. Chi Yeung Lam (The Chinese University of Hong Kong)**

Title: A staggered discontinuous Galerkin method for the simulation of Rayleigh waves

Abstract: Accurate simulation of Rayleigh waves is of critical importance in a variety of geophysical applications, such as exploration geophysics, geotechnical characterization, and earthquake-related damage assessment. There is a variety of finite-difference based and Galerkin-based methods in literature with different pros and cons. In this talk, I will report a discontinuous Galerkin method for the isotropic elastic wave equation, which enjoys energy conservation and extremely low grid dispersion. In other words, it provides accurate long-time/long-range wave propagation. Moreover, it can handle with ease irregular surface topography and discontinuities in the subsurface models as it is Galerkin type methods. This method combines the advantages of both the staggered-grid finite difference method (which is efficient in time-stepping and inefficient for irregular surfaces) and the discontinuous Galerkin method (which is efficient for irregular surfaces and inefficient in time-stepping), and gives a powerful tool for seismic wave modeling. I will also discuss a variation of this method, which gives numerical solutions with strongly symmetric stress tensor instead.

4:30pm – 4:45pm **6. Gary Pui-Tung Choi (The Chinese University of Hong Kong)**

Title: Spherical conformal parameterization of genus-0 point clouds for meshing

Abstract: In this talk, we present an algorithm for computing the spherical conformal parameterizations of genus-0 point clouds. With the aid of the spherical parameterizations, high quality triangulations and quadrangulations can then be built on the point clouds. Also, multilevel representations of point clouds can be easily constructed. Experimental results demonstrate the effectiveness of our proposed algorithm.

4:45pm – 5:00pm **7. Antonie Hei Long Chan (The Chinese University of Hong Kong)**

Title: Hooke's Optimization for 3D triangular mesh

Abstract: A new framework for mesh optimization, the Filtered Hooke's Optimization, is proposed. With the notion of the elasticity theory, the Hooke's Optimization is developed by modifying the Hooke's law, in which an elastic force is simulated on the edges of a mesh so that adjacent vertices are either attracted to each other or repelled from each other, so as to regularize the mesh in terms of triangulation. A normal torque force is acted on vertices to guaranteed smoothness of the surface. In addition, a filtering scheme, called the Newtonian Filtering, is proposed as a supplementary tool for the proposed Hooke's Optimization to preserve the geometry of the mesh. Numerical simulations on meshes with different geometry indicate an impressive performance of our proposed framework to significantly improves the mesh triangulation without noteworthy distortions of the mesh geometry.

5:00pm – 5:15pm **8. Jeffery Ka Chun Lam (The Chinese University of Hong Kong)**

Title: Landmark-matching transformation with large deformation via n-dimensional Quasi-conformal maps

Abstract: We propose a new method to obtain landmark-matching transformations between n-dimensional Euclidean spaces with large deformations. Given a set of feature correspondences, our algorithm searches for an optimal folding-free mapping that satisfies the prescribed landmark constraints. The standard conformality distortion defined for mappings between 2-dimensional spaces is first generalized to the n-dimensional conformality distortion $K(f)$ for a mapping f between n-dimensional Euclidean spaces $n \geq 3$. We then propose a variational model involving $K(f)$ to tackle the landmark-matching problem in higher dimensional spaces. The generalized conformality term $K(f)$ enforces the bijectivity of the optimized mapping and minimizes its local geometric distortions even with large deformations. Experiments have been carried out on both synthetic examples and lung CT images to compute the diffeomorphic landmark-matching transformation with different landmark constraints. Results show the efficacy of our proposed model to obtain a folding-free landmark-matching transformation between n-dimensional spaces with large deformations.

Maps

Location of the Chong Yuet Ming Physics Building

Location of the Meng Wah Complex