Wuhan University--City University of Hong Kong

Joint Workshop on Mathematics and Applications

School of Mathematics and Statistics, Wuhan University

Wuhan, September 26--30, 2014

Organizing Committee:

Hua Chen (Wuhan University)
Hui-Hui Dai (City University of Hong Kong)
Tong Yang (City University of Hong Kong)
Huijiang Zhao (Wuhan University)

Invited Speakers:

Hui-Hui Dai (City University of Hong Kong)
Min Huang (City University of Hong Kong)
Wei-xi Li (Wuhan University)
Xiliang Lv (Wuhan University)
Gengsheng Wang (Wuhan University)
Roderick S. C. Wong (City University of Hong Kong)
Tong Yang (City University of Hong Kong)
Zhijian Yang (Wuhan University)
Xicheng Zhang (Wuhan University)
Xiang Zhou (City University of Hong Kong)

Program of the Workshop

Venue: Academic Hall, 3F, School of Mathematics and Statistics, Wuhan University(院三楼学术报告厅)

September 27-Saturday, 2014

Chair	**Hua Chen (Wuhan University)**
08:30-09:15	**Roderick S. C. Wong (City University of Hong Kong)**
09:15-10:00	**Gengsheng Wang (Wuhan University)**
10:00-10:15	**Tea break**
Chair	**Roderick S. C. Wong (City University of Hong Kong)**
10:15-11:00	**Tong Yang (City University of Hong Kong)**
11:00-11:45	**Xicheng Zhang (Wuhan University)**
11:45-12:30	**Xiang Zhou (City University of Hong Kong)**
13:00	**Lunch, Luojia Villa(珞珈山庄)**

September 29-Monday, 2014

Chair	**Hui-Hui Dai (City University of Hong Kong)**
08:30-09:15	**Zhijian Yang (Wuhan University)**
09:15-10:00	**Min Huang (City University of Hong Kong)**
10:00-10:15	**Tea break**
Chair	**Chaojiang Xu (Wuhan University)**
10:15-11:00	**Hui-Hui Dai (City University of Hong Kong)**
11:00-11:45	**Xiliang Lv (Wuhan University)**
11:45-12:30	**Weixi Li (Wuhan University)**
13:00	**Lunch, Luojia Villa(珞珈山庄)**

Abstracts

An Analytical Study on Crease Formations in a Gel Layer

Hui-Hui Dai (戴晖辉)

Department of Mathematics, City University of Hong Kong, Hong Kong, China

An analytical study on crease formations in a swelling gel layer is conducted. By a method of coupled series-asymptotic expansions, we formulate a nonlinear eigenvalue problem of ordinary differential equations (ODEs), which are then solved analytically to obtain solutions for all the post-bifurcation branches. The results provide deep insights on crease formations, including the unveiling of three pathways to crease, determination of the bifurcation type, establishment of a lower bound for mode numbers and two scaling laws. A number of experimental results are captured, whose interpretations are provided. It appears that the present work offers a comprehensive understanding on crease formation, a widely-spread phenomenon. This is a joint work with Xiaoyi Chen.

Asymptotically Conserved Quantities For Certain Nonlinear ODEs in Singular Regions

Min Huang (黄旻)

Department of Mathematics, City University of Hong Kong, Hong Kong, China

We introduce a new rigorous method to analyze singular behavior of certain second order nonlinear ODEs in a neighborhood of infinity and provide global information about their solutions. The analysis is carried in detail for the first Painlevé Equation, for which we find the Stokes multipliers in closed form and global asymptotics for solutions having power-like behavior in some direction in the complex plane, in particular for the tritronquées. Based on Joint work with Ovidiu Costin and Rodica Costin.

Regularity of Traveling Free Surface Water Waves with Vorticity

Weixi Li (李维喜)

School of Mathematics and Statistics, Wuhan University, Wuhan, China

We present in this talk the real analyticity of all the streamlines, including the free surface, of a steady flow of water over a flat bed, with a Hölder continuous vorticity function. Furthermore, if the vorticity possesses some Gevrey regularity of index s, then the stream function admits the same Gevrey regularity throughout the fluid domain. This is a joint work with Hua Chen and Ling-Jun Wang.

A Primal Dual Active Set Algorithm for the Nonconvex Sparse Optimization Problems

Xiliang Lv (吕锡亮)

School of Mathematics and Statistics, Wuhan University, Wuhan, China

In this talk, we consider the problem of recovering a sparse vector from noisy measurement data. An algorithm of primal-dual active set type for a class of nonconvex sparsity-promoting penalties is proposed. A novel necessary optimality condition for the global minimizer using the associated thresholding operator is derived. The solutions to the optimality system are coordinate-wise minimizers, and under minor conditions, they are also local minimizers. Upon introducing the dual variable, the active set can be determined from the primal and dual variables. This relation lends itself to an iterative algorithm of active set type which at each step involves updating the primal variable only on the active set and then updating the dual variable explicitly. Numerical experiments demonstrate its efficiency and accuracy.

Observability from Measurable Sets for Heat Equations

Gengsheng Wang (汪更生)

School of Mathematics and Statistics, Wuhan University, Wuhan, China

In this talk, we present a kind of observability estimates from measurable sets for heat equations. Several approaches to such estimates are introduced. These approaches are based on the Lebeau-Robbiano spectral inequality, the frequency function method and the Carleman inequality, respectively. The motivation to study such estimates is from control problems of heat equations, which are the null controlability from measurable and the bang-bang property for time optimal controls.

Asymptotics of the Meijer G-functions

Roderick S. C. Wong (王世全)

Department of Mathematics, City University of Hong Kong, Hong Kong, China

Asymptotic expansions of the Meijer G-function are derived for large values of the variable. The derivation is simple and straightforward; it makes use of only the Canchy residue theorem.

Co-author: Y. Lin.

Spectrum Analysis on Some Kinetic Systems

Tong Yang (杨彤)

Department of Mathematics, City university of Hong Kong, Hong Kong, China

The spectrum structures of both the Vlasov-Poisson-Boltzmann and Vlasov-Maxwell-Boltzmann systems for both two species and one species are studied. In particular, 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-sepcies model and one-sepcies model are given. The structure in high frequency illustrates the hyperbolic structure of the Maxwell equation. Furthermore, the optimal convergence rates to the equilibrium follows as an application, this is in particular new to the one-species Vlasov-Maxwell-Boltzmann system that is hard to be obtained by simply energy method. This is about some recent joint works with Hailiang Li and Mingying Zhong.

Derivation of Continuum Models from Atomistic Models

Zhijian Yang (杨志坚)

School of Mathematics and Statistics, Wuhan University, Wuhan, China

In this talk, I will introduce how to derive continuum models from atomistic ones. For static problems, I will discuss the Cauchy-Born rule and its generalizations. For dynamic problems, continuum mechanics quantities can be computed from molecular dynamics (MD) models based on the classical Irving-Kirkwood (IK) formalism. Practical implementations of IK formulas involve a spatial averaging using a smooth kernel function. The obtained results usually need to be further processed to reduce the fluctuation, e.g., by ensemble or time averaging. I will discuss the extension of the IK formalism to systematically incorporate both spatial and temporal averaging into the expression of continuum quantities.

Fundamental solution of kinetic Fokker-Planck operator with anisotropic nonlocal dissipativity

Xicheng Zhang (张希承)

School of Mathematics and Statistics, Wuhan University, Wuhan, China

By using the probability approach (the Malliavin calculus), we prove the existence of smooth fundamental solutions for degenerate kinetic Fokker-Planck equation with anisotropic nonlocal dissipativity, where the dissipative term is the generator of an anisotropic Levy process, and the drift term is allowed to be cubic growth.

Quantification of Extremely High Excursion Solution of Elliptic Equation with Random Coefficients

Xiang Zhou (周翔)

Department of Mathematics, City University of Hong Kong, Hong Kong, China

We study the high excursion behavior of the solution to a linear elliptic PDE with random coefficients. This problem is motivated by the failure problem for brittle material in which the extremely large value of the displacement or the strain or the stress field is related to the breakdown of a bulk brittle material. The Gaussian random function is applied to model the uncertainty of the elasticity parameter. We demonstrate an efficient importance-sampling scheme to calculate the probability of such extreme behaviors, or the failure probability.

Keywords: Uncertainty quantification, extreme event, elliptic equation, Gaussian field, material failure