

**Joint Workshop on ``Frontiers in Mathematics``
Department of Mathematics, NUS & Department of Mathematics, USTC
Friday, 11 September 2009**

Programme

MORNING SESSION

@ IMS Auditorium, Institute for Mathematical Sciences, NUS

Chair: Shen Zuowei, NUS

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|-------------------|---|
| 09:00am – 09:10am | Opening remarks
<i>Welcome by Professor Chi Tat Chong (Head), NUS</i>
<i>Welcome by Professor Chen Falai (Chairman), USTC</i> |
| 09:10am – 09:40am | Diffusion Equations Over Surfaces for Image Processing
Chen Falai, USTC |
| 09:40am – 10:10am | A Fast Optimization Transfer Algorithm for Image Inpainting in Wavelet Domains
Yip Ming Ham, Andy, NUS |
| 10:10am – 10:40am | Break |

Chair Ma Xinan, USTC

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| 10:40am – 11:10am | Pieri rule and Pieri algebras for the orthogonal groups
Lee Soo Teck, NUS |
| 11:10am – 11:40am | Kazhdan-Lusztig polynomials, character and dimension formulas for general linear Lie superalgebras
Su Yucai, USTC |
| 11:40am – 12:10pm | Modelling, algorithm and simulation of wave motion in quantum and plasma physics
Bao Weizhu, NUS |
| 12:10 pm – 02:00pm | Lunch |

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AFTERNOON SESSION

@ CRB (S14, #03-09), Department of Mathematics, NUS

Chair Chen Falai, USTC

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| 02:00pm – 02:30pm | Pointwise time-asymptotic stability of a Boltzmann shock profile
Yu Shih-Hsien, NUS |
| 02:30pm – 03:00pm | Curvature estimates for the level sets of solutions of elliptic partial differential equation
Ma Xinan, USTC |
| 03:00pm – 03:30pm | The HCMU metric on the Riemannian surfaces
Chen Qing, USTC |
| 03:30pm – 04:00pm | Break |

Chair Shen Weixiao, NUS

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| 04:00pm – 04:30pm | Distortion of interval maps and applications
Li Simin, USTC |
| 04:30pm – 05:00pm | Independence of all of monodromy groups
Chin Chee Whye, NUS |

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Abstracts

Bao Weizhu, National University of Singapore (NUS)

Title: Modelling, algorithm and simulation of wave motion in quantum and plasma physics

Abstract: In this talk, I begin with a review of several mathematical models for describing wave motion in quantum and plasma physics. Computational difficulties for simulating wave propagation and interaction in quantum and plasma physics are discussed. Efficient and accurate numerical algorithms for computing ground and excited states as well as the dynamics of the nonlinear Schroedinger equation are presented. Extensive simulation results of wave propagation and interaction in quantum and plasma physics are reported. Finally, some conclusions are drawn.

Chen Falai, University of Science and Technology of China (USTC)

Title: Diffusion Equations over Surfaces for Image Processing

Abstract: In this talk, I will generalize diffusion equations over triangulated surfaces and provide numerical methods to solve the equations. Then I will discuss the applications in image processing including denoising, inpainting, map regularization and texture generation.

Chen Qing, University of Science and Technology of China (USTC)

Title: The HCMU metric on the Riemannian surfaces

Abstract: The extremal metric is the critical points of Calabi Energy defined in fixed Kahler class of a Kahler manifold, and the HCMU metric is a special solution of extremal metric on Riemannian surfaces. In this talk, we will discuss the geometric structure of the HCMU metric, as well as the existence.

Chin Chee Whye, National University of Singapore (NUS)

Title: Independence of ℓ of monodromy groups

Abstract: Lafforgue's proof of the Langlands Correspondence for $GL(r)$ over function fields can be used to establish certain "independence of ℓ " conjectures in the theory of ℓ -adic Galois representations. In my talk, I will discuss the question of independence of ℓ of monodromy groups. I will explain the motivating origin of this conjecture and what is now known about it. If time permits, I will also highlight some new questions which are suggested by the cases that have been settled.

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Abstracts

Lee Soo Teck, National University of Singapore (NUS)

Title: Pieri rule and Pieri algebras for the orthogonal groups

Abstract: The irreducible rational representations of the complex orthogonal group O_n are labeled by certain Young diagrams. We denote the representation corresponding to the Young diagram D by σ_n^D . Consider the tensor product $\sigma_n^D \otimes \sigma_n^E$ of two irreducible representations of O_n . It is given by a sum of irreducible representations

$$\sigma_n^D \otimes \sigma_n^E = \sum_F m(F, D, E) \sigma_n^F$$

where for each Young diagram F , $m(F, D, E)$ is the multiplicity of σ_n^F in $\sigma_n^D \otimes \sigma_n^E$. In the case when the Young diagram E consists of only one row, a description of the multiplicities in $\sigma_n^D \otimes \sigma_n^E$ is called the *Pieri Rule*. In this talk, I shall describe a family of algebras whose structure encodes a generalization of the Pieri Rule.

Li Simin, University of Science and Technology of China (USTC)

Title: Distortion of interval maps and applications

Abstract: In this talk we will consider the dynamics of smooth interval maps. The distortion of the first entry map of interval maps is given by the real bounds theorem. As an application, some equivalent conditions about Markov properties of unimodal maps are generalized to multimodal maps.

Ma Xinan, University of Science and Technology of China (USTC)

Title: Curvature estimates for the level sets of solutions of elliptic partial differential equation

Abstract: We shall report the sharp Gauss curvature and principal curvature estimates for the level sets of harmonic function. Then we state some generalization on the general elliptic partial differential equations under suitable structure conditions. Our technique is maximum principle.

Su Yucai, University of Science and Technology of China (USTC)

Title: Kazhdan-Lusztig polynomials, character and dimension formulas for general linear Lie superalgebras

Abstract: In this talk, we present the following results based on a joint work with R.B. Zhang: The Kazhdan-Lusztig polynomials for finite dimensional irreducible representations of general linear superalgebras are computed. The result is then applied to prove a conjectural character formula put forward by van der Jeugt et al. in the late 80s. We simplify this character formula to cast it into the Kac-Weyl form, and derive from it a closed formula for the dimension of any finite dimensional irreducible representation of a general linear superalgebra.

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Abstracts

Yip Ming Ham, Andy, National University of Singapore (NUS)

Title: A Fast Optimization Transfer Algorithm for Image Inpainting in Wavelet Domains

Abstract: A wavelet inpainting problem refers to the problem of filling in missing wavelet coefficients in an image. A variational approach was used in Chan, Shen and Zhou (Total variation wavelet inpainting, *J. Math. Imaging Vision*, 25(1):107--125, 2006). The resulting functional was minimized by the gradient descent method. In this paper, we use an optimization transfer technique which involves replacing their univariate functional by a bivariate functional by adding an auxiliary variable. Our bivariate functional can be minimized easily by alternating minimization: for the auxiliary variable, the minimum has a closed form solution; and for the original variable, the minimization problem can be formulated as a classical total variation (TV) denoising problem, and hence can be solved efficiently using a dual formulation. We show that our bivariate functional is equivalent to the original univariate functional. We also show that our alternating minimization is convergent. Numerical results show that the proposed algorithm is very efficient and outperforms that in Chan, Shen and Zhou.

Yu Shih-Hsien, National University of Singapore (NUS)

Title: Pointwise time-asymptotic stability of a Boltzmann shock profile

Abstract: In this talk a scheme to construct the wave propagation around a Boltzmann shock profile will be surveyed. This is a parallel processes to decompose a variable coefficient problems in constant coefficient problems around the far field of a shock wave and an essential scalar equation to analyze the global wave interactions. This reduction relies heavily on the Green's function for the constant coefficient problem so that one can show the convergence of the scheme in a exponential pointwise estimate.