3rd Singapore Mathematics Symposium

Date: 28th September 2012 (Friday)
Venue: S17-04-06, Level 4, Department of Mathematics, NUS
Time: 1pm – 5pm

Scheduled talks:

1:00 – 1:50: Image Restoration: Wavelet Frame Approach, Total Variation and Beyond, by Professor Shen Zuowei, NUS.
1:50 – 2:40: List Decoding of Algebraic Geometry Codes, by Professor Xing Chaoping, NTU.
2:40 – 3:10: Tea break
3:10 – 4:00: Rational generating functions for moments and non-convex polytopes, by Dr Dimitrii Pasechnik, NTU.
4:00 – 4:50: Classical groups and invariant distributions, by Professor Zhu Chengbo, NUS.
4:50 – 5:00: Poster Prize Presentation and Closing Remarks.

Titles/abstract/biography of speakers at 3rd Singapore Mathematical Symposium

Speaker: Professor Shen Zuowei (Department of Mathematics, NUS)

Title: Image Restoration: Wavelet Frame Approach, Total Variation and Beyond

Abstract: This talk is about the wavelet frame-based image and video restorations. Main ideas of wavelet frame based models and corresponding algorithms for image restorations will be reviewed. Some of applications of wavelet frame based models image analysis and restorations will be shown. Examples of such applications include image and video inpainting, denoising, decomposition, image deblurring and blind deblurring, segmentation, CT image reconstruction and etc. In all of these applications, spline wavelet frames derived from the unitary extension principle are used. This allows us to establish a connection between wavelet frame base method and the total variation based method. In fact, we will show that when spline wavelet frames are used, a special model of a wavelet frame method can be viewed as a discrete approximation at a given resolution to the total variation based method. A convergence analysis in terms of objective functionals and their approximate minimizers as image resolution increases will be discussed.

Biography: Shen Zuowei is Distinguished Professor at the National University of Singapore where he has been on the faculty at the Department of Mathematics since 1993. His research interests are primary in wavelet frames, Gabor frames and applications. More recently his research has focused on imaging science using wavelet and Gabor frames. He has published over 100 papers. He has been invited to speak at over sixty international conferences and workshops. In particular, he was invited to give a lecture at the International Congress of

Mathematicians in 2010. He is on the editorial board over ten journals in applied and computational mathematics. He won the SPIE wavelet pioneer award in 2012, the outstanding University Research Award in 1997 and 2008 and the National Science Award of Singapore in 1998. He is a fellow of Singapore National Academy of Science.

Speaker: Professor Xing Chaoping (School of Mathematical and Physical Sciences, NTU)

Title: List Decoding of Algebraic Geometry Codes

Abstract: We give a new construction of algebraic geometry codes which are efficiently list decodable up to the Singleton bound. The worst-case list size output by the algorithm matches the existential bound for random codes up to constant factors.

Biography: Chaoping Xing received his PhD degree in 1990 from University of Science and Technology of China. He has been working on the areas of algebraic curves over finite fields, coding theory, cryptography and quasi-Monte Carlo methods, etc.

Speaker: Dr Dmitrii Pasechnik (School of Mathematical and Physical Sciences, NTU)

Title: Rational generating functions for moments and non-convex polytopes

Abstract: We show that the non-convex polytopes, i.e. finite unions of convex polytopes, can be parametrized by multivariate rational generating functions with denominators controlled by their vertices. The starting point for this is a Fantappie transformation of the uniform measure supported on such a polytope. We will also discuss applications of this approach to multidimensional inverse moment problems and inverse harmonic potential problems.

Biography: Dmitrii Pasechnik received the M.Sc. degree in computing from Moscow Institute for Steel and Alloys in 1988 and the Ph.D. degree in mathematics from the University of Western Australia in 1996. Prior to joining the Division of Mathematical Sciences, School of Physical and Mathematical Sciences, in NTU in January 2006 he held a number of postdoctoral positions in the Netherlands, Germany, and USA.
His research interests include combinatorics, optimisation, computational algebra and geometry, and complexity of algorithms.

Speaker: Professor Zhu Chengbo (Department of Mathematics, NUS)

Title: Classical groups and invariant distributions

Abstract: Invariant Theory is the study of invariant polynomial functions of a group action on a vector space. It was first developed in the 19th century by mathematicians such as Cayley and Hilbert. It was later reinvigorated by Weyl, who laid its representation-theoretic foundation in his famous book "The Classical Groups" (1946). Since then it has been incorporated into a subject, and has played an important role in the development, of representation theory (of compact Lie or linear algebraic groups). For non-compact Lie groups, almost always one only finds representations in ∞-dimensional (often function) spaces, therefore demanding tools from functional analysis and in particular theory of invariant distributions (as opposed to invariant polynomial functions). In this talk, I will explain two results (joint with Binyong Sun) on representations of classical groups: multiplicity one theorems and conservation relations, and their (100%) invariant theoretic nature. The first asserts that certain dimension is either 0 or 1, and the second asserts that the sum of certain dimensions is fixed.

Biography: Zhu Chengbo was educated as an undergraduate in Zhejiang University, China from 1980-1984 and received his PhD from Yale University in 1990. He has been with the Department of Mathematics at NUS since 1991. Professor Zhu's research interest is in representation theory of classical groups. Among his main works are the study of invariant and quasi-invariant distributions, the understanding of fine structure of principal series representations, multiplicity one branching for smooth representations, and conservation relations for local theta correspondence.