

HKUST-Keio University Joint Workshop on Mathematics and Applications

Date: Friday, 23 November 2018
Venue: HKUST Jockey Club Institute for Advanced Study (IAS) – IAS Room 2042

9:15 – 9:30 Registration outside Room 2042

9:30 – 10:30 Prof. Tatsuo Iguchi, MATH/Keio U
"A Mathematical Analysis for Water Waves"

10:30 – 10:50 Coffee break outside Room 2042

10:50 – 11:50 Prof. Hai Zhang, MATH/HKUST
"Mathematical Studies of Anomalous Scattering by Subwavelength Slit Structures"

11:50 – 12:50 Prof. Hiroshi Shiraishi, MATH/Keio U
"Time-varying Graphs By Locally Stationary Hawkes Processes"

13:00 – 14:30 Lunch at Unique, Conference Lodge

14:30 – 15:30 Prof. Shiqing Ling, MATH/HKUST
"Testing for Series Correlation and ARCH Effect of High-Dimensional Time Series Data"

15:30 – 15:50 Coffee break outside Room 2042

15:50 – 16:50 Prof. Kenta Hayano, MATH/Keio U
"Stability of Smooth Mappings Between Manifolds"

16:50 – 17:50 Prof. Tsz Ho Fong, MATH/HKUST
"Self-Similar Solutions to Homogeneous Curvature Flows"

18:00 - Dinner at Sai Kung Hung Kee Seafood Restaurant
Coach Bus Pick up outside IAS at 18:00

ALL ARE WELCOME

HKUST-Keio University Joint Workshop on Mathematics and Applications

Speaker: Professor Tatsuo IGUCHI, *MATH/Keio U*

Title: *A Mathematical Analysis for Water Waves*

Abstract: The water wave problem is mathematically formulated as a free boundary problem for an irrotational flow of an inviscid and incompressible fluid under the gravitational field. The basic equations for water waves are complicated due to the nonlinearity of the equations together with the presence of an unknown free surface. Therefore, until now many approximate equations have been proposed and analyzed to understand natural phenomena for water waves. Famous examples of such approximate equations are the shallow water equations, the Green-Naghdi equations, Boussinesq type equations, the Korteweg-de Vries equation, the Kadomtsev-Petviashvili equation, the Benjamin-Bona-Mahony equation, the Camassa-Holm equation, the Benjamin-Ono equation, and so on.

In this talk, we first review on the initial value problem to the basic equations for water waves and on the relations between the basic equations and some of approximate equations. Then, we introduce some new model as a higher order shallow water approximation and present its structure together with a mathematical justification of the model.

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Speaker: Professor Hai ZHANG, *MATH/HKUST*

Title: *Mathematical Studies of Anomalous Scattering by Subwavelength Slit*

Abstract: Since the discovery of the extraordinary optical transmission through nanohole arrays in metallic films by Ebbesen, a wealth of research has been sparked in the experimental and theoretical investigation of localized electromagnetic field enhancement in subwavelength nanostructures. This remarkable phenomenon can lead to potentially significant applications in near-field imaging, bio-sensing, etc. However, there has been a long debate on the interpretation of the enhancement effect since Ebbesen's work. In addition, a quantitative analysis of the field enhancement in subwavelength structures is still widely open. In this talk, using two-dimensional slits as a prototype, I will present mathematical studies of the field enhancement in the subwavelength structures. Based upon the layer potential technique, asymptotic analysis and homogenization theory, the enhancement mechanisms for both the single slit and an array of slits are studied quantitatively.

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Speaker: Professor Hiroshi SHIRAISHI, *MATH/Keio U*

Title: *Time-varying Graphs by Locally Stationary Hawkes Processes*

Abstract: Hawkes Graphs have been recently introduced to grasp the branching structure of multivariate stationary Hawkes processes by Embrechts and Kirchner (2018). However, existing procedure cannot describe the time structural changes since stationary Hawkes processes are a class of stationary processes. We introduce a multivariate locally stationary Hawkes (LsHawkes) process, which is a natural extension of the univariate LsHawkes process introduced by Roueff et.al.(2016). We first consider an approximation of the LsHawkes process by a time-varying integer-

valued autoregressive (tvINAR) process. Then, we propose an estimation procedure for the time varying parameters based on the local least-squares method. Finally, we propose time-varying Hawkes graphs (tvHawkes graphs) by using the estimated parameters.

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Speaker: [Professor Shiqing LING, MATH/HKUST](#)

Title: *Testing for Series Correlation and ARCH Effect of High-Dimensional Time Series Data*

Abstract: This paper proposes two Portmanteau tests for detecting serial correlation and ARCH effect in high-dimensional data. The dimension of data $p = p(n)$ may go to infinity when the sample size $n \rightarrow \infty$. We first show that the sample autocorrelation function of the L1-norm of data is asymptotically normal and a norm-based Portmanteau test statistic is asymptotically χ^2 -distributed. When the cross-sectional variables are s -dependent (i.e., at most s elements are dependent), the test still works well in the case with $p > n$. Using a suitable function of the data, the norm-based test can be applied to the heavy-tailed time series.

We next show that the sample rank autocorrelation function (Spearman's rank correlation) of the L1-norm of data is asymptotically normal and the norm-based rank test statistic is asymptotically χ^2 -distributed. Surprisingly, the norm-based rank test is dimension-free, i.e. independent of p , and without requiring any moment condition of the data or the covariance structure condition as required in the literature. Two standardized norm-based tests are further discussed. Simulation results show that these test statistics have satisfactory sizes and are very powerful even for small n and large p . A real data example is given.

(This is a joint work with Ruey S. Tsay in University of Chicago and Yaxing Yang in Xiamen University)

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Speaker: [Professor Kenta HAYANO, MATH/Keio U](#)

Title: *Stability of Smooth Mappings Between Manifolds*

Abstract: A smooth mapping $f : N \rightarrow P$ between manifolds N and P is stable if for any mapping g sufficiently close to f (with respect to a suitable topology of the space of mappings) one can take diffeomorphisms Φ and ϕ of N and P , respectively, so that they satisfy $\phi \circ g \circ \Phi = f$. In spite of its simple definition, it is in general difficult to check stability of a given mapping. In this talk, we will explain known results on stability, especially how to determine whether a given mapping is stable or not, and discuss stability of smooth functions (i.e. mappings to \mathbb{R}).

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Speaker: [Professor Tsz Ho FONG, MATH/HKUST](#)

Title: *Self-Similar Solutions to Homogeneous Curvature Flows*

Abstract: In this talk, the speaker will examine a large class of curvature flows by degree -1 homogeneous functions of principal curvatures in Euclidean spaces. This class of curvature flows includes the well-known inverse mean curvature flow and many others in the current literature. Self-expanding solutions to these curvature flows are solutions that expand homothetically without changing their shapes. We will talk about the uniqueness, rigidity, and constructions problems of both compact and non-compact self-expanding solutions to these flows. Part of these is joint work with G. Drugan, H. Lee; P. McGrath; and A. Chow, K. Chow.