

2019 Taiwan-Hong Kong Joint Workshop on Applied Mathematics

- Saturday, November 16, 2019

Time	Speaker
09:25~09:30	Opening
09:30~10:20	汪揚 (Yang Wang, HKUST) Scattering Transform and Stylometry Analysis in Arts
10:20~10:40	Break
10:40~11:10	Cristinel Mardare (CityU HK) Existence theorems in nonlinear elastostatics
11:10~11:40	項陽 (Yang Xiang, HKUST) Energy and dynamics of grain boundaries based on underlying microstructure
11:40~12:10	曾國師 (Kuo-Shih Tseng, NCU) Learning submodular functions for robotic applications
12:10~13:40	Lunch
13:40~14:30	王筱平 (Xiao-Ping Wang, HKUST) An iterative thresholding method for topology optimization
14:30~15:00	林得勝 (Te-Sheng Lin, NCTU) Autophoretic motion of an isotropic particle
15:00~15:20	Break
15:20~15:50	楊燦 (Can Yang, HKUST) One Century Journey of Statistical Genetics
15:50~16:20	林奕亘 (Yi-Hsuan Lin, NCTU) Inverse problems for semilinear elliptic equations with partial data
16:20~16:50	俞韋亘 (Wei-Hsuan Yu, NCU) Recent progress on equiangular lines
16:50~17:00	Break
17:00~17:30	Discussion

(11/16 Sat. 09 : 30 — 10 : 20)

Scattering Transform and Stylometry Analysis in Arts

Yang Wang

Department of Mathematics

Hong Kong University of Science and Technology

Abstract: With the rapid advancement in data analysis and machine learning, stylometry analysis in arts has gained considerable interest in recent years. A fundamental topic of research in stylometry is the detection of art forgery. But unlike many other machine learning applications, we typically face the challenge of not having enough data. In this talk I'll discuss how scattering transform can be applied to stylometry analysis, and demonstrate its effectiveness on Van Gogh paintings as well as another data set.

(11/16 Sat. 10 : 40 — 11 : 10)

Existence theorems in nonlinear elastostatics

Cristinel Mardare

Department of Mathematics
City University of Hong Kong

Abstract: In nonlinear elastostatics, the problem of finding the deformation of an elastic body subjected to external forces reduces to solving either a minimization problem, or a boundary value problem associated with a fully nonlinear elliptic system of partial differential equations. I will give a brief overview of the existence theory available in the literature, then will discuss a new approach to solving this problem.

(11/16 Sat. 11 : 10 — 11 : 40)

Energy and dynamics of grain boundaries based on underlying microstructure

Yang Xiang

Department of Mathematics

Hong Kong University of Science and Technology

Abstract: Grain boundaries are the interfaces of grains with different orientations in polycrystalline materials. Energetic and dynamic properties of grain boundaries play essential roles in the mechanical and plastic behaviors of the materials. These properties of grain boundaries strongly depend on their microscopic structures. We present continuum models for the energy and dynamics of grain boundaries based on the continuum distribution of the line defects (dislocations or disconnections) on them. The long-range elastic interaction between the line defects is included in the continuum models to maintain stable microstructure on grain boundaries during the evolution. The continuum models is able to describe both normal motion and tangential translation of the grain boundaries due to both coupling and sliding effects that were observed in atomistic simulations and experiments.

(11/16 Sat. 11 : 40 — 12 : 10)

Learning submodular functions for robotic applications

Kuo-Shih Tseng

Department of Mathematics
National Central University

Abstract: The AI community has been paying more attention to the submodular functions. The objective functions of various applications were formulated as maximizing submodular functions. Due to the submodularity, greedy algorithms can find solutions with theoretical guarantee for maximizing submodular problems even if these problems are NP-hard. However, learning submodular functions is still a challenging problem since the number of function outcome of N sets is 2^N .

In this talk, we will discuss how to efficiently learn submodular functions in the Fourier domain and apply this approach to robotic applications.

(11/16 Sat. 13 : 40 — 14 : 30)

An iterative thresholding method for topology optimization

Xiao-Ping Wang

Department of Mathematics

Hong Kong University of Science and Technology

Abstract: Topology optimization (TO) is a promising numerical technique for designing optimal engineering designs in many industrial applications. It is expected that it might become an unavoidable engineering tool for many new rising technologies such as the additive manufacturing or metal 3D printing. We propose an efficient and robust iterative thresholding method for topology optimization with applications to fluids and heat transfer system. For the Stokes fluid flow, the proposed algorithm is based on minimization of an objective energy function that consists of the dissipation power in the fluid and the perimeter approximated by nonlocal energy, subject to a fluid volume constraint and an incompressibility condition. We show that the minimization problem can be solved with an iterative scheme in which the Stokes problem is approximated by a Brinkman equation and solved with the mixed finite-element method. The indicator functions of the fluid-solid regions are then updated according to simple convolutions followed by a thresholding step. We demonstrate mathematically that the iterative algorithm has the total energy decaying property. The proposed algorithm is simple and easy to implement. Extensive numerical experiments in both two and three dimensions show that the proposed iteration scheme is robust, efficient and insensitive to the initial guess and the parameters in the model. Generalization to heat transfer system will also be discussed.

(11/16 Sat. 14 : 30 — 15 : 00)

Autophoretic motion of an isotropic particle

Te-Sheng Lin

Department of Applied Mathematics
National Chiao Tung University

Abstract: We study the spontaneous autophoretic motion of an isotropic particle by considering the dynamics of a two-dimensional circular shaped particle immersed in the Stokes flow. The particle is assumed to be chemically patterned uniformly and its surface either emits or absorbs surrounding solute particles. The solute concentration is governed by the advection- diffusion equation that is solved numerically by ultraspherical-Fourier spectral method. It is found that the particle exhibits symmetry-breaking behavior as well as chaotic-like motions.

(11/16 Sat. 15 : 20 — 15 : 50)

One Century Journey of Statistical Genetics

Can Yang

Department of Mathematics

Hong Kong University of Science and Technology

Abstract: A central question of genetics is to understand how genetic variations contribute to phenotypic variation. In this talk, we will begin our discussion with RA Fisher's 1918 seminal paper which largely resolved the debate between Mendelians and Biometricians (i.e., Pea vs. Height debate). To see why it is relevant in today's genome era and how it is related to data science, we will share a case study in genetic data analysis -- integration of large-size data with medium-size data for cross-population risk prediction. We will show that math/statistical modelling, efficient computation, and real data analysis are three necessary components to be seamlessly integrated in data science.

(11/16 Sat. 15 : 50 — 16 : 20)

Inverse problems for semilinear elliptic equations with partial data

Yi-Hsuan Lin

Department of Applied Mathematics
National Chiao Tung University

Abstract: We show that the knowledge of the Dirichlet–to–Neumann map on an arbitrary open portion of the boundary of a domain for a class of semilinear elliptic equations, determines the nonlinearity uniquely.

(11/16 Sat. 16 : 20 — 16 : 50)

Recent progress on equiangular line

Wei-Hsuan Yu

Department of Mathematics
National Central University

Abstract: Equiangular lines are the sets of lines such that for each pair of lines forms the same angle. To determine the maximum size of equiangular lines is one of the classical problems in discrete geometry area. In this talk, I will present our new progress on these topics, such as the solution of Lemmens-Seidel Conjecture. This is the joint work with Cao, Koolen and Lin.