
#1) Extended spectral-Galerkin method for singular problems

Chen Sheng, Shen Jie (Xiamen)

Abstract
The usual spectral methods will provide high-order accuracy for problems with smooth solutions. However, they may not work well for problems with singular so- lutions due to various facts such as corner singularities, non-matching boundary conditions, non-smooth coefficients. For many singular problems, it is possible to determine the forms of a few leading singular terms. It is expected that we can improve the convergence rate by adding these singular terms into the spectral basis. We present a new extended spectral-Galerkin method to solve some singular problems whose singularity could be determined in advance. The new method is very easy to implement, very efficient and is capable of providing very accurate approximations for a class of singular problems.

#2) Locally optimal configurations for the two-phase torsion problem in the ball

Cavallina Lorenzo (Tohoku)

Abstract
We consider the unit ball Ω filled with two materials with different conductivities $\sigma_-,\sigma_+>0$. We perform shape derivatives up to the second order to find out information about locally optimal configurations with respect to the torsional rigidity functional. In particular, we analyze the role played by the configuration obtained by putting a smaller concentric ball with conductivity σ_- inside Ω. Depending on the ratio of the conductivities and on the radius of the smaller ball, a symmetry breaking phenomenon occurs.

#3) Fractional spectral methods with applications to some singular problems

Hou Dianming (Xiamen)

Abstract
In this talk, we will present and analyze fractional spectral methods for a class of integro-differential equations and fractional differential equations, which can achieve spectral accuracy for solutions with limited regularity. The proposed methods make new use of the classical fractional polynomials, also known as M\"{u}ntz polynomials. The main novelty of the proposed methods is that the exponential convergence can be attained for any solution $u(x)$ with $u(x^{1/\lambda})$ being smooth, where λ is a real number between 0 and 1 and it is supposed that the problem is defined in the interval $(0,1)$. A series of numerical examples are provided to verify the efficiency of the methods.

#4) Reconstructing function from moments based on Beta distribution

Li Weiming (Peking)

Abstract
We consider how to recover a distribution function on the unit sphere when the only information we have is a finite number of its moments. The motivation for our work comes from attempts to construct moment models for the radiative transfer equation, which is the Boltzmann equation for photons. We propose an ansatz for the distribution function based on the Beta distribution. This ansatz can capture both isotropic and beam-like solutions. It also yields a moment model with fluxes in closed form, making it cost-effective for numerical simulations in engineering applications. Various properties of the model are studied.

#5) Mixing time for lamplighter random walks on fractals

Nakamura Chikara (Kyoto)

Abstract
For a graph G (referred to as underlying graph), a lamplighter graph is a graph equipped with lamps on each vertex of the graph G. A lamplighter random walk is a random walk on a lamplighter graph, which moves on the underlying graph G and switches a lamp at each step randomly. In this poster session, we consider cutoff phenomena of the lamplighter random walks in the case where underlying graphs are fractal like graphs. We discuss that there is no cutoff for the lamplighter random walk when the spectral dimension of the underlying graph is strictly less than 2 and there is a cutoff when the spectral dimension of the underlying graph is strictly bigger than 2. This is based on a joint work with Prof. Amir Dembo and Takashi Kumagai.

#6) Central limit theorems for non-symmetric random walks on nilpotent covering graphs

Namba Ryuya (Okayama)

Abstract
Studying the long time asymptotics for random walks on infinite graphs is a principal topic for both geometers and probabilists. A covering graph of a finite graph with a nilpotent covering transformation group is called a nilpotent covering graph, regarded as an extension of crystal lattices. We investigate non-symmetric random walks on nilpotent covering graphs from a view point of the theory of discrete geometric analysis developed by Kotani and Sunada. Our main purpose of this session is to obtain a functional central limit theorem for them under a certain condition.

We also discuss two examples of non-symmetric random walks on nilpotent covering graphs with several figures and animations. This is based on jointwork with Satoshi Ishiwata (Yamagata University) and Hiroshi Kawabi (Okayama University).

#7) Two-phase eigenvalue problem on thin domains with Neumann type boundary condition

Yachimura Toshiaki (Tohoku)

Abstract
In this talk, we consider an eigenvalue problem with piecewise constant coefficients on a thin domain with Neumann type boundary condition, and we analyze the asymptotic behavior of each eigenvalue as the domain degenerates into a certain hypersurface where the coefficients become discontinuous. Physically speaking, the problem dealt with in this talk is to consider the frequency of the composite material when two different

materials are joined thinly. We show how the discontinuity of the coefficients and the shape of the interface affect the asymptotic behavior of the eigenvalues by using a variational approach.

#8) Emergent dynamics of Kuramoto model in random environment

Ho Min Chan (Seoul)

Abstract
In this talk, we will present a new kinetic Kuramoto-Fokker-Planck model with diffusion.
This kinetic model studies the characteristics of Kuramoto model with the multiplicative noise. This proposed model is much better to analyze Kuramoto model in the random environment, since this model conserves very crucial characteristics of deterministic Kuramoto model, which other additive noise model cannot, such as complete synchronization of particles and other asymptotic behavior. We prove the existence of the equation, and also rigorously show the convergence from solution of particle model to the that of kinetic model.

#9) Emergence of Local Synchronization in an Ensemble of Heterogeneous Kuramoto Oscillators

Lee Jaeseung (Seoul)

Abstract
We study the emergence of local exponential synchronization in an ensemble of generalized heterogeneous Kuramoto oscillators with different intrinsic dynamics. In the classic Kuramoto model, intrinsic dynamics are given by the Kronecker flow with constant natural frequencies. We generalize the constant natural frequencies to smooth functions that depend on the state and time so that it can describe a more realistic situation arising from neuroscience. In this setting, the ensemble of generalized Kuramoto oscillators loses its synchronization even when the coupling strength is large. This leads to the study of a concept of “relaxed” synchronization, which is called “practical synchronization” in literature. In this new concept of “weak” synchronization, the phase diameter of the entire ensemble is uniformly bounded by some constant inversely proportional to the coupling strength.