Monday, 19 January

R102, 13:30-14:00

Liping Zhang (Fudan University)

Homotopy for Rational Riccati Equations Arising in Stochastic Optimal Control

We consider the numerical solution of the rational algebraic Riccati equations in R^n, arising from stochastic optimal control in continuous and discrete-time. Applying the homotopy method, we continue from the maximal stabilizing solutions of the deterministic algebraic Riccati equations, which are readily available. The associated differential equations require the solutions of some generalized Lyapunov or Stein equations, which can be solved by the generalized Smith methods, of $O(n^3)$ computational complexity and $O(n^2)$ memory requirement. For large-scale problems, where the relevant matrix operators are sparse, our algorithms are of $O(n)$ complexity and memory requirement, under favourable assumptions. In comparison, the alternative (modified) Newtons methods require a difficult (if possible) initial stabilization step. Some illustrative numerical examples are provided.

Keyword: Homotopy method, rational Riccati equations, generalized Lyapunov equations, generalized Stein equations, generalized Smith method.

R102, 14:10-14:40

Takeshi Gotoda (Kyoto University)

The alpha point vortex system and enstrophy variations

It is considered that enstrophy dissipation in weak solutions of the Euler equations are closely related with the turbulence theory in two dimension. However, it is uncertain what kind of weak solutions can dissipate. Under such a background, I am studying the alpha-point-vortex (alpha-PV) system derived from the Euler-alpha equations. Since the alpha-PV is a regularization of the point-vortex (PV) system, there is a possibility of obtaining the dissipating solutions of the PV by utilizing the alpha-PV. I will talk about the properties of the Euler-alpha equations and the relationship between the alpha-PV system and the PV system in terms of enstrophy dissipation.

Keywords: Turbulence, Euler-alpha equations, point vortex system

R102, 14:50-15:20

Cheng-Fang Su (National Central University)

The solvability of a linear parabolic equation without weak solutions

In this talk, we focus on the study of a linear parabolic equation which is a simplified version of the equations that describe the Navier-Stokes equations interacting with a nonlinear elastic shell. We investigate the solvability of this parabolic equation by introducing artificial viscosity κ and obtaining κ-independent estimates so that we can pass κ to the limit. The reason why we have to introduce artificial viscosities is that

we cannot even obtain a weak solution to the original problem without that. This work demonstrates the difficulties and technicality that requires to solve the nonlinear problem. This is a joint work with Professor Ching-Hsiao Cheng.

Keyword: Navier-Stokes equations, free boundary problems, shell theory.

R102, 15:40-16:10

Ryuichi Sato (Tohoku University)

Heat equation with a nonlinear boundary condition and unbounded initial functions

We establish the local existence and the uniqueness of solutions of the heat equation with a nonlinear boundary condition for the initial data in uniformly local L^r spaces. Furthermore, we study the sharp lower estimates of the blow-up time of the solutions with the initial data $\lambda\psi$ as $\lambda \to 0$ or $\lambda \to \infty$ and the lower blow-up estimates of the solutions. This talk is based on anoint work with Prof. Ishige in Tohoku University.

R102, 16:20-16:50

Junya Nishiguchi (Kyoto University)

Stabilization of unstable steady solution by delayed feedback control

The objective of the delayed feedback control (DFC) is to stabilize an unstable periodic orbit embedded in a chaotic attractor by adding a delayed feedback term to the original differential system.

For a smooth ODE $\dot{x}(t) = f(x(t))$ on $\mathbb{R}^n$ and its orbitally unstable periodic solution $\gamma(t)$ with the period $T > 0$, we consider the following differential equation:

$$\dot{x}(t) = f(x(t)) + K(x(t-\tau) - x(t)). \qquad (*)$$

Here $K \in \mathbb{R}^{n\times n}$ is an $n \times n$ real matrix, and $\tau = mT$, where m is a positive integer. Then the problem of the DFC is to find K and τ such that $\gamma(t)$ is orbitally stable as a solution of $(*)$.

In this talk, as a special case of the above problem, we consider the stabilization problem of an unstable steady solution $x^*(t) \equiv p$ by DFC. We show that the stabilization is possible on the assumption of the eigenvalues of the steady state p.

Keyword: Delayed feedback control, Delay differential equations, Stability of steady solutions, Characteristic equation.

R102, 17:00-17:30

Jie Kuang (Fudan University)

Two-dimensional steady supersonic exothermically reacting Euler flow past a bending wall

In this paper, we study the two-dimensional steady supersonic Euler flow moving over a Lipschitz bending wall which is a small perturbation of a convex one and establish the global existence of entropy solution when

the total variation of the initial data and the slope of the boundary are suciently small. The flow is governed by an ideal polytropic gas and undergoes a one-step exothermic chemical reaction and the reaction rate function is assumed to have a positive lower bound. We employ the modied wave front tracking scheme to construct the approximate solution In addition, the asymptotic behavior of the entropy solutions in the flow direction are also established.

Keyword: Steady supersonic reacting Euler flow, wave front tracking scheme, large rarefaction wave, bending wall, weak solution.

Tuesday, 20 January

R102, 13:00-13:30

MinKu Lee (Ewha Womans University)

Optimal Portfolios for Pension Plans under Hybrid Stochastic and Local Volatility

Based upon an observation that it is too restrictive to assume a definite correlation of the underlying asset price and its volatility, we use a hybrid model of the constant elasticity of variance and stochastic volatility to study a portfolio optimization problem for pension plans. By using asymptotic analysis, we derive a correction to the optimal strategy for the constant elasticity of variance model and subsequently the fine structure of the corrected optimal strategy is revealed. The result is a generalization of Mertons strategy in terms of the stochastic volatility and the elasticity of variance.

R102, 13:40-14:10

Wei-Da Chen (National Central University)

Martin Boundary for Gaussian Diffusion Processes

In this note, we study the Martin boundary for some Gaussian diffusion processes X_t. General theory of Martin boundary for Markov process has been well developed in the literature. See Kunita-Watanabe (1965), Dynkin (1969), Salminen (1981). One of its important applications is to give the unique representation of harmonic functions in terms of minimal Martin functions. There are very few concrete examples that properties of Martin boundary are studied, such as Brownian motion. Martin bounday for $2D$ Gaussian transient diffusion process were studied in Cranston-Orey-Rosler (1983). They studied the space time Martin boundary for such diffusion process. As a result, they obtained the representaion for positive harmonic functions. The space-time Martin boundary is to consider the Martin boundary for $\widetilde{X}_t = (t, X_t) \in (0, \infty) \times \mathbb{R}^d$ as a Markov process. In this note, we show how to generalize this idea to the high dimensional space. In this case, we first observe that the space-time Martin topology becomes concrete and can be described in terms of Euclidean topology. The Martin functions can be calculated using Riccati's equation. We will discuss the convergence of some h-diffusion process, the diffusion process under h-transform, where h is a positive space time harmonic function. As a result, "Hitting" probability measure will be calculated for some examples.

R102, 14:20-14:50

Ji-Hun Yoon (Seoul National University)

Analytic Approximation Formula for Option Pricing with the Stochastic Elasticity of Variance

They studies the solutions of the leading order term and correction order terms of the option price on the stochastic elasticity of variance (SEV) model using the Mellin transform technique. By using Mellin transform, they obtain the closed solutions of all order terms and they demonstrate that constructing these exact solutions have significant effects on the speed of the calibration of the model in real option market.

R102, 15:10-15:40

Wei-Chan Chang (National Taiwan University)

Asymptotic Analysis of Steric Poisson-Nernst-Planck Model for Multi-species Ions

Poisson-Nernst-Planck(PNP) system is commonly used as a model to describe the behaviour of ionic flow in a narrow and open ion channel. In this talk, we introduce a new type of PNP system by considering the steric effect (or size effect) which occurs due to the fact that each atom within a molecule occupies a certain amount of space. One of the main goals is to find the condition of the parameters exhibiting the steric effect under which the solutions of the multi-species PNP system are asymptotically stable. We make use of the skill, which is easier and more useful than former literature, for eigenvalues including positive semi-definite pencil in linear algebra to simplify the difficulties from analysis. To this end, some related numerical results will be given. Moreover, according to these numerical simulations, an exact point which we can observe is that the analytical results are consistent with the numerical results. Under the consideration of steric effect, our study provides a starting point for further investigations of the behaviour of ionic flow in an open ion channel. This is a joint work with Professor Tai-Chia Lin.

Keyword: Steric Poisson-Nernst-Planck(PNP), Asymptotically stable, Eigenvalue, positive semi-definite pencil

R102, 15:50-16:20

Shoichi Hasegawa (Tohoku University)

A critical exponent for Hénon type equation on the hyperbolic space

In this talk, we discuss a critical exponent for non-trivial stable solutions of a Henon type equation on the hyperbolic space. In 2007, A. Farina showed that Lane-Emden-Fowler equation on Euclidean space has no non-trivial stable solutions if the exponent is smaller than Joseph-Lundgren exponent. On the other hand, Berchio, Ferrero, and Grillo proved that the same equation has stable solutions for any exponent on some manifolds with negative sectional curvature in 2014. This result implies that the structure of stable solutions of the elliptic equation on the manifold is different from that on Euclidean space. In this talk, we study the non-existence of non-trivial stable solutions of the Henon type equation on some Riemannian models for small exponent. We also show an existence of non-trivial stable solutions on the hyperbolic space for large exponent.

R102, 16:30-17:00

Xuexiu Zhong (Tsinghua University)

On some nonlinear elliptic PDEs with Sobolev-Hardy critical exponents and a Li-Lin open problem

Let Ω be a C^1 open bounded domain in $\mathbf{R}^N$ $(N \geq 3)$ with either $0 \in \partial\Omega$ or $0 \in \Omega$. Consider the following PDE involving Hardy-Sobolev exponent:

$$\begin{cases} \Delta u + \lambda \frac{u^p}{|x|^{s_1}} + \frac{u^{2^*(s_2)-1}}{|x|^{s_2}} = 0 \quad \text{in } \Omega, \\ u(x) > 0 \text{ in } \Omega; \quad u(x) = 0 \text{ on } \partial\Omega, \end{cases}$$

where $0 \leq s_1 < 2, 0 \leq s_2 < 2, 2^*(s_2) := \frac{2(N-s_2)}{N-2}, 0 \neq \lambda \in \mathbf{R}, 1 \leq p \leq 2^*(s_1) - 1$. For some unsolved cases of the exponents and parameters, the existence of positive solutions or positive ground state solutions is obtained. We remark that we give the first, partial, answers to a question proposed by Y. Y. Li and C. S. Lin (ARMA, 2012).

Keyword: Li-Lin's open problem, Elliptic PDE, Ground state, Sobolev-Hardy exponent.

R102, 17:10-17:40

Zipeng Wang (Fudan University)

Composition operators on the Bergman space via quasiconformal mappings

Composition operator is a major subject in modern operator theory, and a typical object of study involves an analytic self-map of the unit disc as the symbol of the composition operator. Our goal is to extend the symbol from analytic to non-analytic symbols. We choose to work with symbols which are given by quasiconformal mappings. This also establishes new connections between operator theory and quasiconformal mappings. This is joint work with Professor Xiang Fang(National Central University, Chung-Li) and Professor Kunyu Guo(Fudan University, Shanghai).

Wednesday, 21 January

R102, 9:00-9:30

Kyung-Youn Kim (Seoul National University)

Global heat kernel estimates for symmetric Markov processes dominated by stable-like processes in exterior $C^{1,\eta}$ open sets

In this paper, we establish sharp two-sided heat kernel estimates for a large class of symmetric Markov processes in exterior $C^{1,\eta}$ open sets for all $t > 0$. The processes are symmetric pure jump Markov processes with jumping kernel intensity

$$\kappa(x,y)\psi(|x-y|)^{-1}|x-y|^{-d-\alpha}$$

where $\alpha \in (0,2)$, ψ is an increasing function on $[0,\infty)$ with $\psi(r) = 1$ on $0 < r \leq 1$ and $c_1 e^{\gamma_1 r^\beta} \leq \psi(r) \leq c_2 e^{\gamma_2 r^\beta}$ on $r > 1$ for $\beta \in [0,\infty]$. A symmetric function $\kappa(x,y)$ is bounded by two positive constants and

$|\kappa(x,y)-\kappa(x,x)| \le \kappa_1|x-y|^\rho$ for $|x-y|<1$ and $\rho > \alpha/2$. As a corollary of our main result, we estimates sharp two-sided Green function for this process in $C^{1,\eta}$ exterior open sets.

R102, 9:40-10:10

Guan Guohui (Tsinghua University)

Optimal reinsurance and investment strategies for insurer under interest rate and inflation risks

In this talk, we investigate an optimal reinsurance and investment problem for an insurer whose surplus process is approximated by a drifted Brownian motion. Proportional reinsurance is to hedge the risk of insurance. Interest rate risk and inflation risk are considered. We suppose that the instantaneous nominal interest rate follows an OrnsteinVUhlenbeck process, and the inflation index is given by a generalized Fisher equation. To make the market complete, zero-coupon bonds and Treasury Inflation Protected Securities (TIPS) are included in the market. The financial market consists of cash, zero-coupon bond, TIPS and stock. We employ the stochastic dynamic programming to derive the closed-forms of the optimal reinsurance and investment strategies as well as the optimal utility function under the constant relative risk aversion (CRRA) utility maximization. Sensitivity analysis is given to show the economic behavior of the optimal strategies and optimal utility.

R102, 10:20-10:50

Jehan Oh (Seoul National University)

Global Calderón-Zygmund theory for asymptotically regular nonlinear elliptic and parabolic equations

We consider nonhomogeneous elliptic and parabolic problems involving a discontinuous nonlinearity and an asymptotic regularity over an irregular domain in divergence form of p-Laplacian type, to establish the global Calderón-Zygmund estimate by converting a given asymptotically regular problem to a suitable regular problem.

R102, 11:00-11:30

Yu Wu (Fudan University)

Application of Bayesian networks in Schizophrenia

It has been found in numerous studies that brain volume deficits in schizophrenia. We believe that there are vital regions driving the structural changes and aim to pinpoint these regions to find out the cause of the brain volume deficit. We use the grey matter volume to learn the Bayesian network that represents the interaction between brain regions. The parameters of the network are calculated based on the optimal structure, and both global and local likelihood are obtained for each individual. We are able to classify and predict healthy controls and patients only using the brain volume, which is different from the traditional function-based way.

R102, 11:40-12:10

Kuang-Hui Lin (National Chiao Tung University)

Global Dynamics for Two-species Competition in Patchy Environment

An ODE system modeling the competition between two species in a two-patch environment is studied. Both species move between the patches with the same dispersal rate. It is shown that the species with larger birth rates in both patches drives the other species to extinction, regardless of the dispersal rate. The more interesting case is when both species have the same average birth rate but each species has larger birth rate in one patch. It has previously been conjectured by Gourley and Kuang (2005) that the species that can concentrate its birth in a single patch wins if the diffusion rate is large enough, and two species will coexist if the diffusion rate is small. We solve these two conjectures by applying the monotone dynamics theory, incorporated with a complete characterization of the positive equilibrium and a thorough analysis on the stability of the semi-trivial equilibria with respect to the dispersal rate. Our result on the winning strategy for sufficiently large dispersal rate might explain the group breeding behavior that is observed in some animals under certain ecological conditions.

Keyword: Competition, Patch model, Monotone dynamics, Global dynamics, stability.

Thursday, 22 January

R102, 13:00-13:30

Chao Yi (Fudan University)

On Supersonic Flow past an Infinite Delta Wing

In this talk, we study some mathematical aspects on supersonic flow past a delta wing. Here the wing is assumed to be infinite along its edges, so we need only to seek self-similar solutions to this supersonic shock problem, which is formulated as a free boundary value problem of nonlinear mixed-type equation. In the case that the wing is of no thickness, the mixed-type equation then reduces to a degenerate elliptic equation, and thus an existence result can be established by using the framework of Chen-Feldman for regular shock reflection problem. Moreover, some differences between the regular shock reflection model and the general delta wing model are discussed. This talk is based on a joint work with Prof. Shuxing Chen.

R102, 13:40-14:10

Yi-Hsuan Lin (National Taiwan University)

Reconstruction of penetrable obstacles in the anisotropic acoustic scattering

We develop an enclosure-type reconstruction scheme to identify penetrable obstacles in acoustic waves with anisotropic medium in $\mathbb{R}^3$. The main difficulty of treating this problem lies in the fact that there are no complex geometrical optics solutions available for the acoustic equation with anisotropic medium in $\mathbb{R}^3$. Instead, we will use another type of special solutions called oscillating-decaying solutions. Even though

that oscillating-decaying solutions are defined only on the half space, we are able to acquire needed boundary inputs by the Runge approximation property. Moreover, since we are considering a Helmholtz-type equation, we turn to Meyers' L^p estimate to compare the integrals coming from oscillating-decaying solutions and those from reflected solutions.

R102, 14:20-14:50

Kuan-Hsiang Wang (National Cheng Kung University)

Low Regularity Global Well-Posedness for the Quantum Zakharov System in 1D

In this talk, we consider the quantum Zakharov system in one spatial dimension. Following the approaches given in the works of Ginibre-Tsutsumi-Velo, Colliander-Holmer-Tzirakis, and Jiang-Lin-Shao, we prove the global well-posedness problem of the system for initial data with low regularity, $(E(0); n(0); \partial_t n(0)) \in L^2 \times H^{-\frac{2}{3}} \times H^{-\frac{2}{7}}$.

Keyword: quantum Zakharov system, global well-posedness, multilinear estimates.

R102, 15:10-15:40

Yuexun Wang (Tsinghua University)

Formation of singularities to the EulerVPoisson Equations

We will discuss formation of singularities to the EulerVPoisson equations. The finite time blow-up of smooth solutions to the Cauchy problem for multidimensional EulerVPoisson equations is proved for a large class of initial data, which contains the cases of full EulerVPoisson equations and isentropic EulerVPoisson equations with repulsive forces or attractive. It does not require that the initial data have compact support or contain vacuum in any finite region.

R102, 15:50-16:20

Enlin Yang (Tsinghua University)

Logarithmic version of the Milnor formula and the characteristic cycle of a tamely ramified sheaf

In SGA 7, Deligne proved a formula for the total dimension of the space of vanishing cycles at an isolated singularity of a morphism from a smooth variety to a smooth curve over an algebraically closed field of characteristic $p > 0$. As a logarithmic variant of this formula, we prove an analogous formula for vanishing cycles with a coefficient sheaf tamely ramified along a divisor with normal crossings. This implies that the characteristic cycle of a tamely ramified sheaf satisfies a Milnor formula.

R102, 16:30-17:00

Shih-Wei Chou (National Central University)

The generalized Glimm method to nonlinear hyperbolic balance laws

In this talk, we study the Cauchy problem and initial boundary value problem to nonlinear hyperbolic balance laws. Such nonlinear balance laws arise in, for instance, the nozzle flows of gas dynamics with time dependent ducts, traffic models incorporating lane changing effects model, Fanno-Rayleigh flows with variable ducts and hydrodynamic escape problem involves effects of gravity and heat. The global existence of weak solutions is established by a new version of the generalized Glimm method.