Abstracts

Time delay model for the stochastic volatility with regime switching

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August 21st – August 24th, 2017

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Abstract

We study the effect of communication time delay in the stochastic volitility model introduced by the authors in B-H-K-L-L-Y (2015). Due to the finite propagation speed of communication (information) flow, the positive time delay effect is necessary in many network systems arising from biology, communication networks. When the regime switching and time delay are both present in the coupled system for asset's volatility, many interesting nonlinear and dynamic phenomena can occur, e.g., finite-time oscillators in short-time scale, continuous dependence of time delay in the asymptotic volatility values etc. In this paper, we present a sufficient framework leading to the exponential convergence of the volatilities toward the constant asymptotic values. We also provide several numerical simulations and compare them with analytical results.

MEMO

Convergence to equilibrium in Wasserstein distance for damped Euler equations with interaction forces

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Abstract

In this talk, we study the convergence to global equilibrium of damped Euler equations in Wasserstein distance under the influences of confining and nonlocal interaction forces. We also discuss the strong relaxation limit to a nonlocal equation used in the modelling of granular media by employing Wasserstein distance. This is a joint work with J. A. Carrillo(Imperial College London, UK) and O. Tse(Eindhoven University of Technology, Netherlands).

MEMO

Phase transitions for the Gray-Scott model

Jongmin Han

August 21st - August 24th, 2017

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Abstract

In this talk, we analyze the phase transitions of the n-dimensional Gray-Scott model. For $n = 1, 2$, taking the diffusion coefficient of the reactor as a bifurcation parameter, we verify that the Turing instability occurs below the critical numbers and obtain rigorous formula for the bifurcated stable solutions.

MEMO

On the mathematical analysis of synchronization

Chun-Hsiung Hsia

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Abstract

This is joint work with Professor Bongsuk Kwon and Professor Chang-Yeol Jung. In this talk, we will present our recent work on the synchronization problem for Kuramoto model and some other related models.

MEMO

Synchronization of Kuramoto-type oscillators with applications in power grids

Zhuchun Li

August 21st - August 24th, 2017

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Abstract

In this talk we will introduce some resent results on the synchronization of Kuramoto-type oscillators. The motivation is that the power grid in engineering can be typically modelled by a system of Kuramoto-type oscillators. We pay special attention to its potential applications in the stability of power grid.

MEMO

Emergent behaviors of the Schrödinger-Lohe model on cooperative-competitive networks

Hyungjin Huh

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Abstract

We present several sufficient frameworks leading to the emergent behaviors of the coupled Schrödinger-Lohe (S-L) model under the same one-body external potential on cooperative-competitive networks. The S-L model was first introduced as a possible phenomenological model exhibiting quantum synchronization and its emergent dynamics on all-to-all cooperative networks has been treated via two distinct approaches, Lyapunov functional approach and the finite-dimensional reduction based on pairwise correlations. In this paper, we further generalize the finite-dimensional dynamical systems approach for pairwise correlation functions on cooperative-competitive networks and provide several sufficient frameworks leading to the collective exponential synchronization. For small systems consisting of three and four quantum subsystem, we also show that the system for pairwise correlations can be reduced to the Lotka-Volterra model with cooperative and competitive interactions, in which lots of interesting dynamical patterns appear, e.g., existence of closed orbits and limit-cycles.

MEMO

A dichotomy in the dissipation estimates for the polatomic BGK model

Seok-Bae Yun

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Abstract

In this talk, we consider a dichotomy observed in the dissipation estimates for the polyatomic BGK model. By dissipation estimate, we mean either the entropy-entropy production estimate of the nonlinear polyatomic BGK model, or the coercive estimate of the linearized polyatomic relaxation operator. In the former case, we observe a jump in the coefficient and the target equilibrium state as a relaxation parameter tends to zero. In the latter case, we show that the coefficient and the degeneracy of the coercive estimate see a sudden jump as the same relaxation parameter reaches zero. We also discuss how these two results are related.

MEMO

Approximations of the damped semilinear wave equation on a 1-d bounded domain: error estimates and decay properties

Debora Amadori

August 21st - August 24th, 2017

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Abstract

We consider a semilinear system with space-dependent and nonlinear damping, related to the one-dimensional damped wave equation. On a bounded interval, with reflecting boundary conditions, we define approximate solutions of *well-balanced* type, that preserve stationary solutions.

We present two different approaches to their analysis. The first one leads to rigorous L^1 error estimates in terms of the mesh size and shows that the L^1 difference with exact solutions is bounded uniformly in time, therefore leading to accurate estimates for large times; it extends the analysis done for the Cauchy problem done in [1], [2]. The second approach aims at obtaining decay estimates of the approximation solution to the stationary one, as $t \to \infty$. Such estimates are qualitatively similar to those ones satisfied by the exact solutions. This second approach combines some tools from probability (nonhomogeneous discrete Markov chains) and from matrix analysis. This is a joint work with Fatima Aqel and Edda Dal Santo (University of L'Aquila, Italy).

[1] D. Amadori, L. Gosse. Error Estimates for Well-Balanced and Time-Split Schemes on a Damped Semilinear Wave Equation. *Math. Comp.* **85** (2016), 601-633

[2] D. Amadori, L. Gosse. Error Estimates for Well-Balanced Schemes on Simple Balance Laws. One-Dimensional Position-Dependent Models, *SpringerBriefs in Mathematics*, 2015

MEMO

Conformal field theory of multiple Schramm-Loewner Evolutions

Nam-Gyu Kang

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Abstract

I will present certain implementations of CFT of multiple SLEs in a simply connected domain. The statistical fields in these implementations are generated by the background charge modifications of Gaussian free field under the neutrality condition and N-leg operators. Introducing Ward functional as an insertion operator under which the correlation functions are transformed into their Lie derivatives, I will describe a connection between CFT and the random curves of the multiple SLEs. This presentation is based on an ongoing work with T. Alberts and N. Makarov.

MEMO

On a three dimensional vision based collision avoidance model

Céline Parzani and Francis Filbet

August 21st - August 24th, 2017

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Abstract

This paper presents a three dimensional collision avoidance approach for aerial vehicles inspired by coordinated behaviors in biological groups. The proposed strategy aims to enable a group of vehicles to converge to a common destination point avoiding collisions with each other and with moving obstacles in their environment. The interaction rules lead the agents to adapt their velocity vectors through a modification of the relative bearing angle and the relative elevation. Moreover the model satisfies the limited field of view constraints resulting from individual perception sensitivity. From the proposed individual based model, a mean-field kinetic model is derived. Simulations are performed to show the effectiveness of the proposed model.

MEMO

Molecular Mechanisms Underlying the Kuramoto Model of Coupled Oscillators

Jae Kyoung Kim

August 21st - August 24th, 2017

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Abstract

The Kuramoto model has been widely used to describe the synchronizations of a large set of coupled oscillators. In particular, the Kuramto model successfully captures the key features of synchronization of 20,000 coupled cellular rhythms in the circadian clocks of our brain. However, due to the abstractness of the Kuramoto model, specific molecular mechanisms underlying the sinusoidal coupling terms have not been identified. In this talk, I will discuss that the combination of intracellular transcriptional repression mechanisms and intercellular coupling mechanisms in the mammalian circadian clocks can lead to such sinusoidal coupling.

MEMO

Eulerian hydrodynamics and commutators for Cucker-Smale models with singular couplings

Juan Soler

August 21st - August 24th, 2017

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Abstract

This talk deals with the derivation and analysis of a compressible Euler–type equation with singular commutator, which is derived from a hyperbolic limit of the kinetic description to the Cucker–Smale model of interacting individuals. Some extensions of these ideas to other collective dynamic descriptions, such as those of Kuramoto-type models, are discussed.

MEMO

Rate of Convergence towards Semi-Relativistic Hartree Dynamics

Ji Oon Lee

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Abstract

In this talk, we consider the semi-relativistic system of N graviatating Bosons and analyze the rate of convergence of the Schrödinger dynamics towards Hartree dynamics by using the coherent state in the Fock space representation. We show that the difference between the many-body Schrödinger dynamics and the corresponding semi-relativistic Hartree dynamics is at most of order N^{-1}. The result covers the sub-critical regime and the super-critical regime.

MEMO

Hebbian learning in the Kuramoto model with regular and singular weighted couplings

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Abstract

We study the synchronization of a generalized Kuramoto system in which the coupling weights are determined by the phase differences between oscillators. We employ the fast-learning regime in a Hebbian-like plasticity rule so that the interactions between oscillators are enhanced by the approach of phases. We present the dynamics of the system equipped with both regular and singular types of coupling weights. Especially, for singular weights, we inspect the well-posedness of the system for subcritical and critical cases. We show the distinctive features in the emregence of synchronization.

MEMO

Bianchi solutions to the Einstein-Boltzmann system with a positive cosmological constant

Ho Lee

August 21st - August 24th, 2017

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Abstract

We study the future global existence and late-time behaviour of solutions to the Einstein-Boltzmann system with a positive cosmological constant. For the Einstein equations we consider Bianchi type symmetries, for instance Bianchi type I and V. For the Boltzmann equation we consider the scattering kernel of Israel particles which are the relativistic counterpart of Maxwellian particles. Under the smallness assumption on initial data in a suitable norm we show that solutions exist globally in time and isotropize at late times.

MEMO

A uniform bound from below of the angle between the fast and slow spaces for two-sided sequences of bounded operators in a Banach space

Philippe Thieullen

August 21st - August 24th, 2017

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Abstract

We consider a two-sided sequence of bounded operators in a Banach space which are not necessarily injective and satisfy the following two properties (SVG) and (FI). The singular value gap (SVG) property says that two successive singular values of the cocycle at some index r admit a uniform exponential gap, the fast invertibility (FI) property says that the cocycle is uniformly invertible on the fastest r-dimensional direction. We prove the existence of a uniform equivariant splitting of the Banach space into a fast space of dimension r and a slow space of codimension r. We compute an explicit constant of the bound from below of the angle between these two spaces using solely the constants defining the properties (SVG) and (FI). We extend the results obtained by Bochi-Gourmelon in finite dimension for bijective operators and the results obtained by Blumenthal-Morris in infinite dimension for injective norm-continuous cocycles, in the direction that no dynamical system is involved, no compactness of the underlying system, no smoothness of the cocycle is required. Moreover we give quantitative estimates of the angle between the fast and slow spaces that are also new in finite dimension for bijective operators.

MEMO

A new flocking model: Thermodynamic Cucker-Smale model

Jeongho Kim

August 21st - August 24th, 2017

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Abstract

In this talk, I will provide a new collective dynamics model, called Thermodynamic Cucker-Smale (TCS) model. The original Cucker-Smale model only consider particle's mechanical variables, such as their position and velocity. However, it is not reasonable in the real life example, because each agency has their own internal property. Therefore, in the TCS model, we only consider their "internal variable" in the dynamics. We begin with the particle model, and then move to kinetic and hydrodynamic model.

Stability of basic wave patterns to some kinetic equations

Yi Wang

August 21st - August 24th, 2017

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Abstract

First I will talk about the hydrodynamic limit of Boltzmann equation to the compressible Euler equations in the setting of 1D generic Riemann solutions, which is a superposition of three basic hyperbolic wave patterns: two nonlinear waves, i.e., shock and rarefaction waves and one linearly degenerate wave: contact discontinuity. Then I will talk about the time-asymptotic stability of these three basic wave patterns to the bipolar Vlasov-Poisson-Boltzmann system, based on a new micro-macro type decomposition around the local Maxellian.

MEMO

Emergent dynamics of Kuramoto oscillators under the effect of additive white noises

Dongnam Ko

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Abstract

From Huygens' observation on two synchronous pendulum clocks in the middle of 17th century, its rigorous studies have been started only in several decades ago by two pioneers Winfree and Kuramoto. The Kuramoto model is extensively studied because of its good properties, such as conservation of total phase velocity and existence of analytic potential. In this talk, we consider the Kuramoto model with additive noise, which is given by Brownian motion of oscillators' phases. The main concern is to present a sufficient framework which leads to the synchronization under noise. In the deterministic Kuramoto model, the synchronization phenomenon is observed by particles trajectory which goes to a stable equilibrium point. Due to the additive noise, a sink is no longer stable, and the particle-path analysis can be described only under some probability. With a short introduction on the potential analysis from the large-deviation theory, we will see how Lyapunov functional approach works on particle-path analysis for the stochastic Kuramoto oscillators.

MEMO

Global classical solutions to 2D Compressible Navier-Stokes Fokker-Planck equations with large initial data

Qinghua Xiao

August 21st - August 24th, 2017

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Abstract

We study a hydrodynamic model for the interaction between collision-free Cucker-Smale flocking particles and a viscous compressible fluid. Explicitly our model consists of the kinetic Cucker–Smale–Fokker–Planck (CS–FP) model and the isentropic compressible Navier–Stokes (N–S) equations for the fluid, and these two models are coupled through a drag force. The global existence of classical solutions to the 2D coupled system with large initial data which my contain vacuum is established. This is a extension of our previous work from 1D case to the 2D case.

MEMO

Phase transition and critical coupling in 1-D Cucker-Smale model

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August 21st - August 24th, 2017

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Abstract

We study one-dimensional Cucker-Smale (C-S) model with N agents in potential form, and yield the sufficient and necessary condition for m-cluster formation based on the initial velocity, spatial positions and coupling strength. Then we can construct corresponding critical coupling strength. Moreover, we will study the number of clusters, the structure and asymptotic velocities of each clusters.

MEMO

Phase concentration and incoherent solution of the kinetic Kuramoto equation

Yinglong Zhang

August 21st - August 24th, 2017

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Abstract

The synchronization of large populations of weakly coupled oscillators is a ubiquitous phenomenon in complex biological and physical systems. Such synchronization has received considerable attention because of its diverse applications. In this talk, I will introduce the Kuramoto model and talk about the phase concentration and stability of incoherent solution of its kinetic equation.

MEMO

MEMO

A hydrodynamic limit of the kinetic Cucker-Smale model with local alignment

Moon-Jin Kang

August 21st - August 24th, 2017

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Abstract

We discuss about the kinetic Cucker-Smale model with local alignment as a mesoscopic description for the flocking dynamics. The local alignment was first proposed by Karper, Mellet and Trivisa, as a singular limit of a normalized non-symmetric alignment introduced by Motsch and Tadmor. This talk mainly focuses on the hydrodynamic limit of the kinetic Cucker-Smale model with local alignment towards the pressureless Euler system with nonlocal alignment, under a regime of strong local alignment.

MEMO