Investors' Herding Modeling

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August 6 – 10, 2018

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Abstract

In this paper, we study the herding phenomena in financial markets arising from the combined effect of (1) non-coordinated collective interactions between the market players and (2) concurrent reactions of market players to dynamic market signals. By interpreting the expected rate of return of an asset and the favorability on that asset as position and velocity in phase space, we construct an agent-based particle model for herding behavior in finance. We then define two types of herding functionals using this model, and show that they satisfy a Gronwall type estimate and a LaSalle type invariance property respectively, leading to the herding behavior of the market players. Various numerical tests are presented to numerically verify these results.

A smoothing proximal gradient algorithm for nonsmooth convex regression with cardinality penalty

Wei Bian and Xiaojun Chen

August 6 – 10, 2018

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Abstract

In this report, we focus on the constrained sparse regression problem, where the loss function is convex but nonsmooth, and the penalty term is defined by the cardinality function. Firstly, we give an exact continuous relaxation problem in the sense that both problems have the same optimal solution set. Moreover, we show that a vector is a local minimizer with the lower bound property of the original problem if and only if it is a lifted stationary point of the relaxation problem. Secondly, we propose a smoothing proximal gradient (SPG) algorithm for finding a lifted stationary point of the continuous relaxation model. Our algorithm is a novel combination of the classical proximal gradient algorithm and the smoothing method. We prove that the proposed SPG algorithm globally converges to a lifted stationary point of the relaxation problem, has the local convergence rate of $o(k^{-\tau})$ with $\tau \in (0, \frac{1}{2})$ on the objective function value, and identifies the zero entries of the lifted stationary point in finite iterations. Finally, we use one example to illustrate the validity of the continuous relaxation model and the good numerical performance of the smoothing proximal gradient algorithm.

A collisionless singular Cucker-Smale model with decentralized formation control

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August 6 – 10, 2018

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Abstract

In this talk, we address the design of decentralized feedback control laws inducing consensus and prescribed spatial patterns over a singular Cucker-Smale type model. The control design consists of a feedback term regulating the distance between each agent and pre-assigned neighbors. For the proposed controller, we study consensus formation, collision-avoidance, and formation control features.

A Generalized Continuous-Time Algorithm for Distributed Nonsmooth Constrained Optimization Over Directed Graphs

Wenwen Jia and Sitian Qin

August 6 – 10, 2018

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Abstract

In this talk, I will present a generalized continuous-time algorithm for distributed nonsmooth constrained optimization over directed graphs. Firstly, a generalized continuous-time algorithm modeled by a differential variational inequality is proposed to settle a distributed non-differentiable optimization for a multi-agent network over directed graphs. In the considered communication topology, the first-order neighbors and the second-order neighbors of each agent can exchange information. The proposed algorithm is demonstrated to be able to reach consensus and ultimately converges to the optimal solution under several mild assumptions. Compared with the previous continuous-time algorithms, the proposed algorithm has the least number of state variables and can solve the distributed constrained optimization in directed case. Finally, two numerical simulations and an application in power system are delineated to show the characteristics and practicability of the presented algorithm.

A Subgradient-based Continuous-time Algorithm for Constrained Distributed Quadratic Programming

Xinrui Jiang, Sitian Qin and Xiaoping Xue

August 7, 2018

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Abstract

In this talk, I study a distributed quadratic programming with local linear equality and linear inequality constraints over a directed graph. To solve this distributed optimizaton problem, I propose a subgradient-based continuous-time algorithm. Firstly, I prove that the equilibrium points of the proposed algorithm are corresponding to the optimal solutions of the considered distributed optimization problem. Secondly, in order to derive the convergence of the proposed continuous-time algorithm, I obtain that the Łojasiewicz inequality holds around the equilibrium points and the related Łojasiewicz exponent is 1/2. Next, I obtain the exponential convergence to an equilibrium point of the presented algorithm via Łojasiewicz inequality. In particular, I also derive the finite-time convergence when the considered optimization problem is degenerated to a linear one. To verify the effectiveness of the proposed algorithm, I carry out some numerical examples and an application of the presented algorithm to a realistic scenario of robust estimation in wireless sensor networks.

Emergent behaviors of continuous and discrete thermomechanical Cucker-Smale models on general digraphs

Jiu-Gang Dong[1], Seung-Yeal Ha[2] and Doheon Kim[3]

August 6 – 10, 2018

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Abstract

We present emergent dynamics of continuous and discrete thermomechanical Cucker-Smale(TCS) models equipped with temperature as an extra observable on general digraph. In previous literature, the emergent behaviors of the TCS models were mainly studied on a complete graph, or symmetric connected graphs. Under this symmetric setting, the total momentum is a conserved quantity. This determines the asymptotic velocity and temperature a priori using the initial data only. Moreover, this conservation law plays a crucial role in the flocking analysis based on the elementary ℓ_2 energy estimates. In this paper, we consider a more general connection topology which is registered by a general digraph, and the weights between particles are given to be inversely proportional to the metric distance between them. Due to this possible symmetry breaking in communication, the total momentum is not a conserved quantity, and this lack of conservation law makes the asymptotic velocity and temperature depend on the whole history of solutions. To circumvent this lack of conservation laws, we instead employ some tools from matrix theory on the scrambling matrices and some detailed analysis on the state-transition matrices. We present two sufficient frameworks for the emergence of mono-cluster flockings on a digraph for the continuous and discrete models. Our sufficient frameworks are given in terms of system parameters and initial data.

Asymptotic behavior and stability problem for the Schrödinger-Lohe model

Dohyun Kim

August 6 – 10, 2018

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Abstract

We present asymptotic behavior and stability problem for the Schrödinger-Lohe(S-L) system which was first introduced as a possible phenomenological model exhibiting quantum synchronization. We present several sufficient frameworks leading to the emergent behavior of the S-L system. More precisely, we show that there are only two possible asymptotic states: completely synchronized state or bi-polar state. Furthermore, we provide the standing wave solutions for the S-L model with the harmonic potential and discuss the stability for standing wave solutions.

Remarks on the Fokker-Planck type equations derived from the synchronous particle models

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August 6 – 10, 2018

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Abstract

In kinetic theory of many-body systems, it is well known that the mean-field kinetic equations can effectively describe the large ODE systems. In this talk, we present two types of viscous kinetic mean-field equations: the Kuramoto-Sakaguchi-Fokker-Planck(KS-FP) equation and the swarming model on a unit sphere. For the KS-FP equation, we study the stability and instability of the incoherent state where all particles are uniformly distributed on the phase space. The similar results are also sought with the swarming model on the unit sphere. These phenomena depend on the interplay between the diffusion and coupling strength between the particles.

Closed-loop control of complex network: noise, time, and energy

Wei Lin

August 6 – 10, 2018

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Abstract

Close-loop control, which adjusts its signal instantaneously according to the system states or delayed states, has several outstanding advantages including its robustness against noise. In the literature, developed has been a variety of closed-loop intervention protocols: from deterministic forms to stochastic versions, from finite-time controllers to delayed feedbacks, and even from adaptive forms to controllers with intelligent learning configurations. This talk is to give a brief review of recent progress achieved in closed-loop control of complex networks, and present how the essential parameters of networks and in controllers influence the time and energy consumptions in controlling complex networks. Also, this talk will propose a trade-off problems in realizing the optimal control of complex networks.

A Novel Neurodynamic Approach to Constrained Complex-variable Pseudoconvex Optimization

Na Liu and Sitian Qin

August 6 – 10, 2018

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Abstract

Complex-variable pseudoconvex optimization has been widely used in numerous scientific and engineering optimization problems. In this talk, I will present a neurodynamic approach for the complex-variable pseudoconvex optimization problems subject to bound and linear equality constraints. An efficient penalty function is introduced to guarantee the boundedness of the state of the presented neural network, and make the state enter the feasible region of the considered optimization in finite time and remain there thereafter. The state is also shown to be convergent to an optimal point of the considered optimization. Compared with other neurodynamic approaches, the presented neural network needn't any penalty parameters, and has lower model complexity. Furthermore, some additional assumptions in other existing related neural networks are also removed here, such as the assumption that the objective function is lower bounded over the equality constraint set and so on. Finally, some numerical examples and an application in beamforming formulation are provided.

Consensus, clustering and patterns for delayed group systems

Yicheng Liu

August 6 – 10, 2018

National University of Defence Technology, Changsha

Abstract

Two or more groups with different initial opinions can develop into a consensus with appropriate inter- and intra-group interactions and communication delay. In this talk, we consider the case when zero is a semi-simple eigenvalue of the normalized connection matrix, and we expand the concept of consensus where opinions of all individual agents must converge to the common (consensus) value to the weak consensus where opinions are clustered and the consensus value is no longer a scalar constant but a vector in a certain consensus subspace. The linearity of the system enables us to adopt an argument of Atay, using the phase space decomposition in terms of the standard bilinear form for functional differential equations, to derive sharp conditions for the system to reach a weak consensus, and to calculate the consensus vector. This calculation also informs how the consensus value of the coupled systems depends on the consensus of the subgroups, initial conditions and communication delay. We also point out the challenge of extending these results to nonlinear versions of the opinion dynamical systems with delay.

Several bifurcation results on the Kuramoto model with time delays

Ben Niu

August 6 – 10, 2018

Department of Mathematics, Harbin Institute of Technology, Weihai

Abstract

In this presentation, I will talk about some bifurcation results about the KM with time delays, by which some conditions to ensure the synchronization transition are given. Precisely, I will talk about the KM with one single delay or distributed delays subjected to some PDF, from the point of view of Hopf bifurcation, Bautin bifurcation or double Hopf bifurcation.

Hebbian learning and clustering in Kuramoto models with singular weighted couplings

Jinyeong Park

August 6 – 10, 2018

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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 interaction between oscillators is enhanced by the approach of phases. First, we adapt classical techniques of Kuramoto model to the case of regular types of coupling weights. Second, we present the dynamics of the system equipped with singular weights in all the subcritical, critical and supercritical regimes of the singularity. A key fact is that solutions in the most singular cases must be considered in Filipov's sense. We also study the emergence of synchronization.

Derivation of the Vlasov equation

Peter Pickl

August 6 – 10, 2018

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Abstract

Solving the evolution equation for an interacting N-particle system analytically or numerically is, in many cases, very difficult or even impossible. However, there are situations where the correlations between the particles are negligible. In many such cases it is possible to give an effective one-particle descriptions which explains most of the physics, and to proof the validity of this effective description with mathematical rigor when N goes to infinity ("derive the equation"). One of the most basic systems one can think of is the dynamics of N stars forming a galaxy, interacting via gravitation. The effective one particle description one expects to be valid is the Vlasov equation. Deriving the Vlasov equation for this system is, however, still an open problem: the technical difficulty comes from the singularity of the interaction. In the talk I will present recent results where the interaction is slightly changed by an N-dependent cutoff. Since very similar models, where these techniques can directly be applied, do describe also other systems, e.g. from biology and the social sciences, the results and technique have vast applications for Multi-agent Systems from different fields.

A Neurodynamic Approach to Constrained Nonconvex Optimization Problems

Sitian Qin and Na Liu

August 6 – 10, 2018

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Abstract

In this talk, I will present a neurodynamic approach to nonconvex optimization problems with equality and inequality constraints, where the proposed neural network endows with a time-varying auxiliary function. The new constructed time-varying auxiliary function can guarantee that the state of the proposed neural network reaches the feasible region in finite time and remains there thereafter. It is shown that the state with any initial point converges to the critical point set of the considered optimization problem. Moreover, the state is proved to be globally convergent to an optimal solution of the considered optimization problem when the objective function is pseudoconvex. Compared with other neural networks for related nonconvex optimization problems, the proposed neural network here has lower model complexity and doesn't depend on some additional assumptions, such as the inequality feasible region is bounded, the penalty parameter is sufficiently large and the objective function is lower bounded over the equality feasible region. Finally, some numerical examples and an application in real-time data reconciliation are provided to display the well performance of the proposed neural network.

Emergent dynamics of the inertial spin model with a multiplicative communication weight

Woojoo Shim

August 6 – 10, 2018

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Abstract

We study emergent dynamics of the deterministic inertial spin model with multiplicative communication weight arising from the flocking model of self-propelled particles with spin, which has been designed for the collective dynamics of the active particles with spin as an internal variable. When the generalized moment of inertia tends to zero and mutual communication weight is a function of a relative distance between interacting particles, the deterministic inertial spin model formally reduces to the Cucker-Smale(CS) model with constant speed constraint whose emergent dynamics has been extensively studied in the previous literature. In this paper, we present several sufficient frameworks leading to the asymptotic mono-cluster flocking, in which relative spins and relative velocities tend to zero asymptotically. We also provide several numerical simulations for the decoupled and coupled inertial spin models to see the effect of the C-S velocity flocking and compare them with our analytical results.

Proximal gradient algorithm with extrapolation for structured nonsmooth optimization problems

Bo Wen

August 6 – 10, 2018

Hebei University of Technology

Abstract

In this talk, we mainly consider proximal gradient algorithm with extrapolation for minimizing the sum of a Lipschitz differentiable function and a proper closed convex function. Under one error bound condition, we first establish the linear convergence rate of iterate sequence generated by the algorithm. Moreover, the corresponding sequence of objective values is also linearly convergent. In addition, the threshold reduces to 1 for convex problems and, as a consequence, we obtain the linear convergence of the sequence generated by FISTA with fixed restart. If the Lipschitz differentiable function is in addition convex, we show that for a large class of extrapolation parameters including the extrapolation parameters chosen in FISTA, the successive changes of iterates go to 0. Moreover, based on the Lojasiewicz inequality, we establish the global convergence of iterates generated by the proximal gradient algorithm with extrapolation with an additional assumption on the extrapolation coefficients which allow the threshold of the extrapolation coefficients to be 1. In particular, we prove the length of the iterates is finite. Finally, we present some numerical experiments to illustrate our results.

A Neurodynamic Approach to Pseudomonotone Variational Inequality with Inequality and General Constraints

Xingnan Wen and Sitian Qin

August 6 – 10, 2018

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Abstract

In recent years, variational inequality has attracted wide attention in engineering and economics. In this talk, I will present a projection neural network to solve pseudomonotone variational inequality problem with inequality and general constraints. The state of the proposed neural network starts from general constraints set will remain there forever. And the state will enter the inequality constraints set in finite time and remain there thereafter. Furthermore, the state of projection neural network is shown to converge to an optimal solution of the given variational inequality. Finally, the validity and efficiency are checked out by some simulation examples.

Asymptotic stability of the phase-homogeneous solution to the Kuramoto-Sakaguchi equation with inertia

Qinghua Xiao

August 6 – 10, 2018

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Abstract

We present the global-in-time existence of strong solutions and its large-time behavior for the Kuramoto-Sakaguchi equation with inertia. The equation describes the evolution of the probability density function for a large ensemble of Kuramoto oscillators under the effects of inertia and stochastic noises. We consider a perturbative framework around the equilibrium, which is a Maxwellian type, and use the classical energy method together with our careful analysis on the macro-micro decomposition. We establish the global-in-time existence and uniqueness of strong solutions when the initial data are sufficiently regular, not necessarily close to the equilibrium, and the noise strength is also large enough. For the large-time behavior, we show the exponential decay of solutions towards the equilibrium under the same assumptions as those for the global regularity of solutions. This is a joint work with Prof. Seung-Yeal Ha, Prof. Young-Pil Choi and Yinglong Zhang.

New Challenges for Distributed Cooperative Control and Optimization in Complex Networks

Wenwu Yu

August 6 – 10, 2018

Southeast University, China

Abstract

In this talk, the multi-agent collective behaviors and some of their potential applications are briefly reviewed. In particular, the consensus problem in multi-agent systems with first-order, second-order, and higher-order dynamics is investigated in details. Then, some extensions and recent progress for general protocols in multi-agent systems will be given. Furthermore, the new directions and challenges for the research work on this topic will be discussed.

Quantum BGK model near a global Fermi-Dirac distribution

Seok-Bae Yun

August 6 – 10, 2018

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Abstract

In this talk, we consider the existence and asymptotic behavior of a fermionic quantum BGK model, which is the relaxation model of the quantum Boltzmann equation for fermions, in the case when the initial data starts sufficiently close to a global Fermi-Dirac distribution.

Critical parameters in 1-D Cucker-Smale model

Xiongtao Zhang

August 6 – 10, 2018

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Abstract

In this talk, we will investigate 1-D Cucker-Smale model and yield various critical parameter for mono-cluster and multi-cluster in complete and general graph respectively. More precisely, for all-to-all short range interaction and fixed initial data, we increase the coupling strength κ from 0 to infinity and compute for each κ the number of cluster, number of particles and asymptotical velocity of each cluster. Then we obtain all critical values of κ at which the number of clusters change. While for general graph, we will show the critical condition for non conditional flocking is non-integrability of interaction function. Therefore, for original CS model, the critical parameter is exactly one half.

Collective behaviors of Cucker-Smale and Kuramoto model

Yinglong Zhang

August 6 – 10, 2018

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Abstract

Self-organized collective motions, such as the aggregation of bacteria, flocking of birds, and swarming of fish, are often observed in complex biological systems. Recently, collective motions have been extensively investigated because of their potential applications to unmanned aerial vehicles and client network equipment. In this talk, I will introduce the famous Cucker-Smale model and Kuramoto model, and talk about their collective behaviors.

Understanding physical mixing processes via transfer operator approach

Yiwei Zhang

August 6 – 10, 2018

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Abstract

Industrial and chemical mixing processes of various kinds occur throughout nature and are vital in many technological applications.In the context of discrete dynamical systems, the transfer operator approach has been shown as a powerful tools from both theoretic and numerical viewpoint. In this talk, I will use a toy model (i.e., the one dimensional stretch and fold map) as an example to provide a brief introductionon the relationships between the spectral properties of the associated transfer operator and the estimations of the optimal mixing rate of the mixing process. Moreover, I will address how the optimal mixing rate varies according to thestretch and fold map has "cutting and shuffling" behaviour (i.e., composing with a permutation). If time permits, I will also talk about how to interpret this problem to the eigenvalue estimations for the Random bistochastic matrices (free probability theory) and the locations of poles of the dynamical zeta function.

Formation, stability and basin of phase-locking for Kuramoto oscillators bidirectionally coupled in a ring

Xiaoxue Zhao

August 6 – 10, 2018

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Abstract

We consider the dynamics of bidirectionally coupled identical Kuramoto oscillators in a ring, where each oscillator is influenced sinusoidally by two neighboring oscillator. Our purpose is to understand its dynamics in the following aspects: 1. identify all the phase-locked states (or equilibria) with stability or instability; 2. estimate the basins for stable phase-locked states; 3. identify the convergence rate towards phase-locked states. The crucial tool in this work is the celebrated theory of Łojasiewicz inequality.