



Tsinghua Sanya International Mathematics Forum

(清华三亚国际数学论坛)

Workshop on Collective Dynamics of Multi-agent Systems Modeling, Analysis and Applications

January 9 - 13, 2017

No.100 Tsinghua Rd., Tianya District, Sanya, Hainan.

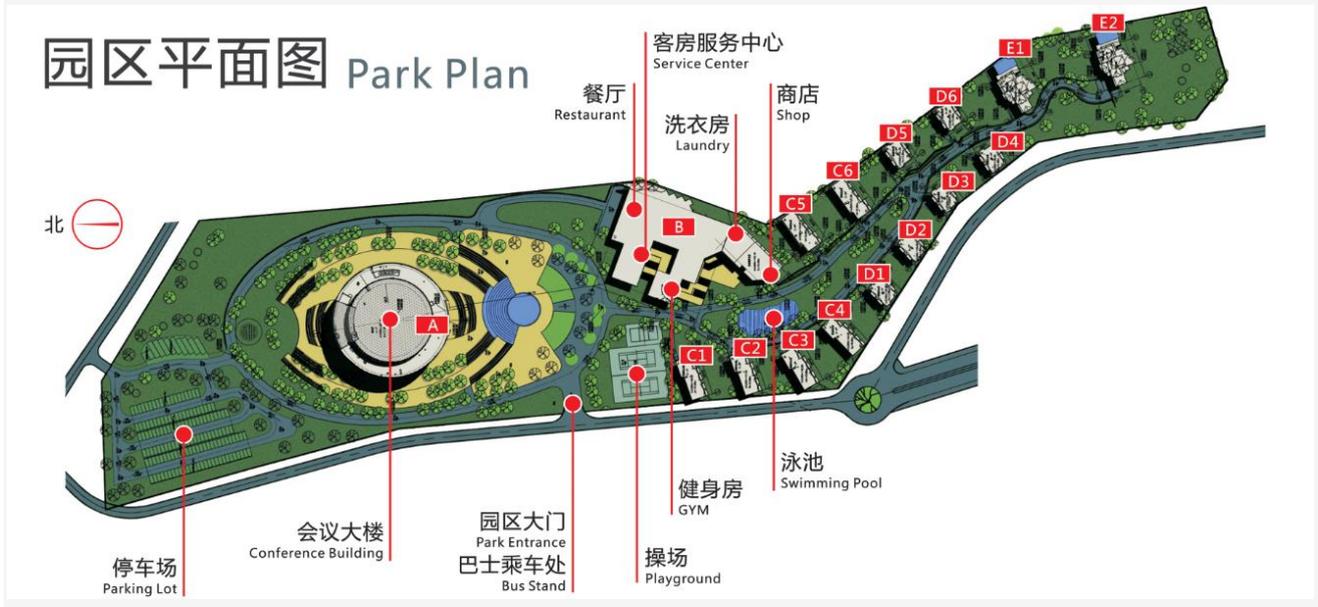
(海南省三亚市天涯区清华路100号)

Welcome to TSIMF

The facilities of TSIMF are built on a 23-acre land surrounded by pristine environment at Phoenix Hill of Phoenix Township. The total square footage of all the facilities is over 29,000 square meter that includes state-of-the-art conference facilities (over 10,000 square meter) to hold many international workshops simultaneously, two libraries, a guest house (over 10,000 square meter) and the associated catering facilities, a large swimming pool, gym and sports court and other recreational facilities.

Mathematical Sciences Center (MSC) of Tsinghua University, assisted by TSIMF's International Advisory Committee and Scientific Committee, will take charge of the academic and administrative operation of TSIMF. The mission of TSIMF is to become a base for scientific innovations, and for nurturing of innovative human resource; through the interaction between leading mathematicians and core research groups in pure mathematics, applied mathematics, statistics, theoretical physics, applied physics, theoretical biology and other relating disciplines, TSIMF will provide a platform for exploring new directions, developing new methods, nurturing mathematical talents, and working to raise the level of mathematical research in China.

About Facilities



Registration

Conference booklets, room keys and name badges for all participants will be distributed at the Registry. Please take good care of your name badge. It is also your meal card and entrance ticket for all events.

Guest Room



Conference Center can receive about 378 people having both single and double rooms, and 42 family rooms.

All the rooms are equipped with: free Wi-Fi, TV, air conditioning and other utilities.

Family rooms are also equipped with kitchen and refrigerator.

Library

Opening Hours: 08:00am-22:00pm

TSIMF library is available during the conference and can be accessed by using your room card. There is no need to sign out books but we ask that you kindly return any borrowed books to the book cart in library before your departure.

Restaurant



All the meals are provided in the Chinese Restaurant (Building B1) according to the time schedule.

Breakfast	07:30-08:30
Lunch	12:00-13:30
Dinner	17:30-19:00

Laundry

Opening Hours: 24 hours

The self-service laundry room is located in the Building 1 (B1), next to the shop.

Convenience Store

The convenience store is located in Building 1 (B1), next to the laundry.

The store sells snacks, beer, soft drinks, notepads, bathing suits and various etc.

Gym

The gym is located in the Building 1 (B1), opposite to the reception hall. The gym provides various fitness equipment, as well as pool tables, tennis tables and etc.

Playground

Playground is located on the east of the central gate. There you can play basketball, tennis and badminton. Meanwhile, you can borrow table tennis, basketball, tennis balls and badminton at the reception desk.

Swimming Pool



Please note that there are no lifeguards. We will not be responsible for any accidents or injuries. In case of any injury or any other emergency, please call the reception hall at +86-898-38882828.

Shuttle Service:

We have shuttle bus to take participants to the airport for your departure service. Also, we would provide transportation at the Haipo Square (海坡广场) of Howard Johnson for the participants who will stay outside TSIMF. If you have any questions about transportation arrangement. Please feel free to contact Ms. Li Ye (叶莉), her cell phone number is (0086)139-7679-8300.

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Schedule for Workshop on Collective Dynamics of Multi-agent Systems Modeling, Analysis and Applications, Jan. 9-13, 2017

Time & Date	Monday (Jan. 9)	Tuesday (Jan. 10)	Wednesday (Jan. 11)	Thursday (Jan. 12)	Friday (Jan. 13)
7:30-8:30	<i>Breakfast</i>				
<i>Chair</i>	<i>Seung-Yeal Ha</i>	<i>Wenwu Yu</i>	<i>Hyeong-Ohk Bae</i>	<i>Yicheng Liu</i>	Discussion
9:00-9:40	Hyeong-Ohk Bae	Yi Wang	Seung-Yeal Ha	Wenwu Yu	
9:40-10:20	Chunyin Jin	Yinglong Zhang	Jiu-Gang Dong	Qinghua Xiao	
10:20-10:50	<i>Tea Break</i>				
10:50-11:30	Xiongtao Zhang	Wei Lin	Xiang Li	Zhuchun Li	Discussion
11:30-12:00	Discussion	Discussion	Discussion & Group Photo	Discussion	
12:00-14:00	<i>Lunch & Break</i>				
<i>Chair</i>	<i>Yi Wang</i>	Free Discussion 13:30-17:00	<i>Zhuchun Li</i>	Free Discussion 13:30-17:00	Departure
14:30-15:10	Seok-Bae Yun		Lining Ru		
15:10-15:40	<i>Tea Break</i>		<i>Tea Break</i>		
15:40-16:20	Dongnam Ko		Le Li		
16:20-18:00	Discussion		Discussion		
18:00-19:30	<i>Dinner</i>	<i>Banquet 18:00-20:00</i>	<i>Dinner</i>	<i>Dinner</i>	<i>Dinner</i>

Asymptotic flocking dynamics of Cucker-Smale particles immersed in compressible fluids

Hyeong-Ohk Bae

Department of Financial Engineering, Ajou University, Suwon 443-749, Korea

Abstract: We propose a coupled system for the interaction between Cucker-Smale flocking particles and viscous compressible fluids, and present a global existence theory and time-asymptotic behavior for the proposed model in the spatial periodic domain T^3 . Our model consists of the kinetic Cucker-Smale model for flocking particles and the isentropic compressible Navier-Stokes equations for fluids, and these two models are coupled through a drag force, which is responsible for the asymptotic alignment between particles and fluid. For the asymptotic flocking behavior, we explicitly construct a Lyapunov functional measuring the deviation from the asymptotic flocking states. For a large viscosity and small initial data, we show that the velocities of Cucker-Smale particles and fluids are asymptotically aligned to the common velocity.

Coworkers: Young-Pil Choi, Seung-Yeal Ha, Moon-Jin Kang

On Flocks Influenced by Closest Neighbors

Jiu-Gang Dong

Department of Mathematics, Harbin Institute of Technology, China

Abstract: We prove, both for continuous time and discrete time, results establishing convergence to flocking in a model in which each agent is influenced by only a few closest neighbors. We show unconditional convergence to flocking when this number of closest neighbors is at least half of the population and, otherwise, conditional convergence. That is, convergence to flocking provided the initial positions and velocities satisfy an explicit constraint. We also show that the proportion of neighbors necessary for unconditional convergence, one half, is sharp. This is a joint work with Prof. Felipe Cucker.

Mathematical challenges for classical and quantum synchronization

Seung Yeal Ha

Department of Mathematical Sciences, SNU

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Abstract: Synchronization of oscillators denotes a phenomenon for the adjustment of rhythms among weakly coupled oscillators, and one of collective modes appearing in oscillatory complex systems such as ensembles of Josephson junctions array, pacemaker cells and fireflies etc. In this talk, I will briefly report the recent progress for synchronization and discuss some challenging open problems arising from synchronization via the Kuramoto and Lohe models.

Some mathematical results on the Cucker-Smale model and related models

Chunyin Jin

Beijing International Center for Mathematical Research, Peking University

Abstract: Cucker-Smale model is a simplified model used for describing flocking phenomenon in nature. In this talk, we will show the bi-cluster flocking phenomenon for the short-ranged Cucker-Smale model under some conditions. As for the kinetic Cucker-Smale model with the cut-off interaction function, we will prove the existence of the weak solutions by using weak convergence method.

Particle-path analysis on Kuramoto oscillators under additive noise

Dongnam Ko

Department of mathematical science, Seoul National University

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 on 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 particle's 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.

CASCADE FLOCKING WITH FREE-WILL AND WEAK FLOCKING BEHAVIOR

Le Li (National University of Defense Technology)

Abstract: In this talk we will introduce a self-organized system with a hierarchy structure to allow multiple leaders in the highest rank, and with free-will. In the model, we use both Cucker-Smale and Motsch-Tadmor functions for the pair influence of agents, and we derive sufficient conditions for such a system to converge to a flock, where agents ultimately move in the same velocity. Also, the weak flocking is introduced which means that the agents do not need have the same velocities to keep together at any time $t > 0$. This is the biggest difference with the flocking behavior. We propose a weak flocking model with two agents and study two different mechanisms for this model. Otherwise, we also consider a system with N agents. Under the weak link mechanism, the system can keep weak flocking.

A Rotating Consensus Algorithm for Second-Order Dynamics

Xiang Li (National University of Defense Technology)

Abstract: Collective behavior is a common natural phenomenon, such as fish swimming, birds flocking and agents synchronizing. Collective theory is an important branch of complex systems and shows various applications in the field of economic, military and management. This paper investigates the collective rotating motions of a team of vehicles in three dimensions by introducing a rotation matrix to an existing algorithm for double-integrator dynamics. The result is that if the topology structure, the rotation angle, and the damping gain satisfy some conditions, the system will finally achieve asymptotic consensus or rotating consensus.

On the synchronization of coupled oscillators with frustration

Zhuchun Li

Department of Mathematics, Harbin Institute of Technology

Abstract: In this talk we will briefly present some rigorous results in the synchronization of coupled oscillators with frustrations, including both first-order and second-order models.

Adaptive Elimination of Synchronization in Coupled Oscillators

Wei Lin (ISTBI and School of Mathematical Sciences, Fudan University)

Abstract: In this talk, we introduce an adaptive control technique with a feedback delay to achieve synchronization elimination in a large population of coupled and synchronized oscillators. We validate the feasibility of this technique not only in the coupled Kuramoto's oscillators with unimodal or bimodal distribution of natural frequencies, but also in representative analog models of neuronal networks, e.g. the FitzHugh-Nagumo spiking oscillators and the Hindmarsh-Rose bursting oscillators. More significantly, we discover how the exact form of natural frequency distribution influences the performance of this technique with a feedback delay. It is expected that the developed technique as well as the physical discoveries could be potentially useful for designing automatic controllers, e.g. deep brain stimulators, to remedy some synchronization-induced mental disorders including Parkinson disease and epilepsy.

Multi-cluster flocking behavior of the hierarchical Cucker-Smale model

Lining Ru

Department of Mathematics, Harbin Institute of Technology

Abstract: In this report, we investigate the multi-cluster flocking behavior of the hierarchical Cucker-Smale model parameterized by a constant β measuring the strength of the interaction between agents. The previous studies showed that when $0 \leq \beta < 1/2$ unconditional flocking would occur, while for $\beta \geq 1/2$ conditional flocking would occur provided the initial data satisfy some given conditions. We will show in this report that, when $\beta = 1/2$, unconditional flocking would occur for the model, while for $\beta > 1/2$, we give a complete understanding for the asymptotic multi-cluster formation when the initial positions and velocities have the ordering relations: by computing the initial data we can specify how many clusters emerge and which agents are in the same cluster.

Keywords: hierarchical Cucker-Smale model; multi-cluster flocking; L_1 -norm.

L^2 -contraction of large planar shock waves for multi-dimensional scalar viscous conservation laws

Yi Wang

Academy of Mathematics and Systems Science, CAS

Abstract: We consider L^2 contraction of large viscous shock wave for the multi-dimensional scalar viscous conservation laws, up to a suitable shift. The shift function depends on both time and space variable, which solves a parabolic equation with inhomogeneous coefficient reflecting the perturbation. We consider a suitably small L^2 -perturbation around a viscous planar shock

wave of arbitrarily large strength. However, we do not impose any conditions on the anti-derivative variables of the perturbation around shock profile. More precisely, it is proved that if the initial perturbation around the viscous shock wave is suitably small in L^2 norm, then L^2 contraction holds true for the viscous shock wave up to a shift function which may depend on the temporal and spatial variables. Moreover, as the time t tends to infinity, the L^2 contraction holds true up to a time-dependent shift function. In particular, if we choose some special initial perturbation, then we can prove a L^2 -convergence of perturbation towards shock profile up to a time-dependent shift. It is a joint work with Alexis Vasseur (University of Texas at Austin, USA) and Moon-Jin Kang (University of Texas at Austin, USA).

Emergent dynamics of the Cucker-Smale particles under the effects of a random communications and incompressible fluids

Qinghua Xiao

Wuhan Institute of Physics and Mathematics, Chinese Academy of Science

Abstract: We study the dynamics of infinitely many Cucker-Smale (C-S) flocking particles under the interplay of a random communication and incompressible fluid. For the dynamics of ensemble of flocking particles, we use the kinetic Cucker-Smale-Fokker-Planck (CS-FP) equation with a degenerate diffusion coefficient, whereas for the fluid part, we use the incompressible Navier-Stokes (N-S) equations. These two subsystems are coupled via the drag force. For this coupled model, we present global existence of weak and strong solutions in \mathbb{R}^d ($d=2$ or 3). Under extra regularity assumptions of initial data, the unique solvability of strong solutions is also established in \mathbb{R}^2 . In a large coupling regime and a periodic spatial domain, we show that the velocities of C-S particles and fluids are asymptotically aligned to constant velocities in a two-dimensional periodic spatial domain $\mathbb{T}^2 = \mathbb{R}^2 / \mathbb{Z}^2$.

Some Thoughts on Distributed Cooperative Control in Multi-agent Systems

Wenwu Yu (Eastsouth University)

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.

Ellipsoidal BGK model for polyatomic particles

Seok-Bae Yun (Sungkyunkwan University, Korea)

Abstract: In this talk, we present our recent results on the polyatomic ellipsoidal BGK model, which is a relaxation type kinetic model describing the time evolution of phase space distribution of polyatomic particles.

Uniform stability and mean-field limit of flocking model

Xiongtao Zhang (Seoul National University)

Abstract: In this paper, we present uniform stability estimates for flocking model with respect to the initial data. In this study, we show that the mixed Lebesgue norm between two solutions is uniformly bounded by the same mixed Lebesgue norm between two initial data with the same total momentum. As a direct application of the uniform stability, we obtain the uniform-in-time mean-field limit from the particle model to the kinetic model in the Wasserstein metric.

Emergence dynamics for Cucker-Smale flocking particles

Yinglong Zhang (Seoul National University)

Abstract: Merging and separation of flocking groups are often observed in our natural complex systems. In this talk, we introduce the Cucker-Smale particle model to model such merging and separation phenomena, and talk about the emergence of global and local flocking for this model.