International Video-workshop on Infinite Dimensional Dynamical Systems

September 12th and 19th 2020,
Donghua University, Shanghai, China

The aim of this workshop is to present recent progress and discuss current challenges on infinite-dimensional dynamical systems and their applications.

VooV/Tencentmeeting webinar links:
https://voovmeeting.com/s/Hfsg3VZpxpA8
Metting ID: 833 0266 3939

List of Invited Speakers

Tomas Caraballo (University of Sevilla, Spain)
Maurizio Grasselli (Politecnico di Milano, Italy)
Xiaoying Han (Auburn University, USA)
Irena Lasiecka (University of Memphis, USA)
Alain Miranville (University of Poitiers, France)
Morgan Pierre (University of Poitiers, France)
Roberto Triggiani (University of Memphis, USA)
Sergey Zelik (University of Surrey, UK)

Organizing Committee

Alain Miranville
(University of Poitiers, Alain.Miranville@math.univ-poitiers.fr)
Yuming Qin
(Donghua University, yuming@dhu.edu.cn)

Sponsor

Institute for Nonlinear Science, Donghua University, Shanghai, China

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Program

Saturday, September 12		
Beijing Time 16:40—17:00	**Opening Ceremony**	**Chair: Alain Miranville**
Beijing Time 17:00—18:00 UK Time 10:00-11:00 France Time 11:00-12:00	Chair: Alain Miranville	Speaker: **Sergey Zelik**
Beijing Time 18:00—19:00 France Time 12:00-13:00 UK Time 11:00-12:00	Chair: Sergey Zelik	Speaker: **Alain Miranville**
Beijing Time 19:00—20:00 France Time 13:00-14:00 USA Time 07:00-08:00	Chair: Xiaoying Han	Speaker: **Morgan Pierre**
Beijing Time 20:00—21:00 USA Time 08:00-09:00 France Time 14:00-15:00	Chair: Morgan Pierre	Speaker: **Xiaoying Han**

Saturday, September 19		
Beijing Time 18:00—19:00 Italy Time 12:00-13:00 Spain Time 12:00-13:00	Chair: Tomas Caraballo	Speaker: **Maurizio Grasselli**
Beijing Time 19:00—20:00 Spain Time 13:00-14:00 Italy Time 13:00-14:00	Chair: Maurizio Grasselli	Speaker: **Tomas Caraballo**
Beijing Time 20:00—21:00 USA Time 08:00-09:00	Chair: Irena Lasiecka	Speaker: **Roberto Triggiani**
Beijing Time 21:00—22:00 USA Time 09:00-10:00	Chair: Roberto Triggiani	Speaker: **Irena Lasiecka**
Beijing Time 22:00—22:10	**Closing**	**Chair: Yuming Qin**

Fractional impulsive stochastic differential equations with unbounded delay

Tomas Caraballo

University of Sevilla, Spain

This talk is first devoted to the local and global existence of mild solutions for a class of fractional impulsive stochastic differential equations with infinite delay driven by both $\mathbb{K}$-valued Q-cylindrical Brownian motion and fractional Brownian motion with Hurst parameter $H\in(1/2,1)$. A general framework which provides an effective way to prove the continuous dependence of mild solutions on initial value is established under some appropriate assumptions. Furthermore, it is also proved the exponential decay to zero of solutions to fractional stochastic impulsive differential equations with infinite delay. Finally, some comments and remarks will be mentioned concerning the existence of attractings sets.

Mass conserving Navier-Stokes-Allen-Cahn and Euler-Allen-Cahn systems

Maurizio Grasselli

Politecnico di Milano, Italy

I intend to present some recent results on a model of phase separation in (incompressible) liquids proposed by M.-H. Giga, A. Kirshtein, and C. Liu in 2018. This model consists of the Navier-Stokes system coupled with the conserved Allen-Cahn equation with Flory-Huggins potential. Density and viscosity may depend on the phase field. The inviscid case will also be discussed.

Lattice models arising from neural networks

Xiaoying Han

Auburn University, USA

In this talk I will introduce a few interesting lattice dynamical systems arising from neural network applications. Their long term dynamics will be studied by theory and techniques of dynamical systems. The talk will focus on the models and methodology applied to study these models, without including details of technical proofs.

Mathematical theory of evolutions arising in flow structure interactions

Irena Lasiecka

University of Memphis, USA

An appearance of a flutter in oscillating structures is an endemic phenomenon. Most common causes are vibrations induced by the moving flow of a gas (air, liquid) which is interacting with the structure. Typical examples include: turbulent jets, vibrating bridges [Tacoma bridge], oscillating facial palate at the onset of apnea. In the case of an aircraft it may compromise its safety. The intensity of the flutter depends heavily on the speed of the flow (subsonic, transonic or supersonic regimes). Thus, reduction or attenuation of flutter is one of the key problems in aeroelasticity with applications to a variety of fields including aerospace engineering, structural engineering, medicine and life sciences.

Mathematical models describing this phenomenon involve strongly coupled systems of partial differential equations (Euler Equation and nonlinear plate equation) with interaction at the interface - which is the boundary surface of the structure. The analysis of the model leads to consideration of nonlocal PDE's.This talk aims at providing a brief overview of recent developments in the area along with a presentation of some recent advances. More specifically the following general issues will be discussed:(1) qualitative properties of the resulting dynamical systems (existence, uniqueness and robustness of weak solutions), (2) asymptotic stability and associated long time behavior that includes the study of global attractors, (3) feedback control strategies aiming at the elimination or attenuation of the flutter. Since the properties of the flutter depend heavily on the speed of the flow (subsonic, transonic or supersonic), it is natural that the resulting mathematical theories will be very different in the subsonic and supersonic regimes. In fact, supersonic flows are known for depleting ellipticity from the corresponding static model.

Thus, both well posedness of finite energy solutions and long time behavior of the model have been open questions in the literature. The results presented include: generation of a dynamical system associated with the model. Existence of global and finite dimensional attracting sets for the elastic structure in the absence of mechanical dissipation. Strong convergence to multiple equilibria for the subsonic models will be also discussed.

Mathematical models for glial cells

Alain Miranville

Universiy of Poitiers, France

Our aim in this talk is to discuss mathematical models for glial cells and energy metabolism in the brain. In particular we discuss the existence of global in times solutions for a Cahn-Hilliard type model.

Convergence of exponential attractors for a finite element discretization of the Allen-Cahn equation

Morgan Pierre

University of Poitiers, France

We consider a space semidiscretization of the Allen-Cahn equation by P1 finite elements. We build a family of exponential attractors associated to the discretized equations which is robust as the mesh parameterhtends to 0. As a corollary, we obtain an upper bound on the fractal dimension of the global attractor which is independent of h. Our proof is adapted from the result of Efendiev, Miranville and Zelik concerning the continuity of exponential attractors under perturbation of the underlying semigroup. We will also discuss the case of a time discretization and some perspectives.

Uniform stabilization of the 3d-Navier-Stokes equations by finite dimensional, localized, boundary-based feedback controllers

Roberto Triggiani

University of Memphis, USA

The study of uniform stabilization of Navier-Stokes equations by feedback controls was initiated about 20 years ago. The following problem remained open: can the localized, boundary-based, stabilizing controls be asserted to be finite dimensional also for d=3? Prior results (2015) required the additional assumption that the Initial Conditions be compactly supported. We shall provide an affirmative solution of this problem. It will require a drastic change of the functional setting from the Sobolev-Hilbert based setting of past literature to a Besov space setting with tight indeces. Moreover, a novel procedure will be given. It will require establishing maximal regularity of the linearized, boundary feedback uniformly stable problem to handle the non-linear analysis. This is joint work with Irena Lasiecka and Buddhika Priyasad.

Deterministic and random attractors for a wave equation with sign changing damping

Sergey Zelik

University of Surrey, UK

We discuss the dynamics generated by weakly damped wave equations in bounded 3D domains where the damping exponent depends explicitly on time and may change sign. It is shown that in the case when the non-linearity is superlinear, the considered equation remains dissipative if the weighted mean value of the dissipation rate remains positive.

Two principally different cases are considered. In the case when this mean is uniform (which corresponds to deterministic dissipation rate), it is shown that the considered system possesses smooth uniform attractors as well as non-autonomous exponential attractors. In the case where the mean is not uniform (which corresponds to the random dissipation rate), the tempered random attractor is constructed. In contrast to the usual situation, this random attractor is expected to have infinite dimension. The simplified model example which demonstrates infinite-dimensionality of the random attractor is also presented.