SCAPDE 2019: SCHEDULE AND ABSTRACTS OF TALKS

SATURDAY, JUNE 1

8:45–9:35

Stochastic Hamilton-Jacobi equations: An update and qualitative properties

Panagiotis Souganidis (Chicago)

I will present new results about qualitative properties of the solutions of stochastic Hamilton-Jacobi equations. These Include domain of dependence, intermittent regularization, long time behavior and regularity properties.

9:45–10:35

Speeds and homogenization for reaction-diffusion equations in random media

Jessica Lin (McGill)

The study of spreadings speeds, front speeds, and homogenization in random heterogeneous media is a driving source of interest in the general study of reaction-diffusion equations, with many applications to mathematical modelling. In this talk, I will discuss the relationship between these three topics, and present a general approach to stochastic homogenization which builds upon the existence of deterministic spreading and front speeds. This talk is based on joint work with Andrej Zlatoš.

———— Coffee Break ————

11:15–12:05

Recent progress on singularity formation of 3D Euler equations and related models

Thomas Hou (Caltech)

Whether the 3D incompressible Euler equations can develop a singularity in finite time from smooth initial data is one of the most challenging problems in mathematical fluid dynamics. We first review the numerical evidence of finite time singularity for 3D axisymmetric Euler equations by Luo and Hou. The singularity is a ring like singularity that occurs at a stagnation point in the symmetry plane located at the boundary of the cylinder. We then present a novel method of analysis and prove that the 1D HL model develops finite time self-similar singularity. We also apply this method of analysis to prove finite time self-similar blowup of the original De Gregorio model for some smooth initial data on the real line with compact support. Self-similar blowup results for the generalized De Gregorio model for the entire range of parameter on the real line or on a circle have been obtained for Holder continuous initial data with compact support. Finally, we report our recent progress in analyzing the finite time singularity of the axisymmetric 3D Euler equations with initial data considered by Luo and Hou.

———— Lunch Break ————

2:00–2:50

Dissipation enhancement by mixing

Gautam Iyer (Carnegie Mellon)

We quantitatively study the interaction between diffusion and mixing in both the continuous, and discrete time setting. In discrete time, we consider a mixing dynamical system interposed with diffusion. In continuous time, we consider the advection diffusion equation where the flow of the advecting vector field is assumed to be sufficiently mixing. We explicitly estimate the dissipation time based on the mixing rate. Moreover, in the discrete time setting, we show that the L^2 energy decays double exponentially in time, and this double exponential rate is achieved for by a large class of toral automorphisms.

———— Coffee Break ————

3:30–4:20

Feeble fish in time-dependent waters and stochastic homogenization of the G-equation

Alexei Novikov (Penn State)

We study the following control problem. A fish with bounded aquatic locomotion speed swims in fast waters. Can this fish, under reasonable assumptions, get to a desired destination? It can, even if the flow is time-dependent. Moreover, given a prescribed sufficiently large time t, it can be there at exactly the time t. We also give an application to homogenization of the G-equation. This Hamilton-Jacobi equation is used to model flame propagation in a turbulent fluid.

4:30–5:20

Some free boundary problems arising from branching Brownian motion with selection

James Nolen (Duke)

I will explain some current work on a stochastic interacting particle system, branching Brownian motion with selection, and its hydrodynamic limit, which is a free boundary PDE problem. At each branch event in the branching Brownian motion, a particle is removed from the system according to a fitness function, so that the total number of particles, N, is preserved. It is interesting to understand how this selection process effects the evolution of the ensemble of particles. De Masi, Ferrari, Presutti, Soprano-Loto recently showed that in one space dimension, when the left-most particle is always selected, then as N grows the particle system converges to the solution of a certain parabolic free boundary problem which has traveling wave solutions – this scenario corresponds to a fitness function which is monotone. In joint work with Julien Berestycki, Éric Brunet, Sarah Penington, we study this problem in higher dimensions with a fitness function that has compact level sets. The hydrodynamic limit (large N limit) is also a parabolic free boundary problem, related to the parabolic obstacle problem. The solution of this PDE problem converges, in the large time limit, to an eigenfunction of the laplacian. With Erin Beckman, we also study the problem in 1-d with non-monotone fitness, which leads to a kind of pulsating traveling wave behavior and a metastability phenomenon depending on the fitness function.

SUNDAY, JUNE 2

9:00–9:50

Head and tail speeds of mean curvature flow with periodic forcing

Inwon Kim (UCLA)

We study large time behavior of mean curvature flow with periodic forcing. It turns out that the behavior of the interface can be characterized by its head and tail speeds, which depend continuously on its overall direction of propagation. We will also discuss formulation of localized traveling waves in the graph setting.

10:00–10:50

Homogenization of Hamilton-Jacobi equations: Optimal rate of convergence

Hung Tran (Wisconsin)

I will give a very brief survey of homogenization of Hamilton-Jacobi equation first. Then, I will discuss recent new results on optimal rate of convergence. Based on joint works with W. Jing, H. Mitake, and Y. Yu.

———— Coffee Break ————

11:30–12:20

Unique continuation and localization on the planar lattice

Charles Smart (Chicago)

I will discuss joint work with Jian Ding in which we establish localization near the edge for the Anderson Bernoulli model on the two dimensional lattice. Our proof follows the program of Bourgain-Kenig and uses a new unique continuation result inspired by Buhovsky-Logunov-Malinnikova-Sodin.