ABSTRACTS

PLENARY SPEAKERS

Nonlocal Evolution Equations (2574)

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We consider various lattice dynamical systems with long range interaction and related integro-differential evolution equations. Typically, these arise in the modeling of phase transitions for a binary material and from activity in families of neurons. The existence and stability of patterns and of traveling waves will be discussed.

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Renormalization Group Methods for Interface Problems (2176)

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Renormalization group methods have been extremely useful for calculating important exponents in several areas of physics. These methods are unified through a common philosophy in which key, global characteristics of a system are invariant upon averaging of smaller length scales which can be done in many ways. I will illustrate these methods on a problem that is easy to define, the percolation problem, in which each site is occupied or unoccupied with a particular probability. The problem involves the critical probability at which infinite clusters form, and the exponents associated with it. The main part of the lecture will involve the application of renormalization group methods to interface problems. In particular, the system of equations comprises the heat equation in each of two phases that are separated by an interface for which a latent heat condition is applied. The temperature at the interface is equal to the capillarity length (arising from surface tension) times the sum of the curvature and the velocity. The methods yield the exponent governing the large time behavior of the characteristic length and the surprising conclusion that the capillarity length is irrelevant for large times under some conditions.

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A Diffusive Lagrangian Formalism and Applications (2658)

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I will describe a representation of Navier-Stokes and of related equations in terms of diffusive Lagrangian transformations. I will then describe applications of the formalism to vortex reconnection and to transport in rotating fluids.

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Mathematical Models for Carnivore Territories (2578)

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Social carnivores, such as wolves and coyotes, have distinct and well-defined home ranges. During the formation of these home ranges scent marks provide important cues regarding the use of space by familiar and foreign packs. In this talk I will propose a set of mechanistic rules that can be used to understand the process of territorial pattern formation through interactions with scent marks.

I will consider different model formulations, with and without the den site as an organizing centre for spatial movement. The models are described as systems of partial differential equations, coupled to ordinary differential equations. Under realistic assumptions the resulting territorial patterns include spontaneous formation of 'buffer zones' between territories which act refuges for prey such as deer. This result is supported by detailed radiotracking studies. In some cases, energy methods can be applied to the system, and the lowest energy solution corresponds to a spatial territory.

The model will also be analysed using game theory, where the objective of each pack is to maximize its fitness by increasing intake of prey (deer)and by decreasing interactions with hostile neighboring packs. Predictions will compared with radio tracking data for coyotes and wolves, including some new data from Yellowstone, where topography and local prey density can be shown to affect movement behavior.

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Analysis on Oldroyd and Related Fluids Models (2577)

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We shall discuss some recent work concerning Oldroyd type models for fluids made of elastic particles(viscoelastic fluids, liquid crystals...) or fluids with special microscopic properties and structures(often refered as complex fluids). To develop a general theory for fluids with multiple scale inputs may be rather difficult, we concentrate here a few analytical issues.

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Computing Multivalued Physical Observables for Wave and Schrodinger Equations (2541)

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H. Liu
Y. Tsai

Motivated by obtaining Eulerian ray tracing algorithms, we develop a level set method for the computation of multivalued physical observables (density, velocity, etc.) for any symmetric hyperbolic system and for Schrodinger's equation. The main idea is to evolve the density near the n dimensional bicharacteristic manifold of the Hamilton- Jacobi equation, identified as the common zeros of n level set functions in phase space. The main advantages over the standard kinetic equation using the Liouville equation with a Dirac measure initial data are: (1) Our initial data is smooth-a singular integral involving the Dirac delta function is evaluated only in a postprocessing step, thus avoiding numerical difficulties and (2) a local level set method reduces the computational effort to an optimal number of operations. These advantages enable us to compute all physical observables for multidimensional systems.

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On 2D and QG Turbulence, An Introduction (2230)

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Elef Gkioulekas

A brief introduction of the relevance of two-dimensional(2D) and quasi-geostrophic (QG) turbulence is given, along with a survey of current problems and controversies.

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Dynamics of Solutions for a Supercritical Semilinear Heat Equation (2293)

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A semilinear heat equation with supercritical nonlinearity is considered. It is known that the equation has a continuum of ordered radially symmetric steady states. Using this property, we can establish a global stability result for steady states, and apply it to show the existence of various solutions such as non-stabilizing solutions and global unbounded solutions. We consider also more precise behavior of such solutions.

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