ECOLE D'ETE

Nonlinear Dynamics in Peyresq

Alpes de Haute-Provence, France

22 - 29 August 2014

Objectives

This CNRS thematic summer school aims to provide a multidisciplinary lecture program to enable the understanding, the study, and the development of research in the field of nonlinear dynamics. The focus is on describing the field from numerous viewpoints including physics, mathematics, mechanics, chemistry, biology, optics, electronics, signal processing,...

3 specialised lectures

Dynamics of systems far from equilibrium

Kirone Mallick (Theor. Phys. Inst., CEA Saclay, France)

We shall present some of the remarkable results that have been obtained for systems far from equilibrium during the last two decades (such as Jarzynski and Crooks Work Identities, the Gallavotti-Cohen Fluctuation Theorem and the Macroscopic Fluctuation Theory). A special emphasis on the concept of large deviation functions that provide us with a unified description of many physical situations.These functions are expected to play, for systems far from of equilibrium, a role akin to that of the thermodynamic potentials. These concepts will be illustrated on simple systems such as the Brownian ratchet model for molecular motors and the asymmetric exclusion process.

Large deviations in noise-perturbed dynamical systems

Hugo Touchette (Nat.Inst.Theor.Phys.,Stellenbosch, South Africa)

I will give in this set of lectures an introduction to the large deviation theory of nonlinear dynamical systems perturbed by Gaussian white noise – a theory known in mathematics as the Freidlin-Wentzell theory of large deviations, which is linked in physics to path integrals and the Onsager-Machlup theory of nonequilibrium systems. The lectures will start with a basic introduction to large deviation theory to then focus on applications for simple noisy dynamical systems modeled by stochastic differential equations. Important applications (and exercises) will include Kramer's thermal escape problem and its nonlinear and non-equilibrium generalizations, as well as optimal exit path or instanton-type problems. Time permitting, we will also discuss numerical methods for simulating large deviations.

2 general lectures

An introduction to the physics of complex networks

Alain Barrat (CNRS, Theor. Phys. Center, Marseille, France)

In this lecture, I will give an introduction to the field of complex networks. I will start by introducing some basic concepts of graph theory (adjacency matrix, paths, degree, clustering...); I will then introduce some tools which are customarily used for the statistical characterization of large networks, such as degree distribution, clustering spectrum, measures of degree correlations. I will give some examples of application of these tools to real-world networks of various origins (social networks, infrastructure networks...). In a second part, I will describe some modelling frameworks whose development has been stimulated by the empirically observed characteristics of many real-world networks. I will also describe some of the many dynamical phenomena which take place on complex networks, such as epidemic spreading, information propagation or opinion formation. I will finally give some ideas about recent developments, in particular about the study of dynamically evolving complex networks.

Local bifurcations: an introduction

Mariana Haragus (Lab. Math. de Besançon, France)

Starting with the simplest bifurcation problems arising for ordinary differential equations in one and two dimensions, the purpose of this lecture is to describe several tools from the theory of infinite-dimensional dynamical systems, allowing to treat more complicated bifurcation problems, as for instance bifurcations arising in partial differential equations. Such tools are extensively used to solve concrete problems arising in physics and natural sciences. We focus on two specific methods, namely the center manifold reduction and the normal form theory. We illustrate these methods on the Lugiato-Lefever equation, a nonlinear Schrödinger equation with damping, detuning and driving arising in optics.

4 introductory short lectures

Networks in Geophysics (P. Davy)
Coupled modes equation in whispering galery resonators (Y. Chembo)
Virtual chimera and brain-inspired computing in nonlinear delay dynamics (L. Larger)
Dynamics in network of oscillators (S. Metens)

Organisation

A. Amon (IPR, Rennes, axelle.amon@univ-rennes1.fr)
Y. K. Chembo (FEMTO-ST, Besançon, yanne.chembo@femto-st.fr)
M. Haragus (LMB, Besançon, mharagus@univ-fcomte.fr)
L. Larger (FEMTO-ST, Besançon, llarger@univ-fcomte.fr)
S. Météns (MSC, Paris VII, stephane.metens@univ-paris-diderot.fr)
L. Pastur (LIMSI, Paris Sud, luc.pastur@limsi.fr)

With the support of:

Information

http://www.enlpeyresq.u-psud.fr/
registration: 300€ (lectures + lodging + meals)
No fees for CNRS affiliates

Pre-registration

mharagus@univ-fcomte.fr