Department of Applied and Computational Mathematics and Statistics Colloquium

Brandon S. Lindley

Naval Research Laboratory

will give a lecture entitled:

Stochastic Pattern Transitions in Nonlinear Dynamical Systems

Abstract

Pattern formation, occurring from large numbers of interacting agents in complex environments, is ubiquitous in nature, and is observable in groups of many types of organisms, including fish, birds, and single-celled organisms. Here, we explore the phenomena of pattern formation and the transitions between these patterns in swarms and other stochastic dynamical systems. Recently, we have examined how time delays in communication can affect the stability of these patterns. We show that, in the case of time delays randomly generated by a distribution, the stability of some of these emerging patterns depends only on the first or second moment of the time delay distribution, while other patterns may depend on all the moments of the distribution. Thus, we predict the bifurcation parameter ranges, allowing us to study how noise induces transitions from one type of pattern to another, especially near the bifurcations of these patterns. In general, a wide variety of dynamical systems exhibit these types of stochastic transitions, and so we develop a robust numerical method for computing the most probable transition path between two stable states or patterns. This procedure involves solving a Hamiltonian system, which is a deterministic formulation of the stochastic problem, by using an iterative procedure that minimizes the effective action. This method is illustrated by applying it to a variety of dynamical systems, including models of epidemics and nonlinear oscillators, and validated by comparing the results to full Monte Carlo simulations of the stochastic system.

Thursday, January 24, 2012
4:00 p.m. to 5:00 p.m.
129 Hayes-Healy Center

Colloquium Tea **3:30 p.m. to 4:00 p.m.** **154 Hurley Hall**