



Curso de Modelización en la Ciencia y en la Industria

Stochastic Processes in Agents Based Models

Prof. Vincenzo Capasso

Università di Milano and ADAMSS Institute
Milan, Italia

Particular attention is being paid these days to the mathematical modelling of the social behaviour of individuals in a biological population. On one hand, there is an intrinsic interest in population dynamics of herds, and, on the other hand, agent based models are being used in complex optimization problems (ACO's, i.e. Ant Colony Optimization). Further decentralized/parallel computing is exploiting the capabilities of discretization of nonlinear reaction-diffusion systems by means of stochastic interacting particle systems. These systems lead to self-organization phenomena exhibiting interesting spatial patterns. As a working example, an interacting particle system modelling the social behaviour of ants is proposed. It consists of a system of stochastic differential equations driven by social aggregating/repelling "forces". Specific reference will be made to the species "Polyergus Rufescens" that has been observed in nature. Extensions to models of nucleation and growth, chemotaxis, such as angiogenesis related to tumor growth, will be presented. In these models, the so called organization process is driven by an underlying field that is strongly coupled with the spatial structure of the population of interacting individuals/agents/cells. Suitable "laws of large numbers" are shown to imply convergence of the empirical spatial distributions of interacting individuals to nonlinear reaction-diffusion equations, as the total number of individuals becomes sufficiently large.

Course Outline:

- Basics on Continuous Time Stochastic Processes:
- The Poisson Process, The Wiener Process
- Ito Integral, Ito formulas
- Stochastic Differential Equations
- Interacting particle systems.
- Continuous approximation of population processes.

Fechas: 9, 10, 13, 15, 16 y 17 de Noviembre de 2006.

Hora: 16:00-18:00.

Lugar: Aula 2.1.D.04. Universidad Carlos III de Madrid (Campus de Leganés)
Avenida de la Universidad 30, Leganés

Grupo de Modelización, Simulación Numérica y Matemática Industrial. URL: <http://scala.uc3m.es>