Seminario Pisa

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Title: A Complex Systems Approach to Population Dynamics

Abstract

In this presentation two typical examples of population dynamics are considered,namely, the spread of epidemics and a discrete traffic flow model,both related to the evolution of large systems of many living,interacting entities. The mathematical approach is based on the kinetic theory of active particles.(KTAP theory) The microscopic state is modeled by a scalar variable called activity, which represents the individual ability to express a specific strategy. The activity is assumed to be heterogeneously distributed among the particles.In the first example,the epidemics spreading model is characterized by the influence of risk perception which can reduce the diffusion of the infection.The evolution of the system is modeled through nonlinear interactions,whose output is described by stochastic games.The result of numerical simulations are discussed for different initial conditions. In the second example a vehicular traffic model is discussed,characterized by a lattice of discrete speeds. The basic idea is to consider each vehicle-driver pair as a so-called active particle. In this case the “activity” is the driving ability of the drivers.The evolution of the system is modeled through nonlinear interactions,whose output is described by stochastic games.The results of numerical simulations for the average velocity,the macroscopic flux and the activity,obtained under various road conditions and different values of the vehicles density,are consistent with what expected from a realistic vehicular traffic behavior.