Seminário de sistemas dinâmicos e estocásticos

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Large Deviations Studies for Small Noise Limits of Dynamical Systems Perturbed by Lévy Processes

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Resumo:

Large Deviations Theory is a very fruitful and mature field nowadays and one of the most popular interface areas of Probability with other branches of Mathematics. Roughly speaking, large deviations studies concern the asymptotic study of certain unlikely events with exponentially small probability in terms of a certain functional, named rate function.
The first problem that we address is the first exit time problem for exponentially lighted jump diffusions. In climate dynamics, it is being efectively used dynamical systems perturbed by jump noises to capture abbrupt changes of temperature in very small time scales in comparison with the time horizon of the study and the comprehension of the first exit time problem is crucial to understand the ocurrence of those abbrupt changes of temperatures. In this setting the big jumps of the jump noise perturbation are used to describe the rapid catastrophic climate changes occurred in the Earth's northern hemisphere (the so called *Daansgard-Oeschger events*). It is known that a dynamical system never leaves the domain of attraction of a stable state after some time and it is remarkable that the excitation of the same dynamical system even in low intensity by a source of randomness allows the particle described by this law of motion to leave the same domain. With this kind of stochastic perturbation, it becomes interesting the problem of transition between the domains of attraction of the stable equilibria of the deterministic system. So the stable states become meta-stable and the stochastic perturbation determines their asymptotic dynamical properties.
The second problem addressed is the small noise limit of a coupled forward-backward system of stochastic differential equations (FBSDEs for short). The class of FBSDEs that we study contains the paradigmatic nonlocal toy-model known as the fractal Burgers equation, that is a mathematical idealization for the velocity of a compressible fluid flow that is affected by external and internal non-local forces. We prove, in a suitable functional space, the convergence of the FBSDE system, when both sources of noise, one Brownian and other Poissonian, converge to zero, to the deterministic limiting differential equations and we state a large deviations result for the laws of the forward and backward processes. Since FBSDEs are responsible for giving probabilistic interpretations to semilinear partial differential equations, generalizing the linear Feynman-Kac formula for parabolic equations, we study, via this probabilistic approach, the convergence, at the level of viscosity solutions, of the partial-integral differential equation associated to the FBSDE system.

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