Partial Control of Chaotic Transients and Escape Times

Prof. Miguel A. F. Sanjuan

Department of Physics, Universidad Rey Juan Carlos, 28933 Mostoles, Madrid, Spain

He received a Bachelor Degree in Physics by University of Valladolid, Spain, in 1981, where he was granted the Outstanding Graduation Honor for Undergraduated Studies and a PhD Degree by National University at a Distance (UNED), Madrid, Spain in 1990, on Nonlinear Dynamics and Chaos. He is Full Professor of Physics at the Universidad Rey Juan Carlos, Madrid, Spain. He is currently Head of the Department of Physics and Head of the Nonlinear Dynamics, Chaos and Complex Systems Research Group. He is a Foreign Member of the Lithuanian Academy of Sciences. Member of Editorial Boards of six international journals (Communications in Nonlinear Science and Numerical Simulation, Discrete and Continuous Dynamical Systems B, Journal of Vibroengineering, Journal of Nonlinear Systems and Applications, International Journal of Bifurcation and Chaos and Mathematical Problems in Engineering). He has been a Visiting Research Associate of the Institute for Physical Sciences and Technology of the University of Maryland, the University of Tokyo and Visiting Research Professor at Beijing Jiaotong University.

Abstract

When we attempt to control a linear system in which some noise has been added, typically we need a control higher or equal to the amount of noise added. When we have a region in phase space where there is a chaotic saddle, all initial conditions will escape from it after a transient with the exception of a set of points of zero Lebesgue measure. The action of an external noise makes all trajectories escape even faster. Attempting to avoid those escapes by applying a control smaller than noise seems to be an impossible task. Here we show, however, that this goal is indeed possible, based on a geometrical property found typically in this situation: the existence of a horseshoe. The horseshoe implies that there exists what we call safe sets, which assures that there is a general strategy that allows one to keep trajectories inside that region with a control smaller than noise. We call this type of control partial control of chaos [1,2] that allows one to keep the trajectories of a dynamical system close to the saddle even in presence of a noise stronger than the applied control. In this talk recent progress and new results [3] on this control strategy by using information obtained from the escape times are presented. This is joint work with James A Yorke (USA), Samuel Zambrano and Juan Sabuco (Spain).

References

