Extreme Events in Fluid Turbulence: Numerical computation of Large Deviation Minimizers

Tobias Grafke*[1]

[1]Courant Institute – United States

Abstract

Rare but extreme events are known to have dramatic influence on the statistics of turbulent flows, but are notoriously hard to handle both analytically and numerically. About 15 years ago, for systems like passive advection and Burgers turbulence, alternative approaches were taken with methods borrowed from field theory, most notably the instanton approach, but full analytical treatment of turbulence remains elusive. In this talk, a numerical method is presented to effectively compute minimizers of the Freidlin-Wentzell action functional that arises in the context of large deviation theory applied to stochastically forced fluid dynamical equations. The presented method is then used to calculate expectations dominated by noise-induced excursions from deterministically stable fixpoints in hydrodynamical equations to gain knowledge on statistics of rare events and the interplay between the nonlinear dynamics and the stochastic forcing. In the course of the talk it will be demonstrated that the numerical method is suitable for computing the minimizing trajectory for degenerately forced systems with a high number of degrees of freedom ($N\approx 10{10}$)$which are frequently encountered in multi-dimensional fluid equations with a large separation of scales an

*Speaker