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Scaling of Lyapunov Exponents in Homogeneous, Isotropic DNS

NICHOLAS FITZSIMMONS, NICHOLAS MALAYA, ROBERT MOSER, University of Texas Austin — Lyapunov exponents measure the rate of separation of initially infinitesimally close trajectories in a chaotic system. Using the exponents, we are able to probe the chaotic nature of homogeneous isotropic turbulence and study the instabilities of the chaotic field. The exponents are measured by calculating the instantaneous growth rate of a linear disturbance, evolved with the linearized Navier-Stokes equation, at each time step. In this talk, we examine these exponents in the context of homogeneous isotropic turbulence with two goals: 1) to investigate the scaling of the exponents with respect to the parameters of forced homogeneous isotropic turbulence, and 2) to characterize the instabilities that lead to chaos in turbulence. Specifically, we explore the scaling of the Lyapunov exponents with respect to the Reynolds number and with respect to the ratio of the integral length scale and the computational domain size.

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