Linear forcing in numerical simulations of isotropic turbulence[1]
CARLOS ROSALES, CHARLES MENEVEAU, Johns Hopkins University — Simulations of forced isotropic turbulence are most often formulated in Fourier space, where forcing is applied to low-wavenumber modes. That forcing is difficult to implement for applications in physical space. A linear forcing recently proposed by Lundgren, where a force proportional to velocity is applied, is an attractive alternative but not much is known about its properties. Using numerical experimentation, various properties of the linear forcing are explored. It is shown that when implemented in physical space linear forcing gives the same results as in spectral implementations and that the linearly-forced system converges to a stationary state that depends on domain size and Reynolds number, but not on the spectral shape of the initial condition. It is also shown that the extent of Kolmogorov -5/3 range is similar to that achieved using the standard band-limited forcing scheme but the integral length scale is smaller, reducing the effective scaling range for a given resolution. It is concluded that linear forcing is a useful alternative that does not require transformation to Fourier space and is easily integrated into physical-space numerical codes.

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