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Stochastic modeling of turbulence

Using ambit fields we construct spatial and spatio-temporal models for the turbulent velocity vector field. An ambit field is a suitably defined integral of a kernel function with respect to a possibly volatility modulated Lévy basis. A Lévy basis is an infinitely divisible, independently scattered random measure. Focusing on the homogeneous isotropic spatial case, we demonstrate how to derive the kernel from the correlation tensor of the field. We apply the machinery to a turbulent velocity vector field obtained through a direct numerical simulation of the Navier-Stokes equations and investigate how the conceptually simple ambit field model is able to reproduce the stylised features of turbulence. Homogeneity and isotropy simplify calculations but are not necessary for the machinery to work. Indeed, ambit fields allow inhomogeneity and anisotropy to be introduced in simple ways.