

On the relevance of stochastic models in turbulence

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Abstract

We consider statistical limit of solution to the compressible Navier–Stokes system in the high Reynolds number regime in a domain exterior to a rigid body. We investigate to what extent this highly turbulent regime can be modelled by an external stochastic perturbation, as suggested in the related physics literature. To this end, we interpret the statistical limit as a stochastic process on the associated trajectory space. We suppose that the limit process is statistically equivalent to a solution of the stochastic compressible Euler system. Then, necessarily,

- the stochastic forcing is not active – the limit is a statistical solution of the deterministic Euler system;
- the solutions S -converge to the limit;
- if, in addition, the expected value of the limit process solves the Euler system, then the limit is deterministic and the convergence is strong in the L^p -sense.

These results strongly indicate that a stochastic forcing may not be a suitable model for turbulent randomness in compressible fluid flows.