Coarse Projective Integration of a One-Dimensional Turbulence Model
ANNE STAPLES, ALEXANDER SMITS, YANNIS KEVREKIDIS, Princeton University — Multiscale methods may be useful in turbulence if we choose the correct level of description of the problem. A typical turbulent velocity field has continua of length and time scales and hence is not amenable to Multiscale methods. The energy spectrum variables, however, exhibit a separation of time scales. Consider a box of fluid, shaken. The energy spectrum will immediately fill out, but the $k^{-3/2}$ character of the intermediate wave numbers and the rest of the overall shape of the spectrum will fill out slowly over time. In this work we apply a Multiscale method, Coarse Projective Integration (CPI), to the simulation of a one-dimensional turbulence model, the MMT equation. We find a significant saving in computational (wall clock) time using CPI, compared to using standard direct numerical (DNS) simulation procedures, $T_{DNS}/T_{CPI} = 4.78$, where $T_{DNS}$ is the wall clock time using DNS and $T_{CPI}$ is the wall clock time using CPI.

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