Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Statistical Mechanics-based Closures for Large Eddy Simulations[1]

ERIC PARISH, KARTHIK DURAISAMY, AYOUB GOUASMI, University of Michigan, COMPUTATIONAL AEROSCIENCES LABORATORY TEAM — The simulation of high Reynolds-number fluid flows is made challenging by the presence of an enormous range of temporal and spatial scales. The Mori-Zwanzig (MZ) formalism originates from non-equilibrium statistical mechanics and provides a formal backdrop for the construction of coarse-grained models. In this work, a class of models inspired from the Mori-Zwanzig formalism are applied to turbulent flows. The MZ-models are derived directly from the governing equations and require minimal heuristics. The resulting closures are non-Markovian and are akin to modeling the divergence of the sub-grid stress. Non-local temporal effects are captured through a finite memory approximation of the MZ memory kernel. Numerical simulations of rotating homogeneous turbulence and turbulent channel flow are presented. The MZ-based models are shown to accurately characterize the behavior of the unresolved dynamics associated energy transfer mechanisms.

[1]This work was supported in part by AFOSR under the project "LES Modeling of Non-local effects using Statistical Coarse-graining" with Dr. Jean-Luc Cambier as the technical monitor.

Eric Parish
University of Michigan

Date submitted: 01 Aug 2016 Electronic form version 1.4