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Effective Numerical Viscosity in Spectral Multidomain Penalty Method-Based Simulations of Turbulence Y.C. LIN, University of Southern California, PETER DIAMESSIS, Cornell University, JULIAN DOMARADZKI, University of Southern California — Numerical methods used to simulate turbulence often employ, explicitly or implicitly, a variety of procedures to control numerical instabilities, introducing in the process unquantifiable dissipation of numerical origin. We describe a methodology that allows to assess such a numerical dissipation on an example of a specific, spectral multidomain method developed for the simulation of high Reynolds number turbulence. The temporal discretization ensures maximum temporal accuracy by combining third order stiffly stable and backward differentiation schemes with a high-order boundary condition for the pressure. In the non-periodic vertical direction, a spectral multidomain discretization is used and its stability is ensured through use of penalty techniques, spectral filtering and strong adaptive interfacial averaging. We show that the effects of stabilizers can be quantified in terms of the numerical viscosity and we find that it can be comparable, and sometimes larger, than the physical viscosity. Away from domain interfaces and boundaries the stabilizers have an expected dissipative character but a strong anti-dissipative character is observed at the interfaces. We attribute this behavior to the way the penalty method prevents catastrophic Gibbs' oscillations, providing the flow variables freedom to adjust by relaxing the interface conditions.

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