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Reproducing the local characteristics of compressible turbulent flows at a low cost: derivation and application GUILLAUME BEARDSELL, GUILLAUME BLANQUART, California Institute of Technology — When performing Direct Numerical Simulations (DNS) of highly turbulent reacting flows, it is often prohibitively expensive to simulate complete flow geometries. For example, simulations of turbulence-flame interactions usually do not capture the full combustor, and instead focus on a specific portion of the domain, e.g. the region around the flame front. However, by doing so, one misses turbulent kinetic energy injection due to shear by the large scales. In the present work, we include these large-scale contributions, e.g., from experimental data, and we solve for the small-scale components only. The resulting equations are the same as the original compressible Navier-Stokes equations, except for the introduction of additional terms involving the large-scale flow features, which appear as forcing terms. This approach allows us to achieve high turbulent Reynolds numbers while keeping the computational cost reasonable. We have already applied this strategy to incompressible flows, but not to compressible ones, where special care must be taken regarding the energy equation. Using the finite-difference solver NGA, we apply this framework to simulations of homogeneous turbulence and premixed flames. We provide comparisons with results obtained with other forcing schemes.

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