Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Simulations of turbulent compressible flows using periodic boundary conditions: high fidelity on a budget GUILLAUME BEARDSELL, GUILLAUME BLANQUART, California Institute of Technology — In direct numerical simulations (DNS) of turbulent flows, it is often prohibitively expensive to simulate complete flow geometries. For example, to study turbulence-flame interactions, one cannot perform a DNS of a full combustor. Usually, a well-selected portion of the domain is chosen, in this particular case the region around the flame front. In this work, we perform a Reynolds decomposition of the velocity field and solve for the fluctuating part only. The resulting equations are the same as the original Navier-Stokes equations, except for turbulence-generating large scale features of the flow such as mean shear, which appear as forcing terms. This approach allows us to achieve high Reynolds numbers and sustained turbulence while keeping the computational cost reasonable. We have already applied this strategy to incompressible flows, but not to compressible ones, where special care has to be taken regarding the energy equation. Implementation of the resulting additional terms in the finite-difference code NGA is discussed and preliminary results are presented. In particular, we look at the budget of turbulent kinetic energy and internal energy. We are considering applying this technique to turbulent premixed flames.

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Date submitted: 01 Aug 2017 Electronic form version 1.4