Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

On the reflectivity of sponge regions in compressible flow simulations[1] ALI MANI, Center for Turbulence Research, Stanford University — In finite-domain compressible flow simulations, one remedy to address lack of boundary information is to gradually relax the flow near the external boundary to a known consistent far-field solution of the Navier-Stokes equations. This treatment, called the sponge treatment, is adopted in many calculations owing to its simplicity, generality and robustness. In practical calculations however, interactions of the sponges with flow features can reflect unphysical signatures into the CFD domain. If the sponge is not carefully designed these reflections can overwhelm the physics of interest particularly when acoustics are concerned. In this work we examine the physics of sponge/flow interactions through analytical and semi-analytical approaches. The reflectivity due to non-linear terms, oblique waves intersecting, and sponge/vortex interactions are separately analyzed. The optimal sponge profiles and the reflection coefficients for asymptotically small or large sponges (compared to flow features) are investigated. These analyses provide estimates of the sponge requirements for CFD calculations in a relatively general framework. In steady state problems the effect of sponge zones on the solution will be discussed.

[1]Supported by AFOSR

Ali Mani
Center for Turbulence Research, Stanford University

Date submitted: 10 Aug 2009 Electronic form version 1.4