Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

A Subgrid Scale Estimation Model for Large Eddy Simulation[1]

RAJES SAU, KRISHNAN MAHESH, University of Minnesota — We discuss a novel estimation procedure to model the subgrid velocity for Large Eddy Simulation. The subgrid stress is obtained directly from the estimated subgrid velocity. The subgrid velocity is modeled as a function of resolved velocity ($\bar{u}_i$) and resolved strain–rate tensor ($\bar{S}_{ij}$). Using tensor invariants, we obtain an expression for subgrid velocity involving $\bar{u}_i$, that is quadratic in $\bar{S}_{ij}$ with three undetermined coefficients. These three coefficients are obtained by imposing the following constraints: (i) Galilean invariance, (ii) ensemble-averaged subgrid dissipation and (iii) local subgrid kinetic energy. Subgrid dissipation is obtained through a new dynamic procedure which uses two scalar level identities without least squares minimization, as opposed to the tensor level Germano identity. Subgrid kinetic energy is obtained either from the dynamic Yoshizawa model or a transport equation for subgrid kinetic energy. The estimation model is applied to isotropic turbulence and good results are obtained. Realistic backscatter is also predicted using this model.

[1]This work is supported by the Air Force Office of Scientific Research (AFOSR) under grant FA-9550-04-1-0064.

Rajes Sau
University of Minnesota

Date submitted: 05 Aug 2009 Electronic form version 1.4