Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Dynamic wall-modeling for LES of shock/boundary-layer interacting separated flow at high Reynolds number[1] SOSHI KAWAI, Institute of Space and Astronautical Science, JAXA, JOHAN LARSSON, Center for Turbulence Research, Stanford University — We present a new dynamic procedure for non-equilibrium wall-modeling in large-eddy simulation (LES) at arbitrarily high Reynolds numbers. The proposed dynamic non-equilibrium wall-model is based on the methods that model the wall shear stress directly, and solves the full RANS equations in the wall-model layer. We first show how the existing non-equilibrium wall-model becomes inaccurate at high Reynolds number and then propose an improved method which solves this issue. The improvement stems directly from reasoning about how the turbulence length scale changes with wall distance in the inertial sublayer and the resolution-characteristics of numerical methods. The proposed method is shown to accurately predict both equilibrium boundary layers and non-equilibrium shock-induced separated boundary layer at very high Reynolds number, with both realistic instantaneous turbulent structures and accurate statistics (skin friction and turbulence quantities) without the use of ad hoc corrections, something that existing non-equilibrium wall-models fail to do robustly.

[1]This work was supported in part by the JAXA International Top Young Fellowship Program, Grant-in-Aid for Young Scientists (B) KAKENHI 24760670, and the US Air Force Turbulence Program (Grant FA9550-11-1-0111).

Soshi Kawai
Institute of Space and Astronautical Science, JAXA

Date submitted: 17 Jul 2012 Electronic form version 1.4