Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

A Three-Dimensional Multi-Domain Immersed Boundary Method, with Application to a Pitching Wing CHENGJIE WANG, JEFF D. ELDREDGE, Mechanical and Aerospace Engineering, University of Califormia, Los Angeles — A three-dimensional multi-domain technique and immersed boundary projection method is implemented for high-fidelity solution of the Navier-Stokes equations based on the approach presented by Colonius and Taira (2008). The principle of the multi-domain approach is to derive the boundary condition on a given domain from the interpolation of the solution on a larger, but coarser, mesh to simulate the unbounded flow. By performing this on a progression of such domains, the resulting flow in the original (finest) domain, which may contain some bodies, is able to account for the effect from the vorticity that is far away from it. On the other hand, the computational requirement is significantly relaxed compared to that of a single monolithic domain due to the compactness of each domain in the hierarchy, and the overall performance of the scheme is improved. The governing equations, and the immersed boundary treatment, are expressed in vorticity-streamfunction form. The resulting scheme is used to explore the physics of a low-aspect-ratio pitching wing in Re=100 flow. A wing of rectangular planform of aspect ratio 2 undergoes a steady pitch-up from 0 to 90 degrees in a uniform flow. Results for different pitching rate are compared and discussed.

Chengjie Wang
Mechanical and Aerospace Engineering,
University of Califormia, Los Angeles

Date submitted: 09 Aug 2012 Electronic form version 1.4