

Detached-Eddy Simulations of Full Aircraft Experiencing Massively Separated Flows

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Abstract

A high resolution turbulence treatment for massively separated flows is presented for fighters at flight Reynolds numbers. The method is Detached Eddy Simulation (DES), a hybrid Reynolds averaged Navier-Stokes – Large Eddy Simulation technique that can accurately capture attached boundary layers at flight Reynolds numbers, while still reproducing the unsteady loads associated with massively separated flow. Three examples of US Department of Defense aircraft, the F-15E, F/A-18C, and F/A-18E, are used as test cases to show the utility of Detached Eddy Simulation in capturing nonlinear phenomena such as wing buffet, vortex breakdown, and abrupt wing stall. Comparison with either flight test or experiment is also accomplished for these cases.

Keyword: Detached Eddy Simulation, Massively Separated Flows, Post-stall Aerodynamics, Vortex Breakdown, Abrupt Wing Stall