Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Effect of Turbulence Modeling on Dynamic Stall Prediction NABIL KHALIFA, AMIR REZAEI, HAITHEM TAHA, University of California, Irvine — A harmonically pitching NACA 0012 airfoil is studied computationally to investigate the three dimensional nature of Dynamic Stall phenomenon and the effect of turbulence modeling on its prediction. In this study, we performed 2D and 3D Computational simulations of Navier-Stokes equations using two different turbulence modeling techniques: Unsteady Reynolds Averaged Navier Stokes (URANS) and Detached Eddy Simulation (DES) defined as a RANS-Large Eddy Simulation (LES) hybrid model. The study was performed at a Reynolds number of 1.35×10^5 to facilitate comparison with experimental results available in literature. The $k-\omega$ Shear Stress Transport (SST) model was used for turbulence modeling in both URANS and DES simulations. Results show that all the models agreed with experimental data during upstroke. However, only 3D DES was able to capture the C_L peak value. In downstroke, 3D URANS show better agreement than 2D URANS with experimental data, while 3D DES surpasses the URANS models significantly, especially at the beginning of downstroke. This study concludes that 3D computational setups are required for proper simulation of the Dynamic Stall phenomenon, which accentuates its 3D nature.

Nabil Khalifa
University of California, Irvine

Date submitted: 30 Jul 2020 Electronic form version 1.4