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Numerical investigation of shock-turbulent boundary layer interaction on flexible panels using wall modelled large eddy simulations[1]
JONATHAN HOY, IVAN BERMEJO-MORENO, University of Southern California — The effect of wall elasticity on shock-turbulent boundary layer interaction (STBLI) is investigated through the use of a coupled fluid structure interaction (FSI) solver. The FSI solver incorporates a wall-modeled large eddy simulation (WMLES) finite-volume flow solver, a geometrically non linear finite-element solid mechanics solver with damping, and a finite element flow mesh deformation solver. An Arbitrary Lagrangian-Eulerian (ALE) approach is employed to account for mesh motion and deformation in the flow domain. For sufficiently strong flow separation, unsteady low frequency motions of the shock separation bubble are present. Numerical simulations are compared to three different experimental flow configurations that vary the Mach number and flow deflection angle. Wall pressure, panel displacement, spanwise normal center-plane snapshots, and three dimensional shock bubble geometry are recorded over time. Notable differences from the rigid flow configuration in the wall pressure power spectral density and shock bubble statistics are observed for cases in which the maximum panel deflection is roughly equal in magnitude to the boundary layer thickness.

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