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Unsteady Computational Tests of a Non-Equilibrium ADAM JIRASEK, PETER HAMLINGTON, CU Boulder, ANDREW LOFTHOUSE, USAFA, USAFA COLLABORATION, CU BOULDER COLLABORATION — A non-equilibrium turbulence model is assessed on simulations of three practically-relevant unsteady test cases; oscillating channel flow, transonic flow around an oscillating airfoil, and transonic flow around the Benchmark Super-Critical Wing. The first case is related to piston-driven flows while the remaining cases are relevant to unsteady aerodynamics at high angles of attack and transonic speeds. Non-equilibrium turbulence effects arise in each of these cases in the form of a lag between the mean strain rate and Reynolds stresses, resulting in reduced kinetic energy production compared to classical equilibrium turbulence models that are based on the gradient transport (or Boussinesq) hypothesis. As a result of the improved representation of unsteady flow effects, the non-equilibrium model provides substantially better agreement with available experimental data than do classical equilibrium turbulence models. This suggests that the non-equilibrium model may be ideally suited for simulations of modern high-speed, high angle of attack aerodynamics problems.

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