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Unsteady Flow Simulation of a Controlled Airfoil¹ SOL KEUN JEE, OMAR LOPEZ, University of Texas at Austin, JONATHAN MUSE, ANTHONY CALISE, Georgia Institute of Technology, ROBERT MOSER, University of Texas at Austin — An airfoil moving with two degrees of freedom (pitching and plunging) is simulated with a closed-loop flow control system. The simulation of the unsteady airfoil is computed using a Delayed Detached Eddy Simulation (DDES), a hybrid non-zonal RANS-LES turbulence model based on DES. The control system controls the airfoil in two modes, first through direct application of forces and torques, and second, through the use of tangential synthetic jet actuators. The approach was designed for an investigation of flow control via synthetic jet actuators on a pitching and plunging airfoil in A. Glezer's wind tunnel at Georgia Tech. The software definition of the controller used for the wind tunnel facility, which includes a robust servomechanism Linear Quadratic Regulator (LQR) and a neural network based adaptive controller, is coupled to a CFD model, which includes a model for the synthetic jet actuators. The coupled CFD/controller model is used to simulate maneuvers of the airfoil as performed in the wind tunnel, and the coupled model is validated against experiment results. Both the results of the validation, and the characteristics of the controlled flows will be discussed.

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