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Low-Order Modeling of Airfoil Pitch Control Effected by Trapped Vorticity Concentrations[1] GUY BEN-DOV, ARNE J. PEARLSTEIN, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, DANIEL BRZOZOWSKI, ARI GLEZER, School of Mechanical Engineering, Georgia Institute of Technology — We describe construction of spanwise vorticity modes by proper orthogonal decomposition (POD) using data obtained by two- component PIV measurements in turbulent flow past a NACA 4415 airfoil undergoing time-periodic pitching motion due to synthetic-jet actuation near the trailing edge. Three- dimensional effects are characterized in terms of a "mass deficit" in the phase-averaged continuity equation. Such effects, in the actuated or unactuated flow, are significant in the near wake, are thought to arise from the three-dimensionality of the geometry of the actuators, and are accounted for in the model. The incorporation of forcing by the jets into two- and three-dimensional models, and the use of vorticity POD modes, are discussed in the context of low-order modeling for feedback control. The vorticity transport equation is used to obtain an ordinary differential equation (ODE) system by Galerkin projection, whose solution behavior is discussed.

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Arne J. Pearlstein
Department of Mechanical Science and Engineering,
University of Illinois at Urbana-Champaign

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