Numerical Modeling and Simulations on Electro-Active Polymer Flow Control

by

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ABSTRACT

The interaction of Electro-Active polymer (EAP) flow control with the flow field over a flat plate and NACA 0009 airfoil was investigated at a Reynolds number of 20,000 using an Arbitrary Lagrangian Eulerian finite element formulation. The primary focus of the investigation was to identify the effects of the oscillating EAP on the flow field and the boundary layer. The effects of the EAP were evaluated with an eye towards implementation on a micro-air vehicle (MAV) system. The EAPs represent a light-weight and adaptable flow control solution for MAVs. A moving boundary mesh model was created for the EAP actuation and tested with a variety of EAP sizes and actuation frequencies. Baseline flow fields for both a flat plate and NACA 0009 airfoil were generated. These baseline flow fields were compared to results from simulations with an activated EAP. Both instantaneous and time averaged flow fields were analyzed. The EAP actuation was found to reduce the length and thickness of the laminar separation bubble on the flat plate. Preliminary results from the NACA 0009 simulations show that the EAP actuation was able to nearly eliminate laminar separation on the airfoil at certain angles of attack.