Control of Laminar Boundary Layers using Electro Active Polymers

by

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ABSTRACT

Micro air vehicles (MAV) are a major focus of aerodynamics today with many military as well as civilian applications. MAV flight is instability is dominated by the unsteady characteristics of low Reynolds number flows. Three dimensional separations occur at random on different parts of the wing due to gust causing highly unsteady lift conditions as well as full wing stall. An Electro-Active Polymer (EAP) was examined in this work as a flow control device with application to MAVs.

Laser Displacement experiments were conducted to calibrate the EAP and examine the displacements generated under selected frequencies and voltages. It was shown that the deflections could reach up to 0.35mmat high frequencies (40Hz). The surface deflection was found to be parabolic across the span and width of the actuator.

Hot-wire measurements were conducted on a flat plate equipped with a trailing edge flap in a low Reynolds number wind tunnel to study the effects of the EAP on the boundary layer in the presence of an adverse pressure gradient. Two actuation frequencies, corresponding to the Tollmien-Schlichting waves of the boundary layer and the Kelvin-Helmholtz waves (due to the presence of an inflection point). The disturbance frequency corresponding to the inflection point was found to be the most effective in altering the boundary layer as well as the turbulence intensities.