AERODYNAMIC PERFORMANCE MODIFICATION OF THE STINGRAY UAV AT LOW ANGLES OF ATTACK

By

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ABSTRACT

Active flow control using fluidic actuators, via arrays of synthetic jet actuators, was used to provide control power for trimming the Stingray UAV in the longitudinal (pitch) and lateral (roll) directions at low angles of attack. Using this technique, the pitching and roll moments were altered such that the effect is similar to that of a deflection of conventional control effectors in trim. The control effectiveness of the synthetic jets on the aerodynamic performance of the Stingray UAV was investigated experimentally in a wind tunnel. Global flow measurements were conducted, where the moments and forces on the vehicle were measured using a six component sting balance. The effect of the actuation was also examined on the surface static pressure at two spanwise locations. In addition, Particle Image Velocimetry (PIV) technique was used to quantify the flow field over the model, both the global flow field as well as the localized interaction domain near the synthetic jet orifice. The synthetic jets were able to alter the local streamlines and displace the boundary layer through the formation of a small quasi-steady interaction region on the suction surface of the Stingray UAV's wing. Phase locked PIV data were acquired to provide insight into the growth, propagation, and decay of the synthetic jets impulse and their interaction with the cross-flow. Furthermore, the changes induced on the moments and forces can be proportionally controlled by either changing the momentum coefficient or by driving the synthetic jets with a pulse modulation waveform. This can lead the way for future development of closed-loop control models.