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Oscillatory motion of flat square wall-hinged winglets inside a turbulent boundary layer[1] AMIR ELZAWAWY, Graduate Center of CUNY, YIANNIS ANDREOPOULOS, City College of CUNY — An experiment in a wind tunnel has been designed to investigate the augmented force generation acting on winglets during periodic rotation between zero and ninety degrees angle to the flow. Square and triangular flaps hinged at the wall beneath the flow have been used which were rotated with angular velocities between 10 and 150 rad/s. Strouhal numbers between 0.05 and 1.1 and Stokes numbers between 6300 and 95000 were achieved. Time-resolved Particle Image Velocimetry was implemented by using a continuous laser and fast frame-rate camera to provide qualitative and quantitative information of the flow field. The dynamic lift and drag force coefficients during the periodic motion of the winglet are different than the corresponding coefficients under stationary conditions at the same deployment angle after adjusting for inertial effects. These effects are enhanced with increasing Strouhal number and decrease with increasing boundary layer thickness. A highly intermittent thin boundary layer developing over the forward moving surface of the winglet separates into a shear layer which wraps around to form a large scale vortex which is causing the force augmentation.

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