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Control of wing-tip vortex using winglets at low Reynolds number[1] SEUNGHYUN CHO, HAECHEON CHOI, Seoul National University — Winglets are considered as one of the effective devices for reducing induced drag, and thus many studies have been conducted, but mainly at high Reynolds numbers ($Re \approx 10^6 \sim 10^7$) for commercial airplanes. However, small-size unmanned air vehicles (UAV), operating at low Reynolds numbers ($Re < 10^5$), become an important transportation system for different purposes. Therefore, in the present study, we experimentally investigate the effect of winglets on the aerodynamic performance of an UAV by varying the cant angle. The WASP UAV model is used and the Reynolds numbers considered are 110,000∼140,000 based on the free stream velocity and mean chord length of the WASP wing. The lift and drag forces on UAV are measured, and PIV measurements are conducted at several cross-flow planes for a few different angles of attack (α). At high angles of attack ($7^\circ \sim 13^\circ$), the winglets with the cant angle of 70° increase the aerodynamic performance, whereas at low angles of attack ($2^\circ \sim 6^\circ$), the wing-tip extension (cant angle of 0°) shows better performances. The velocity fields measured from PIV indicate that, with the winglet, the wing-tip vortex moves away from the wing surface at $\alpha = 12^\circ$, and the downwash motion in the wake behind the trailing edge is decreased, reducing the magnitude of the induced drag. A concept of changing the cant angle during flight is also suggested at this talk.

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