EXPERIMENTAL AERODYNAMICS OF WASHOUT TWIST MORPHING MAV WING

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"I, Muhammad Hakim Bin Mohd Hafiz hereby declared that I am the writer for this thesis. I also declare that none of any part of the thesis or the whole of the thesis has been submitted or published for a degree at UiTM or other institutions."

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ABSTRACT

Micro Air Vehicle also commonly known as MAV is a miniature aircraft that has been gaining interests in the industry. Application of Twist Morphing (TM) on MAV wing had been known to produce better lift performance. However, due to its small size, washin TM MAV wing displayed a massive drag coefficient distribution which subsequently lowers the lift-to-drag ratio. Thus, this research aims to investigate the aerodynamic performance of washout TM MAV wing towards reducing drag coefficient. A suitable test rig is also developed for wind tunnel testing. Four TM wing configurations (Membrane, TM1N, TM3N and TM5N) are subjected to wind tunnel procedure. Wind tunnel results revealed that Membrane wing produced the highest C_{Lmax} at C_{Lmax}=4.196071 and generated the earliest lift coefficient (C_L) at AoA($C_{L=0}$)= -4.4°. Membrane wing also produced the lowest C_{Dmin} magnitude of C_{Dmin}=1.335 at AoA= -13.6° which is 16.27% lower compared to nearest C_{Dmin} found in wing TM1N. However, TM5N wing produced the lowest average C_D increment with a 20.37% increase between AoA=0° and AoA=20°. Meanwhile, Moment Coefficient (C_M) analysis shows that Membrane wing has the steepest slope magnitude of $\Delta C_M / \Delta C_L$ = -6.45 which is 21.78% steeper than the next steepest slope of $\Delta C_M / \Delta C_L$ = -5.044 found in TM1N wing. This indicates the high stability performance shown by Membrane wing. As for the aerodynamic efficiency (C_L/C_D) analysis of the wing, TM5N wing displays the highest (C_L/C_D) magnitude of $(C_L/C_D)_{max}$= 0.729, slightly better than wing TM3N of $(C_L/C_D)_{max}$= 0.727 with 0.35% difference. As a conclusion, it is shown that a higher washout morphing force applied

to wing will result in a lesser C_D performance which in turn improves the aerodynamic efficiency of TM wing.