AERODYNAMICS PERFORMANCE OF OPTIMAL WING PROFILE ON MAV WING

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A thesis submitted in partial fulfillment of the requirements for the award of Bachelor Of Mechanical Engineering (Manufacturing) (Honours)

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JULY 2017

ACKNOWLEDGEMENT

Thanks to almighty Allah for helping and giving me the strength to complete this thesis. I would like to extend my deepest appreciation to my supervisor, Dr. Noor Iswadi Bin Ismail for his knowledge, advice, suggestion and guidelines throughout my simulation work and my thesis writing and to my panels, Dr Hamid Bin Yusoff and Mr Khairul Fauzi Bin Karim for their suggestion and ideas in improving my research.

I am highly thankful to Mohamad Afieq Bin Sabri and student under Dr. Noor Iswadi for giving me a hand and valuable ideas during my simulation work. Their help and ideas make my simulation work going smoothly.

Lastly, I would like to express a great thanks to my father, Hamdan Bin Kassim, my mother, Suriah Binti Painin and all my family members who never give up to giving their help, support and encouragements throughout my studies. I also would like to thanks to a person, who directly or indirectly helps me during this research.

ABSTRACT

The optimum design for Micro Air Vehicle (MAV) fixed wing is Zimmerman based on the optimal efficiency, however, the effect of camber to aerodynamics performance on the Zimmerman design are not fully discovered by previous researchers due to wide range of airfoil profile. Thus, the objectives of this research are to compare the aerodynamics performance of Zimmerman wing design with different percentage of camber.Three types of Zimmerman wing design known as Profile 1, Profile 2 and Profile 3 with 3%, 6% and 12% of camber, respectively which has different polynomial equation are used for ANSYS-CFX simulations. The three types of wing are initially developed by using ANSYS-Design Modeler before the aerodynamic simulation executed based on ANSYS-CFX simulation. The results shows that the stall angle of attack (AOA) for Profile 2 is 35° which is 3° and 5° higher than Profile 1 and Profile 3, respectively.The maximum lift coefficient ($C_{L_{max}}$) results shows that Profile 3 has better $C_{L_{max}}$ at 179.19% and 22.89% higher than Profile 1 and Profile 2, respectively. Based on the minimum drag coefficient (C_{Dmin}) analysis, all three profile produceC_{Dmin} at AOA $\approx$ 0°. However, at this stage, Profile 1 produce the lowest C_{Dmin} at 99.6% and 99.9% lower than Profile 2 and Profile 3, respectively. The moment coefficient analysis shows that Profile 3 shows the steepest curve slope at $\Delta C_L/\Delta C_M$ which is 22% and 35.32% higher than Profile 2 and Profile 1, respectively. Based on aerodynamic efficiency (C_L/C_D) study, Profile 2 shows the highest C_L/C_D value at 10.1175 which is higher about 23.38%

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CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Micro air vehicle (MAV) is defined as small, portable flying vehicle which is designed for performing useful work. MAV maximum length is 6 inch with the gross takeoff weight at 200 gram or less[1]. Reynolds Number divided into three regimes which are the first one is dominated by viscous forces; this is the regime where the entire small organism fit in. The second regime is the most difficult regime where the insects and small birds fit in. lastly, the third regime where the body moving through the fluid[1]. MAV fly in the low Reynolds Number regime which is 10^5 or less[1]. Due to the low Reynolds number, the suitable airfoil should be thin and well-cambered[2]. Recent study shows that thinner thickness of airfoil lead to