INDUCED DRAG ANALYSIS OF MULTI-WINGLETS FOR AERODYNAMIC PERFORMANCE ON NACA 23015

ZAIM ARIEFIN BIN AZWAN AFFENDI NUAL

(2017282228)

BACHELOR OF MECHANICAL ENGINEERING (MANUFACTURING) (HONOURS)

UNIVERSITI TEKNOLOGI MARA (UiTM)

AUGUST 2020

"I have declared that this thesis is the result of my own work except the ideas and summaries which I have clarified their sources. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any degree"

Signed: _____

Date : _____

Zaim Ariefin bin Azwan Affendi Nual

UiTM No: 2017282228

"I have declared that I have read this thesis and in our point of view this thesis is qualified in term of scope of quality for the purpose of awarding the Bachelor of Mechanical Engineering (Manufacturing)(Hons.)"

Signed: _____

Date : _____

Supervisor

Dr. Hamid bin Yusoff

Faculty of Mechanical Engineering

Universiti Teknologi MARA (UiTM)

13500 Permatang Pauh

Pulau Pinang

ACKNOWLEDGEMENT

First and foremost, praises and thanks to Allah S.W.T, the most merciful and gracious for His showers of blessings throughout my research work to complete the research successfully. My peace and blessing as well to His messenger, Muhammad S.A.W.

I would like to express my deep and sincere appreciation and gratitude to my supervisor, Dr. Hamid Yusoff for his continuous support, guidance and hard work. His dedication to teach and guide me has given me the capability to successfully finish my research. His dynamism, vision, sincerity and motivation have deeply inspired me. He has taught me the methodology to carry out the research and to present the research works as clearly as possible. It was a great privilege to work and study under his guidance. I am extending my heartfelt thanks to his wife, family for their acceptance and patience during the discussion I had with him on research work and thesis preparation.

I would also like to extend my gratitude to my family and friends that have supported me directly and indirectly. May Allah S.W.T. bless all of you. Finally, I am grateful to Universiti Teknologi MARA (UiTM) for giving the opportunity for this study.

Zaim Ariefin

July 2020

ABSRACT

An eagle can reach high velocities and stay airborne for hours. It is believed that the capability of an eagle to do so is due to the multi-winglets during its gliding and soaring flight without flapping its wings. Multi-winglets as a device for reducing induced drag in unmanned aerial vehicles (UAVs) was tested through a simulation study. The usage of multi-winglets as a wingtip device is inspired by the bald eagle that is an exceptionally efficient creature in terms of aerodynamics. The objective of this research is to study the aerodynamic effect of implementing multi-winglets on UAVs in terms of induced drag and lift coefficient. The design of 3 different multi-winglets based on NACA 23015 was computationally modelled. The winglet design with chord length (C) of 216.5 mm, 866 mm wingspan (L) and angles of attack of -5°, 0°, 5°, 10°, 15°, 20° were improvised with multi-winglets of differing amounts at 3 multi-winglets with cant angles of 15° between each winglet, 5 multi-winglets with cant angles of 7.5° between winglets and 7 multi-winglets with cant angles of 5° between each winglets. The three multi-winglet models and the baseline were tested at Unmanned Aerial Vehicles (UAVs) flying speed at 30 m/s with the boundary condition of air temperature at 293.3 K. The investigation has shown that the multi-winglets can improve the aerodynamic performance of airfoil in reduction of induced drag and increase of lift coefficient.