THE EFFECT OF WINGLET ON WING PERFORMANCE

By

Eslam Mansour Mohamed Abo-Seria

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
In
Aerospace Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2016

THE EFFECT OF WINGLET ON WING PERFORMANCE

By

Eslam Mansour Mohamed Abo-Seria

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
In
Aerospace Engineering

Under the Supervision of

Prof. Dr. Mohamed Madbouli Abdelrahman

Professor of Aerospace Department
Faculty of Engineering, Cairo University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2016

THE EFFECT OF WINGLET ON WING PERFORMANCE

By

Eslam Mansour Mohamed Abo-Seria

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
In
Aerospace Engineering

Approved by the
Examining Committee:

Prof. Dr. Mohamed Madbouli Abdelrahman, Thesis Main Advisor
Professor of Aerospace Department,
Faculty of Engineering, Cairo University

Prof. Dr. Galal Bahgat Salem, Internal Examiner
Professor of Aerospace Department,
Faculty of Engineering, Cairo University

Prof. Dr. Osama E. Abdellatif, External Examiner
Professor of Mechanical Department,
Faculty of Engineering, Shoubra, Benha University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2016

Engineer Name: Eslam Mansour Mohamed Abo-Seria

Date of Birth: 24 / 2 / 1987

Nationality: Egyptian

E-mail: Eslam_man@hotmail.com

Phone: +20 12 89498683

Address: Flat 205, Building 23, Block no. 28012, Third District, Obour City, Qalubia, Egypt

Registration Date: 1 / 10 / 2010

Awarding Date: 2016

Degree: Master of Science

Department: Aerospace Engineering

Supervisors: Prof. Dr. Mohamed Madbouli Abdelrahman

Examiners: Prof. Dr. Osama E. Abdellatif, External Examiner
Prof. Dr. Galal Bahgat Salem, Internal Examiner
Prof. Dr. Mohamed Madbouli Abdelrahman, Thesis Main Advisor

Thesis Title: The Effect of Winglet on Wing Performance

Key Words: Winglet, Wing sails, Wingtip devices

Summary: This work aims to increase wing aerodynamic performance by reducing the induced drag by using the winglet, hence increase airplane range. This is done by study the effect of different winglet geometric parameters on wing aerodynamic performance. Then generate the optimum winglet which gives maximum lift to drag ratio.

To reach this, two optimization and parametric studies on four geometric parameters of winglet were conducted. The first was low fidelity using Matlab code to solve potential flow, and the second was high fidelity using commercial code ANSYS Fluent to solve real flow. The low fidelity optimization was used to provide an initial guess to start the high fidelity optimization from it. The winglet four geometric parameters are: the cant angle, the sitting angle, the sweep back angle, and the tapered ratio.

Acknowledgment

I have great appreciation to my supervisor Prof. Dr. Mohamed Madbouli Abdelrahman for his technical advices, continuous support and deep revising that added a lot to the value of this work. I wish him the very best in both professional and personal life.

I would like to thank all my family, my father, mother, and brother for their encouragement and help during working on this thesis. I wish them the best in their life.

I wish to especially thank my wife for her contributions in running the solvers and recording outputs, the thing that saved a lot of time for me.

Eslam Man
Aug. 2016

Table of Contents

List of Tables

List of Figures