International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue XI, Nov 2018- Available at www.ijraset.com

Airfoil Selection for a Solar UAV Wing Design using Characteristic Mapping

Midhun Mohan Kudayattutharayil[1], Sunny Dayal Pande[2]
[1, 2]Institute of Aeronautical Engineering

I. INTRODUCTION

In the design process of an airplane, the air foil selection is very important and always different because of the of the specific flight requirements such as terrain mapping, surveillance, aerial photography etc. A solar UAV would need to travel at lesser speeds for the purpose of obtaining ground data and have enough wing span for the solar cells to be mounted.

By researching on RC forums, the sailplane air foil named WE3.55-9.3 was selected for its high CL/ CD ratio. The chosen air foil is very thin, thus allows high velocity with smaller drag than wider air foils. It is designed for low Reynolds numbers sailplanes as it produces high lift at low drag. The lift and drag coefficients are plotted in figure below for different Reynolds number using the program X-foil. For angles of attack between-2 ◦ and 8 ◦, the airflow around the profile is laminar what gives valid data.

A. *Air foil Selection*

Choice of right air foil is very essential in a Solar Powered UAV.

A suitable air foil is a balance of the following parameters.

1) High Lift
2) Low Camber
3) Low Speed
4) Low Reynolds Number

To investigate the air foil performances at low Reynolds numbers using air foil coordinates and computational analysis software such as XLFR.

B. *Characteristic Mapping*

a) As we have seen the desired characteristics required for a Solar Powered UAV, we will choose 4 similar already existing Solar aircrafts and compare their air foil parameters.

AIRCRAFT NAME	AIRFOIL	SPAN	% AREA OF SOLAR CELLS
SUNRISE 1	E387	9.8M	75% AREA
Titan	NACA 63412	64M	85% OF THE AREA
PATHFINDER	LA2573A	30 M	74% OF THE AREA
AQUILA	AQUILA 9.3% smoothed	45M	90% OF THE AREA

Table 1: List of 4 selected aircrafts

b) From the above table it is easily understood that a lower wing span like Sunrise 1 is preferable was longer wingspan aircrafts are not structurally viable.

c) As the aircraft is mostly used for surveillance it needs to have a higher glide rate which implies having a higher wing span. So the selected air foil satisfy all the above conditions.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue XI, Nov 2018- Available at www.ijraset.com

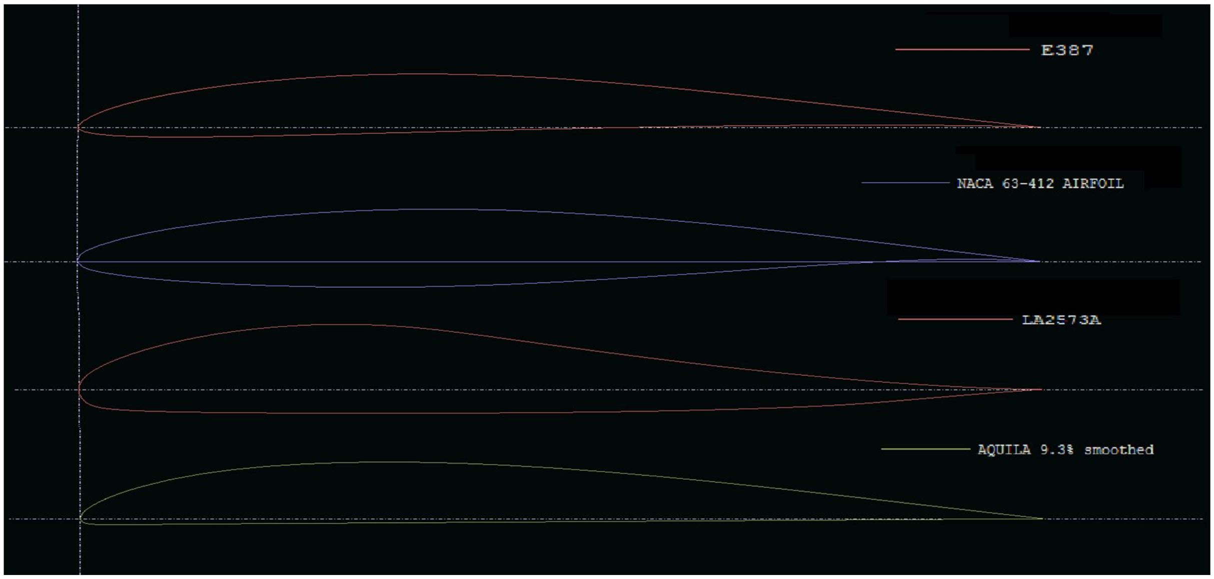

Fig 1. Airfoil Plots of considered UAVs

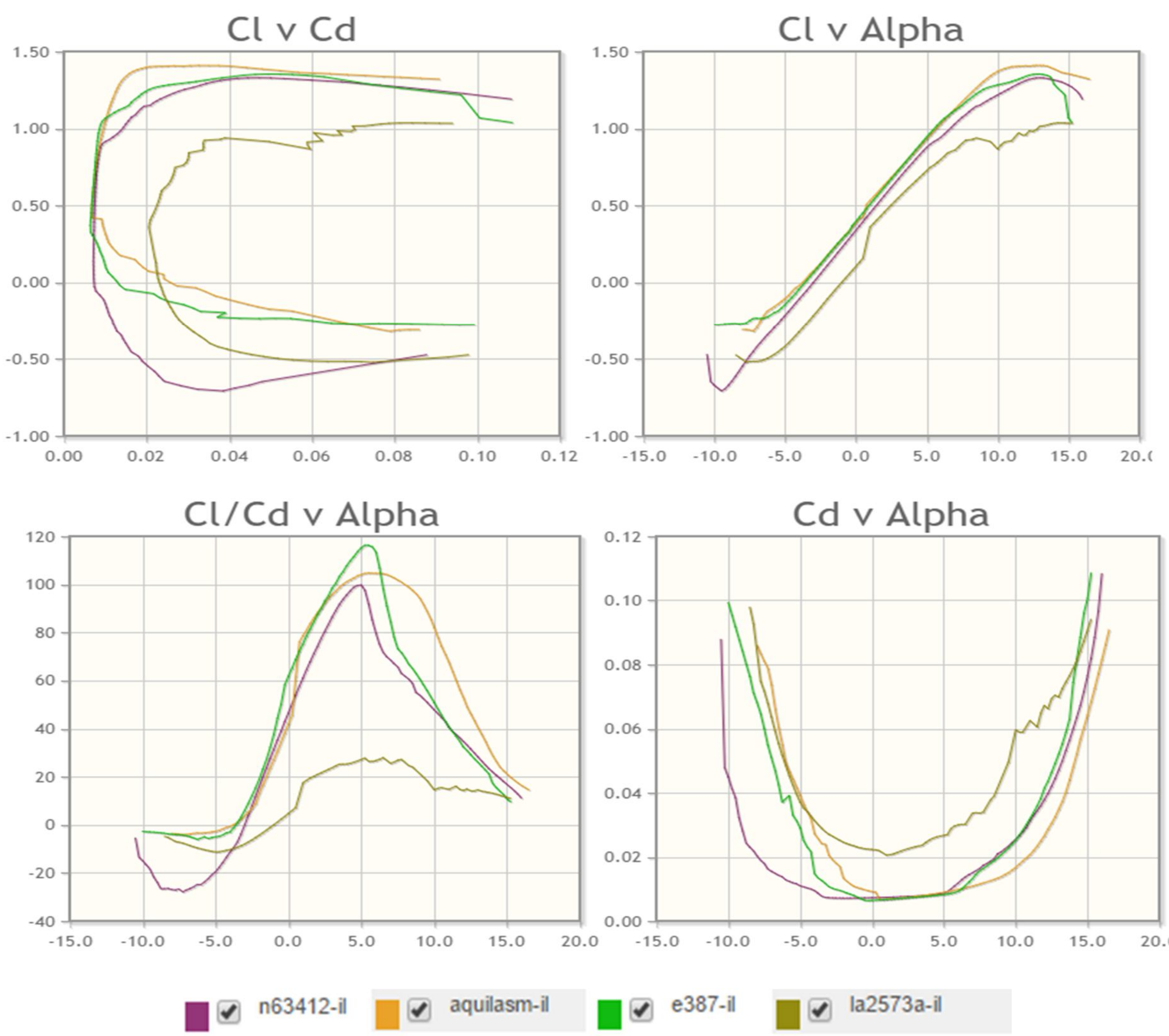

Fig 2. Aerodynamic Characteristics of the selected Air foils

AIRFOIL	E387	NACA 6341	LA2573A	AQUILA 9.3% smoothed
CL	0.828	0.6309	0.7744	0.8284
CD	0.01568	0.03276	0.00887	0.01408
CL/CD	52.80612245	19.25824176	87.30552	58.83522727

Table 2 . Aerodynamic Analysis

From the parametric analysis of each air foil of the aircraft.

a) Higher CL of E387 is preferable.
b) Lower CD of LA2573A is preferable
c) Drag polar of LA2573A is preferable.
d) Although the above table does not show an air foil having stable values. But LA2573A has a lower CD value, Hence the CL can compensate for it. Moreover, the CL/CD is also high.

II. RESULT ANALYSIS AND CONCLUSION

Conclusions drawn from the analysis of 4 air foils are

1) From the 4 selected air foils, LA2573A with 9% camber was found to be more effective with more CL (0.77), lowest drag coefficient CD(0.008) and maximum CL/CD(87.30) less camber making it perfect for mounting the solar cells.

A. Future Work

The following are broad areas where research can be conducted:

1) The considered airfoils can be optimized to have better lift, drag and C_L/C_D values.

REFERENCES

[1] Air foil Optimization for a Solar Powered Aircraft by Prof. Eugino Denti, of UNIVERSITÀ DEGLI STUDI DI PISA
[2] Project Solaris – Analysis of airfoil for solar powered flying wing UAV by Mikis Tsagarakis