Analysing the Performance of Solar Powered Wing (UAV)

Rohini D[1], RajKumar E[2], Karthick V[3], Dhayanandh R[4]

[1]*Assistant Professor, Aeronautical Engineering, Bannari Amman Institute of Technology, Sathyamangalam, India.*
[2,3,4]*Student, Final Year, Aeronautical Engineering, Bannari Amman Institute of Technology, Sathyamangalam, India.*

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Abstract - *Unmanned Aerial vehicle (UAVs) has become significant in the field surveillance sectors of Many Nations. Endurance is the one of the foremost problem in the Unmanned Aerial Vehicle, Generally most of the aircrafts use conventional fuel which cause pollutant, which it is also have a short time life and Expensive. So there is an Enormous demand for using a non exhaustible source of energy as a fuel. A solar energy is one of the obtainable renewable energy. Above the years, the optimization and designing of the aerodynamics of those Aerial vehicle have obtained lot of importance to the enlarging the usage to developing the UAV with effective endurance and stability at a subsonic speed. This paper contracts with comparison of analysing the Performance of a solar powered wing consisting of two different airfoil sections. Which are combined into a single wing and these wings are with each of the two homogeneous airfoil sections. The separate wing structure models were modelled through CATIA and imported into ANSYS FLUENT. Lift and Drag were calculated around it .Results were contrasted around it. Determination in regards to the benefits of utilizing a sun powered wing as use of wing with homogeneous airfoil.*

***Key Words*: Solar wing, Eppler 421, UAV, Selig 1223, ANSYS FLUENT and CATIA V5.**

1. INTRODUCTION

In the ongoing years the upsides of utilizing UAVs has expanded exponentially for guard reconnaissance and natural life investigation. Its capacity to give the required information without the danger of human existence with an additional benefit of having the capacity to investigate areas which are infeasible for people. Since the exploration on UAVs is still in crude stages when contrasted with the examination on kept an eye on airplane, a great deal of minor problem are as yet present. Which gives the degree to additionally innovative work in the field of UAVs. These flying machines are worked to continue the extended periods of trip in changing the States of air. Attributable to this test which certainly needs to the counter the study on the optimal design of the UAVs. Wing is given real consideration among the different research spaces related with UAVs.

The objective for UAVs is to fly to the extent that this would be possible. Be that as it may, current flight times are constrained by the battery life of the framework. Including a lightweight, sustainable power sources like Alta gadgets' solar oriented arrangement fundamentally expanded time limit, and much of the time, can kill the need to revive from a power matrix. Including power without looking at the weight, size, or mobility of the airplane is perfect for unmanned frameworks that require control for long continuance missions without coming back to ground.

Two airfoils to be specific Eppler 421 and Selig 1223 were considered as essential profiles of the solar light based wing. E421 has a thicker cross area which represents the strength of wing and results in better soundness amid wing blasts. Then again the flimsy cross area of s1223 helps in higher lift and lesser steadiness when contrasted with e421.

In the above talk, the solar oriented wing comprising of Eppler421 at root and Selig1223 at tip is demonstrated and dissected in ANSYS FLUENT so as to acquire its execution qualities with utilizing of the CFD apparatuses.

2. METHODOLOGY

The first and foremost step refers to the determining the wing loading factors. Such fundamental laws has applied to the system. Which obtain the appropriate equation for the stall velocites, landing distance, cruise speed. In order to prevent the tip stall the airfoils with high coefficient of lift have to be placed on the tip. Certainly this had a include advantages with respect to structural behaviour. The Eppler421 is than Selig 1223, as a result, which the wing can be well-made structurally on the certain root section and it correspondingly may provide the enough void space to retain the payload in the wing (if required).

The smaller in the wing loading (WS) is certainly better on the wing gliding and also further flight factor at the rate of the increasing the gross weight,The results suitable involves to be made in-between a gross weight and a wing loading. Which the red coloured statistics shows the important parameters of the wing loading.

Theoretically the tapered wings were preferred as (or) compared to the rectangular (or) quadrilateral wing. One of a major cause is to obtain a elliptical lift distribution over the wings and is to have a aspect ratio high for the same wing material and same reference area.

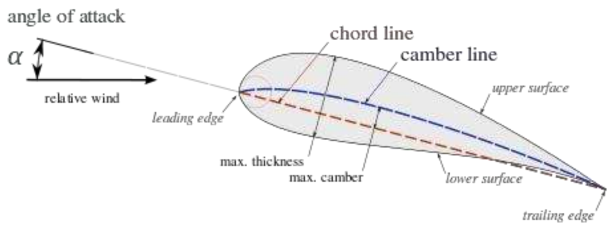

Fig-1: Airfoil Nomenclature

In the continusion to prevent the tip stall, the airfoils of high coefficient of lift had to be positioned on the tip region. In the foremotive cases Selig1223 placed on the tip of the wing. This had an include advantage with respect to the structural behaviour. The Eppler421 placed at the root section of the wing. The Eppler421 is more thicker than Selig1223, as result of the wing were structurally study in the root section, and it may provide the sufficient area to keep payload on the wing(if required).

The design models of the wing were completed in CATIA V5 through the assist of the tools " Multi-section solids". The Eppler421 cross-sections are outlined on the vertical axis plane and Selig1223 are outlined on a parallel axis plane. Which are at the distance equivalent to half of the wingspan. "Multi-section solid" were used to generate the solid model.which are by drawing two grid lines in top and bottom staring from Eppler421 at the root and Selig1223 at the tip of the wing.

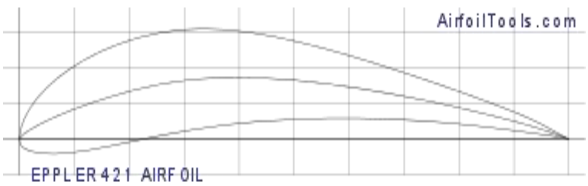

Fig -2: Eppler 421 Airfoil

The another step was to define the accurate aerodynamic performance from a Computational Fluid Dynamic technique through a ANSYS (Fluent) software. The wing were designed of the two different airfoil sections because of the non-existence of experimental result for the different airfoil sections. Since, we own Computational fluid Dynamic techniques. We found that using the different cross section and different airfoil types results in the good conditional values. In prevalence to various checks of the relative performances of the solar powered wing were completed of Selig1223 and E421, analyse were carried on each of them independently.

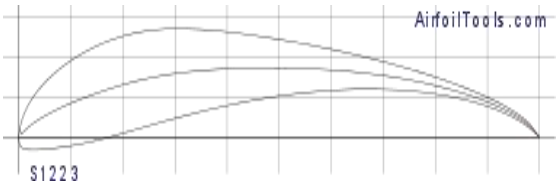

Fig -3: Selig 1223 Airfoil.

After the certain iterations, coefficient of a drag and coefficient of a lift are obtained from the ANYSYS (Fluent). Those iterations are repeated for the several angle of attack's and also for the three different design specifically Eppler421, Selig1223 and solar wing structure. The concluding data were plotted in the order to verify, whether the characteristics of a solar powered wing lies in between that of Selig1223 and Eppler421.

Fig -4: Design of Eppler 421 Airfoil

In the continusion it is to verify the 3D grid validation, over the flow analyse were complete on both combined airfoils. Later It may originate that an error of 5% to 7% found on the analyse which are exactable and it may accordance with the Computational Fluid Dynamics technique. Similarly the wing has to be finished of different two airfoil sections Because of the absence of computational result for the different airfoil sections.Certainly we had Computational Fluid Dynamic technique at our disposables. In prevalence to verify the relative performance of the solar powered wing were made of Eppler421 and Selig1223, Analysis was carried on each of them independently. Based on a result attained are matched with the predicted values.

Fig -5: Design of Selig1223 Airfoil.

After the certain iteration over the cross section of a wing were taken at the regular interval from the root sections in order to obtain the airfoil value at the similar section.

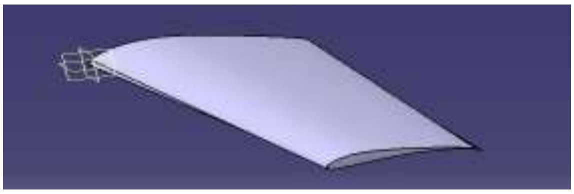

Fig -6: Design of Solar wing

The CATIA V5 demonstrate is imported into ANSYS Workbench (FLUID FLOW-FLUENT). Subsequent to bringing in geometry, a quadrilateral control volume is made and the symmetry is made along the foundation of the wing in geometry. The medium inside the far field is considered as air. When geometry is made, the model is currently exposed to lattice.

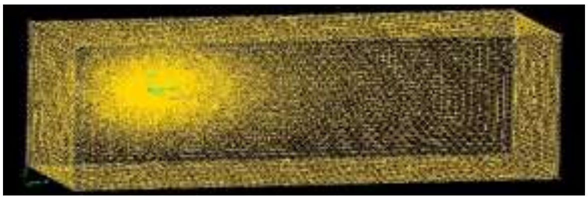

Fig -7: Mesh over the control volume

The partial difference equation that governs the fluid flow and the heat transfer were not generally resemble to analytic solutions and except for certain simple case. In order to analyse the flow domains, fluid flows are split into huge sub-domains. The governing equations are laterally discretized and worked inside each of these sub-domains. These sub-domains are certainly named as cell or element, and collection of all element or cell are named as grid or mesh.

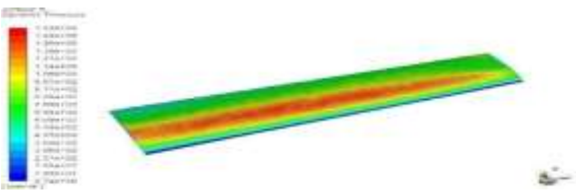

Fig -8: pressure contours over the wing

Fig -9: velocity magnitude over the wing

3. RESULTS AND DISCUSSIONS

The design analysis has existed and came into a inference concerning two aspects. Which are the plots of co-efficient of lift vs Angle of Attack and plots co-efficient of drag vs Angle of Attack and plot of co-efficient of drag vs co-efficient of drag.

4. CO-EFFICIENT OF LIFT VS ANGLE OF ATTACK

The co-efficient of lift were certainly attained from the fluent Software and those solutions are plotted for the iteration, Angle of Attack certainly from zero angle of degree to fifteen angle of degree. It is to be considered that the combined wing profile may matches with the intermediate value. Certain point are to be infered from the plot that is the Selig 1223 although it has better coefficient of lift (Cl).

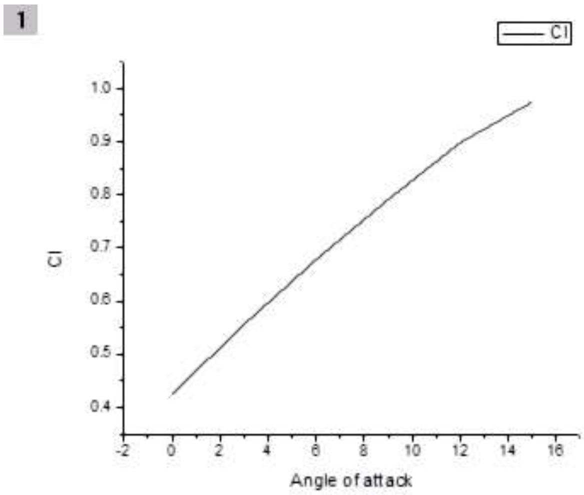

Fig -10: coefficient of lift vs Angle of Attack for wing.

3.2 CO-EFFICIENT OF DRAG VS ANGLE OF ATTACK

The co-efficient of lift were acquired from the fluent and those values were certainly contrived on the iteration for the Angle of Attack from zero angle of attack to fifteen angle of attack. It is to be considered that combined wing profile match with the intermediate values. Certain point are to be infered from the plot that is a Selig1223 it may cause greater coefficient of drag (Cd) on the working range of Reynolds number of 200000.

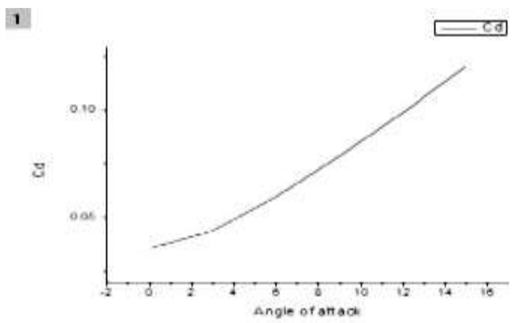

Fig -11: Co-efficient of drag vs Angle of Attack for wing.

3.3 CO-EFFICIENT OF DRAG VS CO-EFFICIENT OF LIFT

The Defined co-efficient of drag vs co-efficient Lift were certainly attained from the ANSYS Fluent software and those values are plotted on the different angle of attack from zero angle of degree to fifteen angle of degree.

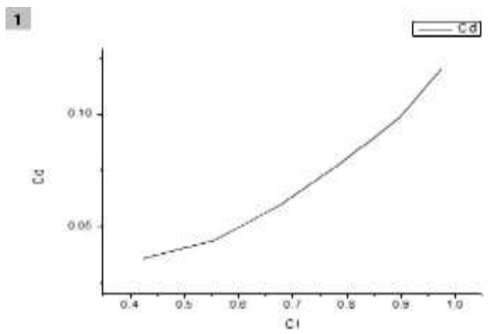

Fig -12: Co-efficient of drag vs Co-efficient of lift for wing.

4 SOLAR POWERED UAV FABRICATION

The Design of solar powered Aerial Vehicle were fabricated through the various parameters and the design calculations. The Detailed Design, Weight estimation, Performance and Stability calculations were done on the future work.

5 CONCLUSIONS

The inference were strained from those work which are two-fold in nature. The Performance attributes the Drag and Lift exist in the area according to the check and its qualities of the Solar Powered Unmanned Aerial Vehicle wing have high endurance.

The demonstrating of sun based UAV wing has done utilizing a homogeneous interjection procedure. The middle airfoils can be neither Eppler421 nor Selig1223. A noteworthy change can be actualized in the wing is that can be partitioned into two sections where the one section involves Selig1223 while different includes Eppler421, those section extent shifted to get outcomes and more progress starting with one airfoil then onto the next airfoil can be made smoothly there by effectively remodifying the issue of middle of road airfoils having similar cross-section.

However, certainly aspect of the analysis had a certain possibility for improvements. The Design of the solar powered wing were done on correspondent interpolation techniques. Where the intermediary aerofoils of a certain solid model can't be improve as per necessities. The intermediary airfoils can sometimes can be neither of Eppler 421 nor Selig 1223. A major changes can be executed on the wing that can divided into dual section. where unique section is Selig 1223 while the other may of Eppler421. [1]

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BIOGRAPHIES

Mrs Rohini D, Assistant Professor, Aeronautical Engineering, Bannari Amman Institute of Technology, Sathyamangalam, Tamilnadu, India.

Dhayanandh R he is pursuing his Final Year Aeronautical Engineering in Bannari Amman Institute Of Technology, Sathyamangalam, Tamilnadu, India. BATCH (2016-2020)

Rajkumar E he is pursuing his Final Year Aeronautical Engineering in Bannari Amman Institute Of Technology, Sathyamangalam, Tamilnadu, India. BATCH (2016-2020)

Karthick V he is pursuing his Final Year Aeronautical Engineering in Bannari Amman Institute of Technology, Sathyamangalam, Tamilnadu, India. BATCH (2016-2020)