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Conceptual Design of UAV at Low Reynolds Number and High Payload Lifting Canard Configuration

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Abstract – In the present world, everyone is trying to integrate manned missions into unmanned missions. In this paper we will be discussing the use of lifting canard has a high payload lifting configuration. The airfoils used are interpolated to get better results; configuring lifting canard with pusher gives the desired values. These values are obtained by the analysis in XFLR5 V6 which is open source software issued under general public license (GNU). Analyzing the airfoil graphs with the existing airfoil graph results are described. The Aerodynamic & stability analysis using XFLR5 and obtaining Cl vs Alpha & Cm vs Alpha graph plotting from results are discussed in the present work.

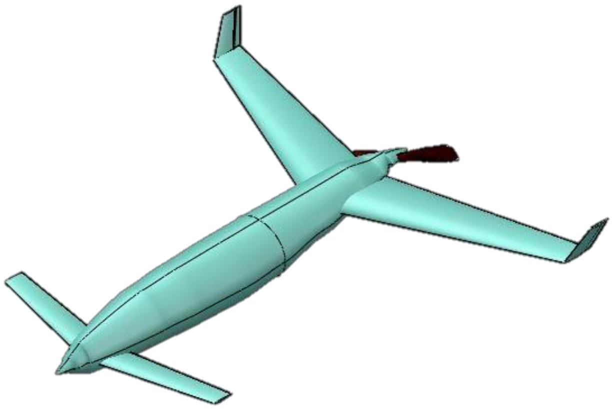

Fig:1 Conceptual design isometric view (designed in openvsp(vehicle sketch pad)).

Keywords: conceptual design, XFLR5 analysis, Canard configuration, pusher configuration.

I.INTRODUCTION

Unmanned aerial vehicle (UAV) is a remote-controlled aircraft with no pilot on board which is flown by a pilot at ground station controller or by autonomously based on pre-programmed flight plans or more complex dynamic automation systems. The entire system is called as Unmanned Aerial System (UAS), it consists of UAV, Ground Control System and a means of Communications between them. UAV's are designed based on their functional profile. The United States began developing first UAV technology during the first world war in 1916 and created first pilotless aircraft in the history, In 1930 the US NAVY began experimenting with radio control aircraft resulting in the creation of the CURTISS N2C-2 drone in 1937, during world war-2 REGINALD DENNY created the first remote-controlled aircraft named radio plane OQ-2 this was the first massed produced UAV in the US. The significance of UAV's has become greater. UAV's are assisting mankind in various fields such as military, medical, surveillance, agricultural, infrastructural monitoring, GPS tracking, telemetry, logistics and transportation, photography, and geospatial data and in space exploring missions. Usage of UAV's in wars will reduce the loss of human life. By this technical implementation, we can say that UAV's are going to service humans in day to day life and hence there is a need for the study and development of UAVs.

The present paper describes the usage of lifting canard, interpolated airfoils, and pusher configuration for acquiring better results. Mainly canard configuration is used to stabilize the plane mostly we see the canards in combat aircraft but in this paper, we will see how it can contribute to and satisfy the high payload lifting requirement.

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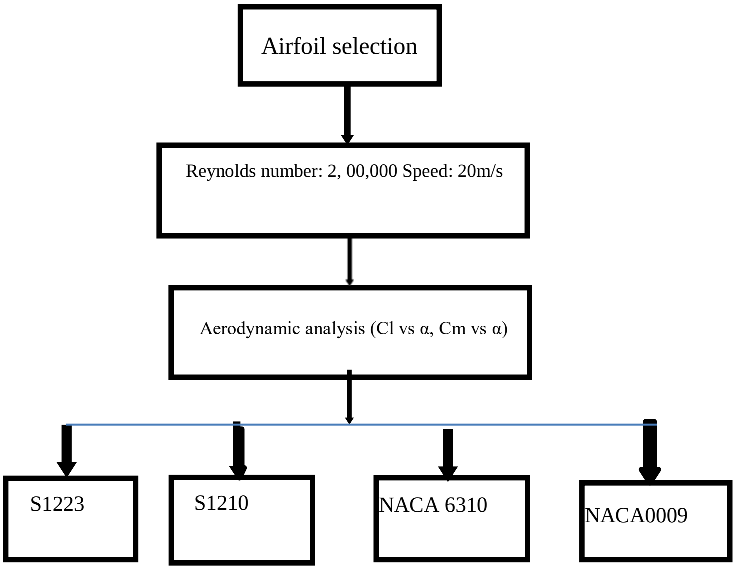
II. RESEARCH METHODOLOGY

A canard is an aeronautical arrangement wherein a small forewing is placed forward of the main wing of a fixed-wing aircraft. The term "canard" may be used to describe the aircraft itself, the wing configuration. The canard configuration is popular on precision-guided projectiles for the advantages including high responsibility, small volume, and high efficiency. They are classified into two types they are lifting canard and control canard, in lifting canard the weight of the aircraft is shared between the wing and the canard, in control canard design whole weight of aircraft is carried by the wing and it is used primarily for pitch control during maneuvering. Planes having canards have high stall angle. In rockets and missiles canards are used has guiding purposes, the range of projectiles increment is a considerable importance of canards. Using canard in the present design help us to increase the lifting characteristics indeed contribute to lift more payload. In the present analysis vortex lattice method (VLM) is used to perform the aerodynamic analysis.

III.AIRFOIL SELECTION AND ANALYSIS

Each airfoil has unique characters in their usage, but the interpolation of airfoils helps us to interpolate the two unique characters in one airfoil. In the present design, the interpolation of s1223 and s1210 airfoil gives better results. Fig.2 gives us the comparison between different airfoils.



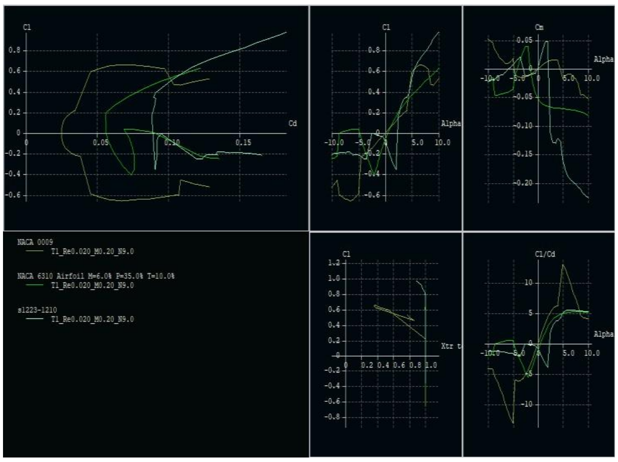


FIG.2 Analysis of the above-mentioned airfoil

IV. RESULTS AND DISCUSSION

The conceptual design is made and analyzed; the following results plotted between the different aerodynamic parameters are discussed below.

i. Cl vs alpha graph shows it is increasing slope, at zero angle of attack it has cl of 0.6.

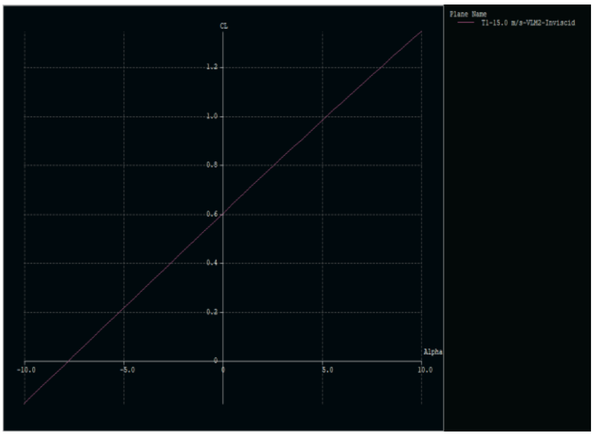


Fig.3 Cl vs alpha

ii. Cm vs alpha shows it has a negative slope i.e. it is longitudinally stable

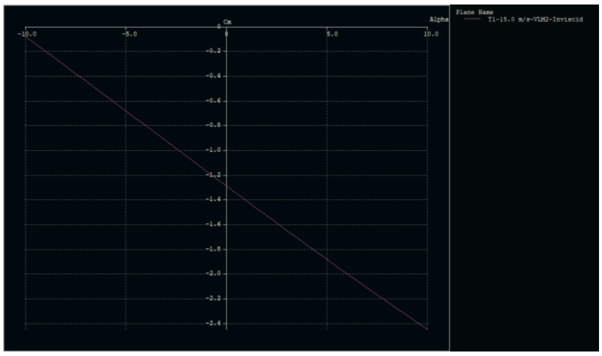


Fig 4 Cm vs alpha

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iii. Cl vs Cd shows cl is proportional to cd

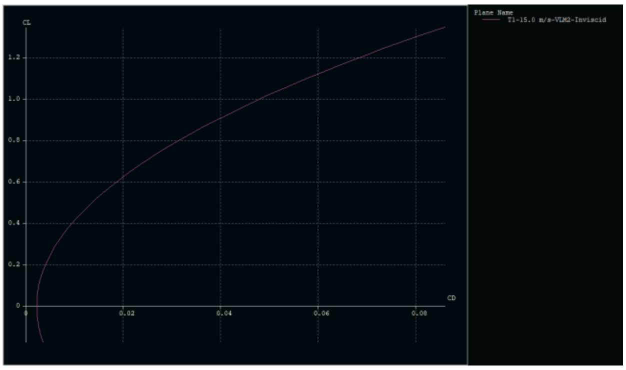

Fig.5 cl vs cd

iv. Cl vs span location Y (the model is simulated in openvsp (vehicle sketch pad) and the graph is plotted at different conditions varying Mach number, Reynolds number, angle of attack.)

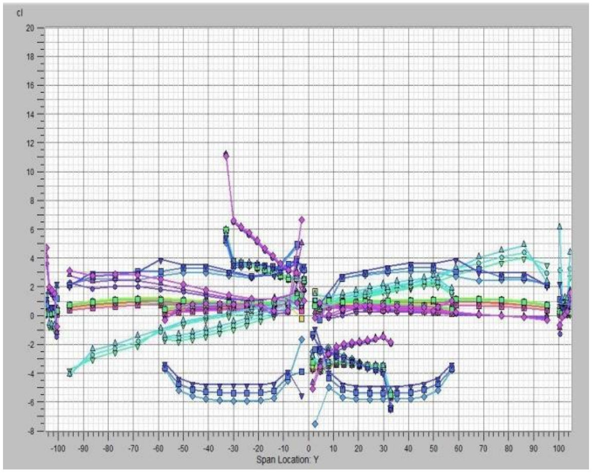

Fig.6 cl vs span location Y

v. Mach vs alpha (it is also simulated in openvsp(vehicle sketch pad))

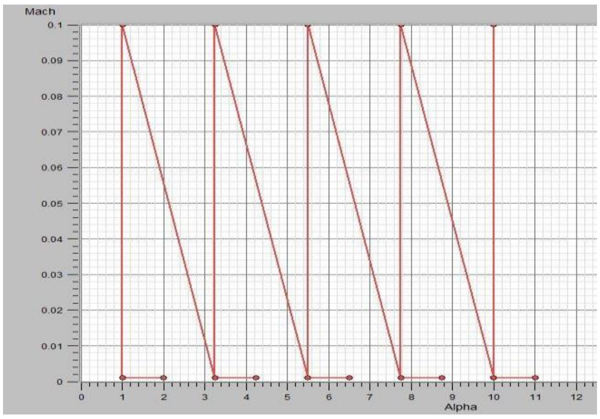

Fig.7 Mach vs Alpha

Streamlines view

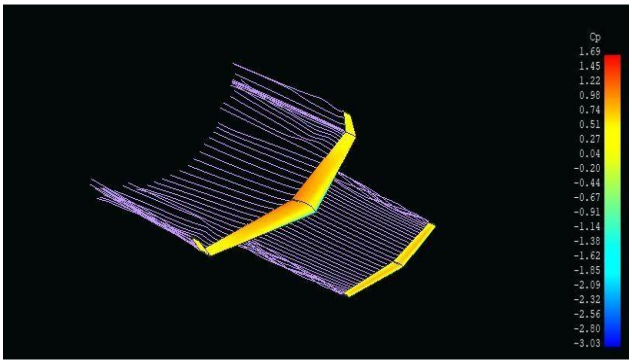

Fig.8 streamlines view ignoring fuselage body and prop wash

V. CONCLUSION

Hereby the conceptual design of UAV operate at low Reynolds number high payload lifting is aerodynamically efficient by interpolating different airfoils and canard configuration that also regulates the streamline flow. From the above analysis, it is clear that we use lifting canards has high payload lifting configuration. Canards give us good longitudinal stability.

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