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Computational study on chamber morphing wing concept for efficient lift at various angle of attack

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Abstract:
Modern day aerospace engineering is enabling us with new innovative methods to overcome he existing challenges faced by the aircrafts at higher altitude. Camber morphing of wing is a concept to increase the lift significantly while eliminating the use of flaps. The new smooth surface design will eliminate or reduce the drag and will upsurge maneuverability along with fuel efficiency. Wings are crucial part for an aerodynamic flight, the shape and mechanism incorporated in the wing directly affects the lift generation. an airfoil incorporated with a mechanism to provide negative camber is studied in detail. Analysis and simulation has been performed to note the differences and lift generation from that wing. Changing shape of the wing at different flight conditions has been studied and a model was designed in CATIA V5. Theoretical and experimental values are compared and aerodynamic performance is analyzed.

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Date of Conference: 28-29 Dec. 2020 **DOI:** 10.1109/ICPS51508.2020.00020

Date Added to IEEE *Xplore*: 21 May 2021 **Publisher:** IEEE

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Contents

I. Introduction

There are numerous airfoil designs that were researched, found and tested from the beginning of the flight era. Flights are becoming more and more efficient by evolving the current designs and our current understanding of airfoils. There are slats, slots and flaps that came into picture which showed great performance ability by reducing the drag and generating maximum lift coefficients which led to less fuel consumption. But as for growing needs of efficient and high performance aircrafts it becomes essential to find new ways to make the flight more efficient. Researchers and engineers and companies like Boeing and Airbus are cramming to find out new ways to build air vehicles to have more range and endurance which in fact reduces the fuel consumption. The significant problems in designing an airfoil are to produce maximum coefficient of lift and at higher drag reduction rate by that the air vehicle can produce sufficient structural rigidity to sustain enough load carrying capacity. So variable camber wing is a better alternative for current wing structures as it reduces the attachment complexities as it performs all the slats operations solely. Which reduces the weight of the aircraft as removal of extra parts such as slats or slots. It has shown good capabilities during our experimentation and result analysis that it can generate good as compared to current wing capabilities. Flaps can be defined as the devices which used to vary the lift. These kinds of flaps are used for higher efficiency and simplicity of structure. When variation is applied on the plain flaps shows the ability to be designed to be rigid in a given direction while being flexible in another direction. This high lift device is currently used to vary the lift of the aircraft as this device considered varying the camber of the airfoil and by looking into these it is found out that what if the flap is removed from the structure of wing and make the wing itself variable. This idea led to making an airfoil with a variable camber. This idea has been tested and found by many researchers very efficient in many ways and some of which are listed in our experiment too. As this previous experimental and analyzed data helped us to understand the concept better and by applying these new ideologies in this experiment we have found some similar and some improved results.

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