

Enhancement of Aircraft Longitudinal Stability Using Tubercles

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Abstract : Mimicked from the humpback whale flippers, the application of tubercle technology is seen to be particularly advantageous at high angles of attack. This particular advantage is of paramount importance when it comes to structures producing lift at high angles of attack. This characteristic of the technology makes it ideal for horizontal stabilizers and selecting the same as the subject of study to identify and exploit the advantage highlighted by researchers on airfoils, this project aims in establishing a foundation for the application of the bio-mimicked technology on an existing aircraft. Using a baseline and 2 tubercle configuration integrated models, the project targets to achieve the twin aim of highlighting the possibility and merits over the base model and also choosing the right configuration in providing the best characteristic suitable for high angles of attack. To facilitate this study, the required models are generated using Solidworks followed by trials in a virtual aerodynamic environment using Fluent in Ansys for resolving the project objectives. Following a structured plan, the aim is to initially identify the advantages mathematically and then selecting the optimal configuration, simulate the end configuration at angles mimicking the actual operation envelope for the particular structure. Upon simulating the baseline configuration at various angles of attack, the stall angle was determined to be 22 degrees. Thus, the tubercle configurations will be simulated and compared at 4 different angles of attacks: 0, 10, 20, and 24. Further, after providing the optimum configuration of horizontal stabilizers, this study aims at the integration of aircraft structure so that the results better imply the end deliverables of real life application. This draws the project scope closer at this point into longitudinal static stability considerations and improvements in the manoeuvrability characteristics. The objective of the study is to achieve a complete overview ready for real life application with marked benefits obtainable from bio morphing of the tubercle technology.

Keywords : flow simulation, horizontal stabilizer, stability enhancement, tubercle

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