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Performance Assessment of HLFC (Hybrid Laminar Flow Control) Aircraft

Diplomarbeit (diplom thesis) in compliance with § 21 of „Ordnung der staatlichen Zwischen- und Diplomprüfung in den Studiengängen Fahrzeugbau und Flugzeugbau an der Fachhochschule Hamburg“.

Background

Hybrid Laminar Flow Control (HLFC) is an drag reduction technique that permits extended laminar flow control on an aircraft surface at chord Reynolds numbers normally associated with turbulent flow. The delay in transition of the boundary layer is usually achieved by the application of suction over the first 10 to 20% of the chord (i.e. ahead the front spar of the wing). With HLFC a correctly profiled wing, empennage or nacelle could permit laminar flow to extend back to about 50% of the chord. This is however at the expense of an increase in system weight, maintenance costs and increased Specific Fuel Consumption. A computer performance model of a twin engine aircraft in the class of the Boeing 757 has been developed at the University of Limerick to study the potential fuel saving of a HLFC aircraft, taking into account the possible increase in the SFC (Specific Fuel Consumption) of the engines due to the energy required for the suction system. In calculating the fuel required for a specific mission, the program uses a series of “lookup” tables that define the primary aerodynamic characteristics of the aircraft and the fuel flow versus thrust relationships (as a function of height and airspeed).

Task

It is required that the candidate develops a second series of „lookup“ tables for a generic aircraft of greater size and longer range, in the class of the Airbus A330-200. Partial performance information on this aircraft is available. It is required that the candidate works backwards from the given performance results to derive the basic aerodynamic characteristics and the fuel relationships for this aircraft, using the existing twin jet data as a model. Having established the input data for the second aircraft, it will be necessary to validate the model against published operational data for this aircraft. If necessary the input data will be adjusted to improve the accuracy of the results. The computer model will then be used to perform a sensitivity study to investigate the impact on fuel burn of various levels of Drag reduction, SFC penalty, and OEW increase.