Accepted Manuscript

Simulations of an aircraft with constant and pulsed blowing flow control at the engine/wing junction

David Hue, Christophe François, Julien Dandois, Anna Gebhardt

PII: S1270-9638(17)30801-5
DOI: http://dx.doi.org/10.1016/j.ast.2017.07.031
Reference: AESCTE 4126

To appear in: *Aerospace Science and Technology*

Received date: 3 May 2017
Revised date: 17 July 2017
Accepted date: 20 July 2017

Simulations of an Aircraft with Constant and Pulsed Blowing Flow Control at the Engine/Wing Junction

David Hue[1], Christophe François[2], Julien Dandois[3]
ONERA-The French Aerospace Lab, 92190 Meudon, France

Anna Gebhardt[4]
German Aerospace Center (DLR), Lilienthalplatz 7, 38108 Braunschweig, Germany

Keywords: High-lift, high bypass ratio turbofan engines, nacelle wake flow separation, active flow control, fluidic actuators, pulsed blowing jet

In high-lift and especially landing conditions, the vortices emerging from the engine strake and pylon as well as from the inboard and outboard slat tips of civil aircraft configurations can be the cause of the so-called nacelle wake flow separation. This phenomenon might be responsible for the wing stall and sudden lift loss; the effect is expected to increase with the coming up of enlarged nacelles and larger slat cutouts typical of Ultra High Bypass Ratio turbofan engines. In the framework of the European project AFLoNext, DLR and ONERA performed numerical studies focused on a realistic aircraft in high-lift configuration. Structured and unstructured grids were generated to perform Reynolds Averaged Navier-Stokes computations aimed at analyzing the baseline flow without control and determining relevant location and settings for active flow control systems. Constant blowing devices with different slot sizes, types and injection velocities were evaluated with RANS simulations over complete lift polars. The gains in CL_{max} were quantified; they range from 1 to 3% for actuator capacities compatible with manufacturer requirements, the nacelle wake separation appears at angles of attack one to two degrees higher than without control and the lift levels in post-stall conditions are significantly improved. Finally, unsteady RANS computations were carried out to investigate the potential of a pulsed blowing device. The gains in CL_{max} and flow separation containment obtained with the latter are similar to those of constant blowing devices which yet exhibit greater momentum coefficient and mass flow rate values.

[1] Engineer, Applied Aerodynamics Department, david.hue@onera.fr.
[2] Engineer, Applied Aerodynamics Department, christophe.francois@onera.fr.
[3] Engineer, Applied Aerodynamics Department, julien.dandois@onera.fr.
[4] Engineer, Transport Aircraft Department, anna.gebhardt@dlr.de.