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Abstract

Active Flow Control (AFC) is one of the envisaged future elements of better aircraft performance. Large efforts have been made up to date to investigate different AFC concepts. However the focus was mainly on basic aerodynamic principles. In light of more comprehensive overall aircraft feasibility studies an Active Flow Control wind tunnel test campaign in collaboration with the Technische Universität Berlin was conducted in the Airbus Low Speed Wind Tunnel test facility in Bremen. The AFC system, which was designed by the TU Berlin, was integrated into an industrial high-lift half-model. As AFC concept pulsed blowing was selected and the air was blown trough slots incorporated in the inboard and outboard flap shoulder of this high-lift configuration. By adjusting the gap via spoiler droop the flap was made receptive to AFC by deteriorating the high-lift setting and supporting therewith separations. In the following it was shown that the AFC system was capable of eliminating those flap flow separations. In this paper the aerodynamic performance will be evaluated and compared to the reference setting without active flow control. Additionally, the performance will be analyzed with respect to various AFC system parameters, such as mass flow rate, pulse frequency and gap settings. Concluding, the use of active flow control in order to enhance the high-lift potential seems feasible from an aerodynamic point of view. However, the aircraft integration and its associated constraints with respect to space provisions, energy supply and consumption have to be considered as well. Therefore, a concept for active flow control integration into a trailing edge flap of the generic type (FNG) will be described herein. For actuation a self-excited fluidic diverter was chosen and implemented into the leading edge box of the inboard flap. Synergies were generated by using the cavity between by the structural support of the actuator, the flap front spar and the flap covers as supply air tubing. An assembly concept was developed focusing on low weight as well as low manufacturing complexity. Compliant with the requirements, the new system can be retro-fitted into the existing flap without changing the main flap center-box structure. With respect to the aircraft system integration, this work developed a concept for an efficient air supply with minimum weight increase. Several multidisciplinary aspects had to be treated in an iterative manner. In order to study those interactions, a program was developed, which calculates total pressure loss trough the whole AFC system as well as the characteristic flow properties in the plenum. With this set of information sensitivity studies showed off-design behaviour of the system through

the whole flight envelope to be acceptable. In the end it could be shown that the weight increase is also within an acceptable level.