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CFD sensitivity analysis on bumped airfoil characteristics for inflatable winglet

P. Caso, E. Daniele, P. Della Vecchia and A. De Fenza
University of Naples Federico II, Department of Industrial Engineering
Via Claudio 21, 80125, Naples, Italy

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Abstract

The new aerospace technological milestone is aimed to reducing direct operating costs and pollution. In order to obtain pollution reductions via high aerodynamic efficiency, a performance analysis for bumped airfoil based winglet has been proposed. Most conventional aircrafts are equipped with fixed winglets to decrease the induced drag; thus, saving more fuel. New projects point towards advanced smart materials and telescopic wing tip devices to obtain an adaptive morphing shape that gives, through performance improvement, a fuel consumption reduction resulting in less pollutants. The focus of this paper is to evaluate the aerodynamic performance, in terms of lift, drag and moment coefficient for a bumped airfoil in climb/descent flight condition at 5000 meters altitude. The performance analysis has been conducted via a numerical investigation of the effects of bumps number, height and width for inflatable winglet airfoil, a system that would guarantee a more comfortable arrangement of extraction system and just minor surplus of weight compared to classical winglet solutions, with all the subsequent advantages.

1 Introduction

This paper presents a CFD sensitivity analysis on the aerodynamic characteristics of a bumped airfoil at medium Mach number ($M = 0.5$) and high Reynolds number ($Re = 1.37 \times 10^7$). The work aims to continue a previous paper carried out by the AELAB and ADAG research groups of the Department of Industrial Engineering of University of Naples during 2012 [1]. The conceptual design, proposed by Daniele et alii in Ref. [1] involves the design of a telescopic inflatable variable height wing-tip device for long range jet transport aircraft. The span variation is pursued toward a telescopic device moved by an electrical engine. The inflatable system is distributed chord wise and along the base of a tip and it assures the elastic stiffness, while preserving the aerodynamics shape. This conceptual design, with a schematic

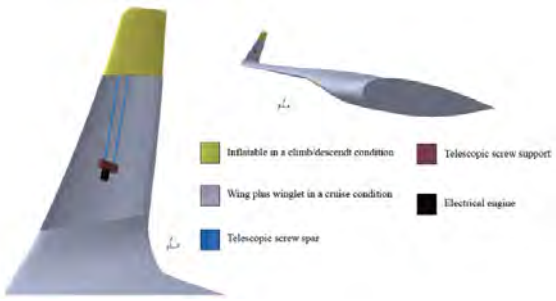

Figure 1: Telescopic device concept

sketch of the main components, is shown in Fig. 1. The main goal of the design proposed in Ref. [1] was to optimize the aircraft aerodynamic efficiency during the whole flight envelope in such a