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# CFD sensitivity analysis on bumped airfoil characteristics for inflatable winglet

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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

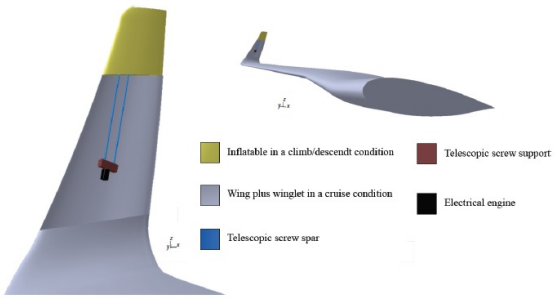


Figure 1: Telescopic device concept

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