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Short Communication

Comparison of Linear Vortex Lattice Method and Higher Order Panel Method with CFD and Wind Tunnel Data

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Abstract

In order to evaluate the applicability and efficacy of two distinct induced drag computational techniques based upon linearized, attached potential flow theory, a generic trapezoidal wing is analyzed. These two techniques are extensively utilized in academia and aerospace industry and are founded upon vortex lattice method and higher order panel method respectively. An extended VLM-based technique approximates the three dimensional wing and fuselage into a co-planar geometry. Moreover suction parameter that is calculated analytically, is given as an input to capture three dimensional leading edge thrust and vortex lift effects. On the contrary, the higher order panel method, models the complete geometry. It varies the wake orientation with angle of attack, to better predict the effects of downwash. Both techniques incorporate compressibility effects and therefore are more apt to analyze, both subsonic and supersonic regimes. Due to its wide spread applications in conceptual design and optimization of aircraft geometry, these two methods is compared for accuracy, set-up time and input controllability. Wing geometry with identical boundary conditions, flow parameters and number of panels or networks is examined through both the techniques. The pressure distribution thus obtained is then plotted and results are compared with wind tunnel and CFD data. This comparison concludes the most favorable flow solving technique that better predicts inviscid aerodynamics accurately and efficiently

Keywords

Aerodynamic design, Aerodynamic,optimization, Enhanced potential method,Morphing wing,Nonlinear vortex lattice method,Quasi-3D aerodynamic method,UAS optimization

Introduction

The air transportation industry is a commercial and economical sector with a very fast growth rate. The International Civil Aviation Organization (ICAO) estimates that the number of flights will triple by 2040.1 This growth rate, together with growing global concern for environmental protection and the reduction of greenhouse gas emissions obliges the aerospace industry to search for solutions to improve aircraft efficiency. One possibility for achieving this desired efficiency is wing morphing, through its active and controlled modification of one or several wing geometrical characteristics during flight. Researchers have proposed different technological solutions for obtaining the desired wing adaptability, with some concepts achieving significant performance improvements with respect to the baseline design. Sofla et al.2, Stanewsky3 or Barbarino et al.4 presented exhaustive reviews on the research performed on various morphing wing technologies, both by academia and by the aerospace industry.

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