Aerodynamic Interference Significance Analysis of Two-Dimensional Front Wing and Rear Wing Airfoils with Stagger and Gap Variations - DTU Orbit (21/10/2019)

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Unconventional aircraft configurations, such as biplane, joined-wing, tandem-wing, and box-wing configurations, have considerable application potential due to aerodynamic interference between the front wing and rear wing airfoils. Here, the aerodynamic interference of a two-dimensional front wing and rear wing airfoil system with different relative positions was simulated using a computational fluid dynamics (CFD) method, and the significance of the correlations between the aerodynamic coefficients and stagger or gap variations was investigated by ANOVA. The results indicate that the front wing and rear wing aerodynamic coefficients are distributed unilaterally with stagger and gap variations at a small angle of attack, although regional differentiation behavior was observed for an angle of attack exceeding 4°. The fake stall phenomenon, which is caused mainly by a decrease in the front wing upper surface suction force, is proposed and discussed. The significance level analysis results highlight that (1) the rear wing lift coefficient is the most sensitive to stagger and gap variations among the four lift and drag coefficients, and (2) the front wing lift coefficient is hardly affected by the stagger variation.

General information
Publication status: Published
Organisations: Department of Mechanical Engineering, Thermal Energy, Beihang University, China Aerospace Science and Technology Corporation
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Publication date: 2019
Peer-reviewed: Yes

Publication information
Journal: Journal of Aerospace Engineering
Volume: 32
Issue number: 6
ISSN (Print): 0893-1321
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
Original language: English
DOIs:
10.1061/(ASCE)AS.1943-5525.0001090
Source: FindIt
Source ID: 2453537662
Research output: Contribution to journal › Journal article – Annual report year: 2019 › Research › peer-review