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Title

Scaling of Aircraft Incorporating the Semi Aeroelastic Hinged Wings

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Abstract

There has been much recent research focusing on improving aircraft performance to reduce fuel burn and environmental impact. The current focus is primarily on increasing wing aspect ratios, leading to a reduction in induced drag. The use of folding wing-tips, as found in the B777-X [1], has been put forwards as a means of solving the problem of exceeding airport gate limits whilst enabling higher aspect ratios. An extension of this concept is to implement *floating folding wing tips* in-flight which have been shown as a means to enable gust loads alleviation and improved roll control [2,3]. The so-called *semi-aeroelastic hinge* concept, whereby the hinge is fixed until a significant amount of turbulence is encountered, is to be employed on the Airbus X-Wing technology demonstrator [4] .

It is usual to develop prototype test air vehicles to investigate new concepts in wind tunnels, or indeed as UAVs, and in order to get a full understanding of the behavior aeroelastic scaling needs to be used to develop an equivalent small aircraft model so that the controlled test characteristics in the wind tunnel can then be used to predict the behaviour for full size models at realistic flight conditions. Such approaches are reasonably standard for conventional aircraft but the occurrence of nonlinearities, such as those that might be found on highly flexible wings undergoing large geometric deflections and those occurring in wings incorporating floating folding wingtips.

This paper will describe an aeroelastic scaling methodology that can be used for aircraft with highly flexible wings incorporating floating folding wing-tips, with particular consideration of the inherent geometric and aerodynamic nonlinearities. The technique will be demonstrated on several test cases of different full-scale aircraft where scaled wind tunnel models will be designed to give equivalent aeroelastic stability and vertical / lateral gust responses (both one minus cosine and random turbulence). This study is part of the Innovate UK Aerospace Technology Institute funded DAWS (Design of Aircraft Wing Structures) project investigating the flight performance of semi-aeroelastic hinged wings subject to gust excitation.

References

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