Nonlinear aeroelastic wing benchmark evaluation and modeling

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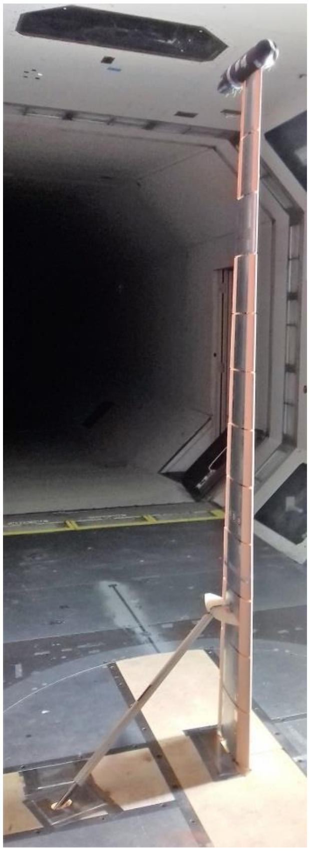
In the quest to develop new aircraft with improved fuel efficiency and lower environmental impact, airliner manufacturers are evaluating the benefits that can be obtained from higher aspect ratio wings. These offer improvements in aerodynamic efficiency but the wing structural design process is significantly more challenging than with current aircraft configurations. This is because, in order to achieve high aspect ratios with low structural mass, wing flexibility increases and this results in complex aeroelastic effects.



Over the past few years, in an ATI-funded project in the UK, the University has been developing computational tools to better predict the behaviour of such flexible high aspect ratio wings in the preliminary design stage. These modelling methods account for the nonlinearity inherent in such systems, in particular from geometric effects during large deflections and also potentially from aerodynamic stall. As a part of the project, an experimental campaign was conducted to provide relevant data that can be used to validate the modelling techniques. This wind tunnel test involved the design, manufacture and testing of a unique 2.4m semi-span flexible tapered aeroelastic wing model, of aspect ratio 20. The wind tunnel testing was conducted in 2018 where an extensive suite of instrumentation was used to extract a very large set of load, strain, deflection, acceleration and flow pressure data.

<u>Objective of PhD:</u>

The objective of this PhD is to exploit this unique data base for a highly flexible aeroelastic wing. The data will be processed, evaluated and relevant insight gained into the wing behaviour. The results will be used to compare with one or more of the developed computational modelling methods and thereby to effectively evaluate their potential for use in airliner flexible wing design.

Of particular interest is the onset and development of nonlinear wing dynamic responses, including phenomena such as limit cycle oscillations arising from geometric or aerodynamic nonlinearity.

Where indicated, the methods may need to be extended or improved (e.g. through better aerodynamic modelling) in order to provide a better match with the experimental data. Ultimately, the PhD will contribute to ongoing studies of the challenges for high AR wing design and may contribute to recommendations for further wind tunnel testing.

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