MULTIPHYSICS SIMULATION OF THE AEROELASTICITY OF AIRCRAFT WINGS

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ABSTRACT

The aeroelastic behavior of wings is an important consideration in aircraft design from both safety certification and efficiency perspectives. The flutter response of the wing must be accounted for at critical points in the flight envelope. Higher fidelity understanding of wing aeroelastic behavior is becoming more important as aircraft manufacturers innovate wing designs to further reduce drag where even very small improvements can have significant cost benefits over the lifecycle of the aircraft. Accordingly, there is a need to predict and understand the aeroelasticity of the wing early in the design process, where changes are relatively easy and cheap to handle.

Aeroelasticity is a complex physical phenomenon that depends on the dynamic nature of the flow around the airplane wings and the response of the wing itself. It is a multiphysics problem at its core. Traditionally, wind tunnel testing using models has been used to analyze the aeroelasticity of wings. However, it is expensive to build aircraft and aircraft models for physical testing and the wind tunnel might not replicate all flight conditions. Accurate and efficient computer simulation can play a large role in minimizing the cost and time associated with designing aircraft.

In this presentation, we will show how multiphysics simulation can be used to practically predict static and dynamic aeroelastic phenomena and responses on an aircraft wing. This work was initially done as part of the 1st AIAA Aeroelastic Prediction Workshop in 2012. The presentation will show the results from simulating the impact of forced oscillations at the 2nd bending mode frequency on an aeroelastic wing attached to a generic fuselage. The workflow and impact of grid density on results will be discussed. Results from additional analyses, performed after the workshop, will also be included.