MA

Technische Universität München

Fakultät für Luftfahrt, Raumfahrt und Geodäsie
Lehrstuhl für Luftfahrtsysteme

Implementation of an Aeroelastic Coupling Method for Flutter Simulation of Sailplanes

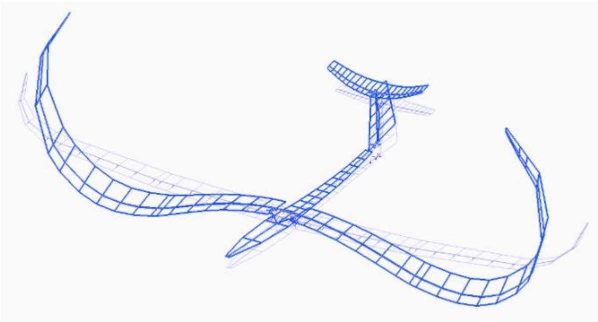

Fig. 1 Symmetrical bending in modal analysis

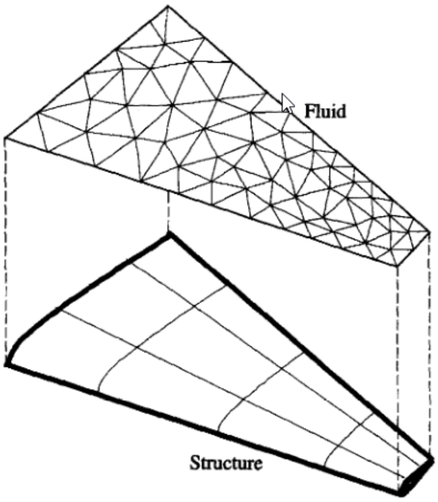

Fig. 2 Fluid and structure meshed with non-matching interfaces [1]

Motivation

In the scope of the ProFla project (Process Chain Flutter), an aeroelastic process chain is being created with which small aircraft with highly stretched wings can be efficiently developed and safely certified at an early design stage. In addition to researching the aerodynamics of modern laminar airfoils, this includes the development of a numerical tool chain and its validation through extensive ground and flight tests. For this purpose, suitable computational methods will be implemented to enable automatic adaptation of the simulation models to experimental results.

Topic

For the safe operation of a sailplane up to the certified maximum speed, freedom from flutter must be ensured, i.e. no undamped vibrations may occur. The finite element method will be used to acquire the structural dynamics behavior. The doublet lattice method can be used to acquire the unsteady aerodynamic behavior, which can be coupled with structural model for flutter analysis. The goal of the thesis is the implementation of a suitable aeroelastic coupling method for transferring the aerodynamic loads to the structural model and updating the aerodynamic model based on the structural deformation. The structural model is already available and the aerodynamic model can be automatically generated with the existing tools. The coupling method should be validated with the aeroelastic simulation in Nastran, which is a solid validated commercial software.

Work Packages

WP1: Literature research and familiarization with existing Software

WP2: Implementation of a coupling method („Splining“) with structure model and calculation of deformation

WP3: Updating of the geometry in the aerodynamic model with large deformation

WP4: Iterative calculation of aerodynamic force and structural deformation

WP5: Validation with aeroelastic simulation in Nastran

WP6: Documentation of software and results

We define the exact task in a meeting in order to take individual interests and previous knowledge into account.

Requirements

- Motivation for the topic
- Structured way of working
- Experience in programming (e.g. Python)
- Good knowledge in aeroelasticity

References

1. C. Farhat, M. Lesoinnea, P. LeTallecb, Load and motion transfer algorithms for fluid/ structure interaction problems with non-matching discrete interfaces: Momentum and energy conservation, optimal discretization and application to aeroelasticity

Begin

As soon as possible

Supervisor

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