Proposal 2019-2020

Topic #3 - Aeroelastic analysis of interflap seals

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Context

Interflap seals ensure the connection between inboard and outboard flaps on aircraft wings. The flexible seals are made of elastomeric material reinforced by fibers, in order to provide a smooth connection between the flaps and to improve the aerodynamics of the wing. As a flexible structure subject to aerodynamic forces the seal can undergo aeroelastic phenomena, leading to important vibrations and potential breakage.

Numerical simulations (see Fig. 1) have been performed to better understand the aerodynamic excitation responsible for the vibrations of the seals.

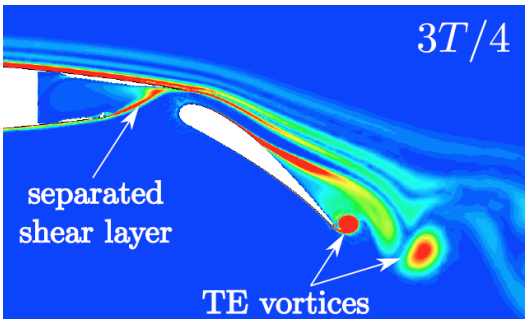

Figure 1: Snapshot of the unsteady flowfield around the flap [1]

The purpose of this work is to develop an experimental framework capable to reproduce the aeroelastic behavior of the seal in a wind tunnel. For that purpose a reduced scale model of a rigid wing+flap will be built. The interflap seals, with the adapted stiffness will be designed and installed on the wing. The experimental set-up will be characterized at wind-off conditions, similarly to a Ground Vibration Test.

The set-up will be tested in the wind tunnel for different angles of attack of the wing and the flaps and the response of the seal will be measured in order to analyse its dynamic behaviour in stalled conditions. In addition, pressure measurements will be performed on the static parts of the set-up (wing and flap) in order to correlate the unsteady features of the flow to the vibrations of the seal.

The experimental measurements collected in the scope of this work will serve as validation data for further numerical simulations.

Tasks

The project consists in 5 main tasks:

- Literature review about aeroelastic responses of seals and panels.
- Design of the experimental set-up, with a special attention to the scaling laws.
- GVT of the experimental set-up.

- Wind tunnel testing for several combinations of airspeeds, angles of attack and seals.
- Comparison of the experimental and modelling outputs.

In addition to the Master thesis manuscript, it is expected to integrate the experimental data in a conference article to be presented at ISFA2020[1] in May 2020 in Paris.

[1] R. Dubois, 'Methodological study of aeroelastic risks of interflap seals', Master Thesis ULiège 2019

[1] ISFA2020 = International Symposium on Flutter and its Applications https://www.ladhyx.polytechnique.fr/isfa2020/