Proposal 2016-2017

Topic #1 - Unsteady pressure measurement around aerodynamic bodies: Development of a calibration apparatus and wind tunnel testing

Contacts

ULg / WTL Thomas Andrianne (t.andrianne@ulg.ac.be)

Context

In experimental aerodynamics, measurement of unsteady pressure distribution is an important step towards the understanding of separated flows. Information about the three-dimensionality and dynamic behaviour in the separation region can be quantified and further used for comparison with CFD results.

The Wind Tunnel Laboratory is equipped with a novel dynamic pressure measurement system made of 128 channels in the +/- 2.5kPa range. The acquisition frequency of the system can reach up to 4kHz. Each channel is connected to the pressure taps on the surface's model by a vinyl tube. Because of the dynamic behaviour of the pressure wave inside the tube, the system must be calibrated dynamically in order to obtain the Frequency Response Function (FRF) of the measurement chain. The range of measurable pressure that can be corrected typically reduces to 600 Hz.

For this reason, the first step towards unsteady pressure measurement is to characterize the FRF of each pressure channel in order to be able to reconstruct adequately the complete unsteady pressure distribution.

Objectives

The objective of this project is first to design, build and use an accurate and robust dynamic calibration system. In a second phase, the calibrated pressure system will be used to perform unsteady pressure measurement on a wind tunnel model where flow separation takes place.

The project consists in:

- Literature research about dynamic pressure measurement and calibration techniques
- Preliminary calculation of the static pressure variation
- Design and fabrication of the mechanical parts of the system
- Instrumentation (based on the pressure measurement system and Labview environment)
- Characterization of the FRF of the tubes, for different length and pressure levels.
- Validation of the experimental characterization through comparison with theoretical analytical predictions of the FRF.
- Wind tunnel testing on around a selected geometry characterized by flow separation (stalled wing or bluff shape): analysis of the unsteadiness and 3D characteristics of the flow.

It is expected that the outputs of this project will be submitted in a conference proceeding or in the Journal 'Experiments in Fluids' (http://link.springer.com/journal/348)