Proposal 2019-2020

Topic #1 - Aerodynamics of tandem cylinders in fully turbulent flow regime

Contacts

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Context

Aerodynamics of bluff-bodies at very high Reynolds numbers (up to 10^7) takes place for several specific engineering such as Ariane 6 space launcher in ground conditions, TV antennas or even cooling towers. Because of their large dimensions (above several meters) and the wind conditions in which these structures are placed, the assessment of their aerodynamic loading and aeroelastic response represent a novel technologic/scientific challenges. The lack of knowledge for the aerodynamic characteristics of the flow in the transcritical regime is due to the difficulty to perform tests at such Reynolds numbers without inducing compressibility effects in standard atmospheric wind tunnels.

One manner to reach the transcritical flow regime, where the wake, the shear layers and the boundary layers are turbulent, is to modify the roughness of the body surface. In this context, it is planned to measure the pressure distribution on a tandem configuration of circular cylinders in the wind tunnel facility of ULiège.

An alternative and complementary approach corresponds to the use of Computational Fluid Dynamics (CFD) simulation. In the scope of this master thesis, it is expected to study the possibilities to use a numeric tool (Ansys Fluent or OpenFOAM) using a uRANS approach to compute aerodynamic features of the same tandem arrangement.

This master thesis is proposed by the CRM Group to support its development in the field of aerodynamics of large and innovative structures.

Objectives

The project consists in:

- Literature review about single and tandem bodies in transcritical regime.
- Participate to the development to an experimental test bench to be tested in the wind tunnel laboratory of ULiège. The test bench is dedicated to the study of single and tandem circular cylinder(s), using different roughness surfaces.
- Perform the wind tunnel test and processing of the results, leading to steady (C_L, C_D) and unsteady (C_L', C_D', St) aerodynamic quantities.
- Assess the potential of existing CFD codes (Ansys Fluent or OpenFOAM) to model the flow around the cylinder(s) in transcritical regime.
- Comparison of the experimental and numerical outputs.

In addition to the Master thesis report, it is expected that the results be summarized in a publication that could be submitted to a conference or to an international journal, such as Journal of Wind Engineering and Industrial Aerodynamics.