Proposal 2016-2017

Topic #2 - Galloping of vertical structures: wind tunnel testing and analytical investigations

Contacts

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Context

Galloping phenomenon is a damping driven aeroelastic instability that takes place in the direction perpendicular to the incoming flow, above a critical airspeed. In this case the aerodynamic damping is higher than the structural one: part of the energy of the aerodynamic flow is transferred to the structure, which undergoes high amplitude oscillations.

Galloping is usually characterized by a large reduced velocity U*=U/(fD), where U [m/s], is the airspeed f [Hz] is the frequency of the mode perpendicular to the flow and D [m] is a reference length. For these large reduced velocities, the quasi-steady theory can be used to predict the critical galloping velocity. When the structure is complex, it is envisaged to simplify both the dynamics and the aerodynamic loading in the scope of the quasi-steady theory in order to assess the critical velocity of the structure.

Objectives

The objective of this master thesis is to design and build a new wind tunnel model that will be used to validate the simplified quasi-steady model. The model will consist in 2 free standing structures, each characterized by a vertical spine, clamped to the floor of the test section, on which a square skin foam will be attached to reproduce the aerodynamic shape. The model will be adjustable in order to study different structural coupling between the vertical structures. The orientation of the wind will be changed through the rotation of the turntable. Instrumentation will be carried out by wireless accelerometers and/or displacement lasers.

The project consists in:

- Literature research about galloping phenomenon in uniform and non-uniform flows
- Quasi-steady modelling of galloping to guide the design of the wind tunnel model
- Design of the mechanical parts of the model
- Instrumentation of the model
- Implementation of the simplified galloping model (Matlab).
- Validation of the simplified galloping model based on wind tunnel testing of the different configurations

It is expected that the outputs of this project will be submitted in a conference proceeding or in the 'Journal of Wind Engineering and Industrial Aerodynamics' (http://www.journals.elsevier.com/journal-of-wind-engineering-and-industrial-aerodynamics/)