Modelling the role of turbulence in flow attachment

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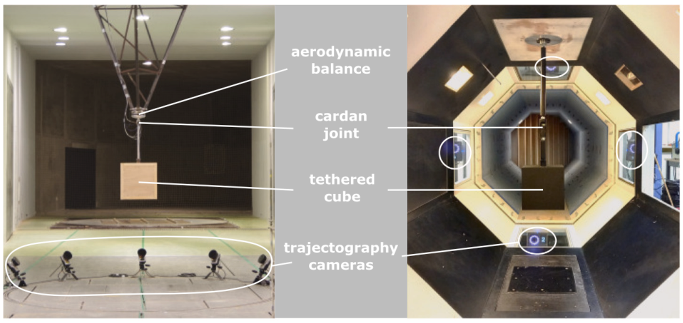
Cable transport systems are currently being explored in many cities both in France (Brest, Grenoble, Toulouse, St Denis de la Réunion, Ajaccio) and abroad (Medellín, La Paz, Ankara, New York). The dynamics of these systems, comparable to that of a pendulum in a flow which may be turbulent, can exhibit different behaviors. These dynamics are the subject of investigation of project TurbCAB.

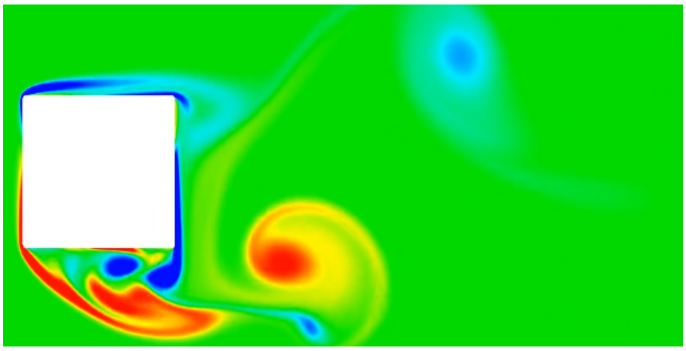
Recent investigations carried out at ISAE-ENSMA [1] point towards boundary layer attachment-detachment dynamics being a key element leading to the self-sustaining oscillations, and that these dynamics are affected by the turbulent intensity of the incoming flow. Understanding the mechanics that facilitate flow attachment can provide new insights leading to new regulations and cabin design practices, increasing passager safety and comfort.

The goal of this internship is to use linear stability tools to model the sensitivity of boundary layer reattachment around a square body to incoming turbulence. The study uses the *Resolvent analysis* framework, leveraging a stability code developed internally [2], to model flow turbulent structures, and analyse these to seekidentigy mechanisms that can lead to flow attachment.

During this internship, the student will develop modelling and linear algebra skills, while gaining new insights into fluid mechanics systems. Candidates with have a background and interest in fluid dynamics and that curious and independent, should send their CVs and motivation letters to eduardo.martini@ensma.fr.



(a) Wind tunnel experimental setup.



(b) Flow vorticity behind a square cylinder.

Figure 1: Illustration of the wind tunnel used in [1] (a) and the flow topology of a square cylinder (b).

References

[1] Myskiw, A. et al. (2024) 'One-degree-of-freedom galloping instability of a 3D bluff body pendulum at high Reynolds number', Journal of Fluids and Structures, 127, p. 104123. Available at: https://doi.org/10.1016/j.jfluidstructs.2024.104123.

[2] Martini, E. and Schmidt, O. (2024) 'Linstab2D: stability and resolvent analysis of compressible viscous flows in MATLAB', Theoretical and Computational Fluid Dynamics. Available at: https://doi.org/10.1007/s00162-024-00706-0.