RESEARCH MASTER INTERNSHIP

Département Aérodynamique, Energétique et Propulsion

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INTERNSHIP DESCRIPTION

Domain : Hydrodynamics, Vortex dynamics

Title : **THREE-DIMENSIONAL INSTABILITY OF AN INHOMOGENEOUS TRAILING VORTEX**

Context and previous results

Trailing cortices are limiting the take-off and landing frequencies in airports and play a central rôle in persistant condensation trails. They are consequently the target of numerous efforts aiming at decreasing their size or lifetime. These studies are based on stability analyses and look for optimal perturbations for the isolated vortex (close wake) or the counterrotating vortex pair (far wake). We participate to the first kind (isolated vortex) focusing on the effect of radial variations of density resulting either from the engine jet or fluid injection at the wingtip. The Batchelor vortex or q-vortex exhibits gaussian distribution of vorticity and axial velocity. It is the model generally adopted to represent trailing vortices. We have already studied the 2D stability of this vortex without axial velocity (called the Lamb-Oseen vortex). We found it sensitive to a Rayleigh-Taylor instability when mass is concentrated at the vortex core. These results have been published in a first journal see herein.

Joly, L., Fontane, J. & P. Chassaing 2005 The Rayleigh-Taylor instability of two-dimensional high-density vortices, J. Fluid Mech. 537, pp. 415-431.

Objectives

We want to extend the modal stability analysis to the case with axial velocity, i.e. to the inhomogeneous Batchelor vortex. We will search for normal modes of this vortex in a viscous frame with high Reynolds number on a realistic range of density contrasts. The applicant will have to modify an existing tool for linear stability analysis (coded with MATLAB) to take the viscosity and the third velocity component into account. This internship is preliminary to a PhD thesis adopting a non-modal approach of the optimal control of the trailing vortex together with an experimental campaign in the ISAE large wind-tunnel.

80 % Theoretical Research	10 % Applied Research	10 % Experimental Research

Possibility to go on a Ph.D.: o Yes o

APPLICANT PROFILE

Knowledge and required level:

Hydrodynamics, vortex dynamics
Langages/Systèmes : Matlab

Applications should be sent by e-mail to the supervisor.