



HAL
open science

Two-dimensional instabilities of a viscous vortex dipole

Rémi Jugier, Laurent Joly, Pierre Brancher, Jérôme Fontane

► **To cite this version:**

Rémi Jugier, Laurent Joly, Pierre Brancher, Jérôme Fontane. Two-dimensional instabilities of a viscous vortex dipole. Sixth International Symposium on Bifurcations and Instabilities in Fluid Dynamics (BIFD 2015), Jul 2015, Paris, France. pp.1-1. hal-04085241

HAL Id: hal-04085241

<https://hal.science/hal-04085241>

Submitted on 28 Apr 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



OATAO is an open access repository that collects the work of Toulouse researchers and makes it freely available over the web where possible.

This is an author-deposited version published in : <http://oatao.univ-toulouse.fr/>
Eprints ID : 14155

To cite this version : Tran-Thai, Tuan and Chaganti, Vasanta and Lochin, Emmanuel and Lacan, Jérôme and Dubois, Emmanuel and Gelard, Patrick (2015) [Enabling E2E reliable communications with adaptive re-encoding over delay tolerant networks.](#)
In: IEEE International Conference on Communications, 8 June 2015 - 12 June 2015 (London, United Kingdom)

Any correspondence concerning this service should be sent to the repository administrator: staff-oatao@listes-diff.inp-toulouse.fr

TWO-DIMENSIONAL INSTABILITIES OF A VISCOUS VORTEX DIPOLE

Rémi Jugier¹, Laurent Joly¹, Pierre Brancher² & Jérôme Fontane¹

¹*Institut Supérieur de l'Aéronautique et de l'Espace, Université de Toulouse, 31055 Toulouse Cedex 4.*

²*Institut de Mécanique des Fluides de Toulouse, INPT, UPS, Université de Toulouse, F-31400 Toulouse.*

Abstract Vortex dipole, vortex pair, Lamb–Oseen vortex, linear stability.

We extend the linear stability analysis of the inviscid Lamb–Chaplygin dipole (LCD) carried out by Brion *et al.* [1] to a family of viscous Lamb–Oseen dipoles (LOD) for varying aspect ratios a/b , where a is the characteristic radius of the vortices and b their separation distance.

Brion *et al.* have recently discovered a new family of modes which correspond to a large-wavelength instability with a maximum growth rate in the two-dimensional (2D) limit. Their study suggests that vortex shedding in the wake of the dipole is the leading physical mechanism of those instabilities. Though the LCD is a peculiar model of vortex dipole, since it does not exhibit a viscous trail and presents a singular vorticity distribution, Brion *et al.* compared their results with the more regular LOD defined by Sipp *et al.* [2] and confirmed the existence of a 2D instability of vortex dipoles.

Despite a similar structure, the instability of the LOD presents an oscillating symmetric mode and growth rates that are significantly different than the LCD. The present study investigates these differences by looking at the influence of the dipole aspect ratio on the characteristics of the unstable 2D modes. The results show that the growth rate of both antisymmetric and symmetric modes presents some nontrivial variations with a/b and Re (fig. 1): it increases with decreasing Reynolds number and a stationary antisymmetric branch emerges for low aspect ratios. The analysis of the time evolution of the modes allows to highlight the basic mechanisms at play.

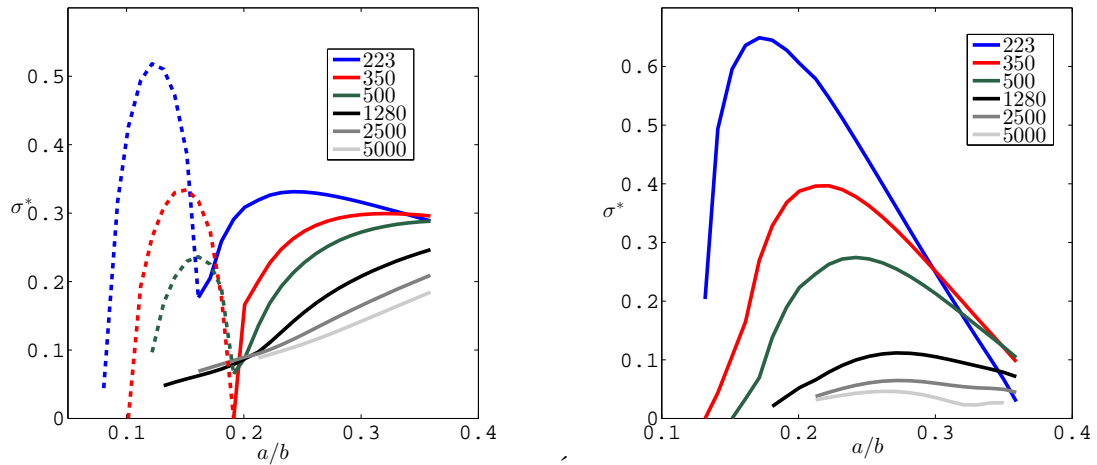


Figure 1: Growth rates normalized by dipole advection time as a function of the dipole aspect ratio a/b for different Reynolds numbers Re : oscillating antisymmetric modes (left) – the dashed lines represent the stationary antisymmetric modes – and stationary symmetric modes (right).

References

- [1] V. Brion, D. Sipp & L. Jacquin *Linear dynamics of the Lamb–Chaplygin dipole in the two-dimensional limit* (2014), *Phys. Fluid.* **26** (6), 064103.
- [2] D. Sipp, L. Jacquin & C. Cossu *Self-adaptation and viscous selection in concentrated two-dimensional vortex dipoles* (2000), *Phys. Fluid.* **12** (2), 245–248.