

Sensitivity analysis and passive control of flows around NACA 4412 swept wings

G. Nastro^{ab}, J.-C. Robinet^b, J.-C. Loiseau^b, P.-Y. Passaggia^a and N. Mazellier^a

Sensitivity analyses^{1,2} can provide valuable insights for determining control strategies suppressing separation and minimising the drag force. Indeed, during take off and landing phases, which are characterised by relatively large angles of attack, the use of complex wing geometries can lead to the formation of massively separated flow regions on the suction side of the wing. This reversed flow region causes a large increase of the drag exerted on the wing and can possibly induce stall, a major limiting cause for rapid take off and climbing to cruise altitude. Designing efficient control strategies to mitigate these issues is thus critical and represents the objective of the H2020 Clean-Sky project *PERSEUS* which supports the present research.

Global stability analysis is performed on steady spanwise-homogeneous separated flows developing around periodic NACA 4412 swept wings for different angles of attack and Reynolds numbers. The objective is to provide a complete description of the stability properties of the global eigenmodes and the adjoint-based sensitivity¹ of such flows with respect to the application of external forces.

^a Laboratoire PRISME, Université d'Orléans, 45072 Orléans Cedex, France

^b Laboratoire DynFluid, Arts et Métiers ParisTech, 75013 Paris Cedex, France

¹ Marquet et al., *J. Fluid Mech.* **615**, 221-252 (2008).

² Boujo and Gallaire, *Proc. R. Soc. A* **470**, 20140365 (2014).

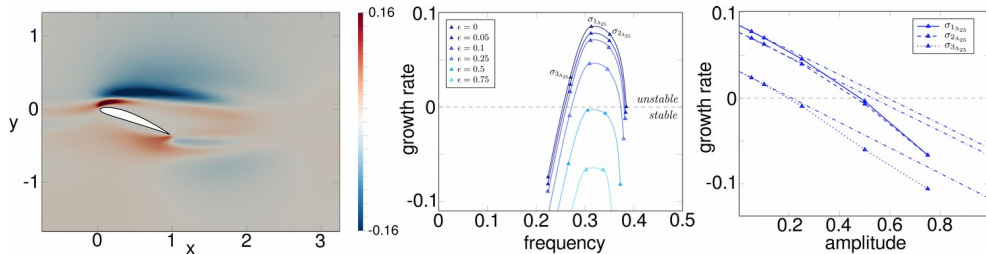


Figure 1: (a) Variations of the growth rate as a function of the location of a localised steady force; (b) eigenspectrum of the uncontrolled ($\epsilon = 0$) and controlled flow ($\epsilon \in]0;0.75]$); (c) growth rate as a function of the amplitude ϵ for the most unstable global modes depicted in (a).