Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Stabilization by shape optimization CHRISTOPHE HENNEKINNE, MATTHEW P. JUNIPER, University of Cambridge, Department of Engineering — In a wide range of flows called oscillator flows, the transition to turbulence starts with a modal instability. This first instability can be accurately predicted by performing a linear stability analysis. With the aim of preventing this instability, we examine one of the simplest passive control strategies : the modification of the shape of the boundary. We present a gradient-based algorithm to recover a locally optimal shape of our problem. This algorithm is similar to existing shape optimization algorithms in that it requires computation of the shape gradient, which is the gradient of the objective function with respect to a modification of the boundary. However it differs from existing shape optimization algorithms in the sense that the objective to minimize is not a functional of the flow field but the growth of the most unstable mode of the linearized operator. Consequently two adjoint equations need to be solved sequentially to recover the shape gradient: one associated with the eigenproblem and the other with the steady Navier–Stokes equation. The algorithm is tested on the flow over a backward facing slope. By changing the shape of the slope, the three-dimensional instability that grows on top of the two-dimensional flow is delayed.

Christophe Hennekinne
University of Cambridge, Department of Engineering

Date submitted: 01 Aug 2013 Electronic form version 1.4