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Second-order sensitivity of eigenvalues: large or spanwise wavy perturbations OUTI TAMMISOLA, University of Cambridge, FLAVIO GIANNETTI, VINCENZO CITRO, University of Salerno, MATTHEW JUNIPER, University of Cambridge — Sensitivity maps can be used to determine how the stability of a flow changes with control (by for example a control cylinder), or changes in the flow parameters. However, being linear with respect to the control parameter, the sensitivities can only represent the influence of small-amplitude control. More importantly, the sensitivities vanish for some important classes of perturbations, such as spanwise wavy base flow modifications. Spanwise wavy modifications can appear in a flow due to inflow asymmetry or streakiness. In flow control, spanwise wavy steady blowing and suction has been shown to suppress vortex shedding behind a cylinder in computations at $Re=140$ (Kim & Choi, PoF 2005, 17, 033103). Sensitivities can be derived from a standard perturbation analysis. In this study, we generalize the sensitivities by considering the second-order term in the perturbation expansion. We derive some general insights about the effects of large and wavy base-flow modifications from an expansion in the eigenmode basis. As an example of the “second-order sensitivity,” we consider the effect of steady streakiness on the global instability of a backwards-facing step.

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