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Sensitivity analysis of unstable periodic orbits in a weakly chaotic Kuramoto-Sivashinsky system DAVIDE LASAGNA, University of Southampton — Unstable periodic orbits (UPOs) often explain to a remarkable degree of accuracy global statistical features of the turbulent flow in which they are found. In other words, orbital averages, even for short-period UPOs, are good approximation of long-time averages computed over a chaotic, turbulent realisation. Here, we re-examine this property from a design perspective: Does the same degree of approximation exists between the *sensitivity* of orbital averages with respect to design parameters and the sensitivity of the long-time average itself? Knowledge of this quantity is key in many fundamental design problems involving turbulent flows, most notably in control. In this work, we present an efficient, well conditioned adjoint algorithm derived from specialising well-known variational techniques to the inherent temporal periodicity of UPOs. Once an UPO is available, this algorithm computes the sensitivity of orbital averages with respect to many design parameters at once, regardless of the orbital stability properties. As a demonstration, we analyse the sensitivity to in-domain linear feedback of UPOs found for the Kuramoto-Sivashinsky system in a weakly chaotic regime.

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