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Stability, receptivity and sensitivity of linear, periodic and chaotic flows: application to a thermoacoustic system[1] LUCA MAGRI, University of Cambridge , QIQI WANG , Massachusetts Institute of Technology — We present and compare three methods to calculate the stability and sensitivity of linear, periodic and chaotic time-delayed thermoacoustic systems. First, eigenvalue analysis calculates the stability of a fixed point. The stability is governed by the Jacobian operator. Secondly, Floquet analysis calculates the stability of a nonlinear periodic solution. The stability is governed by the monodromy matrix, which is the linearized Poincare map built on the periodic attractor found by continuation. Thirdly, Lyapunov analysis calculates the stability of a chaotic solution. The stability is governed by the tangent operator, which is the linearized operator built on the unsteady chaotic solution. The three methods are then applied to the adjoint operator, which provides information on the systems receptivity to physical sources. Finally, the direct and adjoint Floquet and Lyapunov analyses are combined to calculate the thermoacoustic systems sensitivity to feedback mechanisms. The application of adjoint Floquet and Lyapunov sensitivity analyses to thermoacoustic systems opens up new possibilities for the passive control of thermo-acoustic oscillations by providing gradient information that can be combined with constrained optimization algorithms to reduce the instability.

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