

RECENT PROGRESS IN THE DETERMINATION OF HYDRODYNAMIC INSTABILITIES OF NATURAL CONVECTION FLOWS

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ABSTRACT We present a general methodology for studying the hydrodynamic stability of flows enclosed in cavities. To this aim, different tools consisting of time integration of the unsteady equations, steady state solving, continuation, computation of the most unstable eigenmodes of the Jacobian and of its adjoint have been developed. These methodologies are implemented with different types of spatial approximations, Chebyshev and Fourier spectral methods for simple geometries and finite volume for complex ones. These tools are applied to the classical differentially heated cavity, where the steady solution branch is followed for very large values of the Rayleigh number and most unstable eigenmodes are computed at selected Rayleigh values. Their effectiveness for complex geometries is illustrated on a configuration consisting of a cavity with internal heated partitions. We also address the accurate determination of the critical parameters for aspect ratios comprised between 1 and 8, and the computation of adjoint eigenmodes which are instrumental for the purpose of flow manipulation and control.