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Heat Transfer Enhancement by Localized Time Varying Thermal Perturbations at Hot and Cold Walls in a Rectangular Differentially Heated Cavity

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Abstract : In this work, we study numerically the effect of a thermal perturbation on the heat transfer in a rectangular differentially heated cavity of aspect ratio 4, filled by air. In order to maintain the center symmetry, the thermal perturbation is imposed by a square wave at both active walls, at the same relative position of the hot or cold boundary layers. The influences of the amplitude and the vertical location of the perturbation are investigated. The air flow is calculated solving the unsteady Boussinesq-Navier-Stokes equations using the PN - PN-2 Spectral Element Method (SEM) programmed in the Nek5000 opencode, at RaH= 9x107, just before the first bifurcation which leads to periodical flow. The results show that the perturbation has a major impact for the highest amplitude, and at about three quarters of the cavity height, upstream, in both hot and cold boundary layers.

Keywords : direct numerical simulation, heat transfer enhancement, localized thermal perturbations, natural convection, rectangular differentially-heated cavity
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