Numerical Investigation of Natural Convection in an Inclined Wavy Cavity Using a High-order Differential Scheme

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Abstract

A numerical study of natural convection inside an inclined cavity with a hot wavy wall was carried out. This problem is solved by using a high order Galerkin discretization scheme for the steady compressible Navier-Stokes equations. The pointwise numerical fluxes are separated into convective/viscous fluxes and acoustic fluxes. The decoupling of the acoustic flux is due to non-central scheme employed near the wall. The overall residual is integrated using the second-order Runge-Kutta scheme with a preconditioning matrix. The validation of the numerical code used is ascertained by comparing our results with previously published results. Results are shown in the form of streamlines, isotherms, local and average Nusselt number distribution at Rayleigh number 105. The results are presented for different angles of inclination (0o-180o) for three different undulations (0-3) with different wave amplitude (0.0-0.4). The results obtained show that the angle of inclination at 120o using two undulations gives the highest heat transfer rate. With the increase of amplitude from 0.1 to 0.4, the average Nusselt number raises by only 5%.

Keyword：Galerkin high-order differential scheme, Rayleigh number, Wavy wall, Angle of inclination