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Large Eddy Simulations of Turbulent Flow and Heat Transfer in Three-Dimensional Lid-Driven Shallow Cavities ARINDOM JOARDAR, SURYA VANKA, ANTHONY JACOBI, University of Illinois at Urbana-Champaign — Large-eddy simulations (LES) of turbulent flow and heat transfer in three-dimensional lid-driven cavities of aspect ratios (AR) of 1, 2 and 4 are carried out at Reynolds numbers of 5000, 10000 and 20000. The governing equations are box-filtered implicitly by a finite volume scheme and are solved using a fractional-step method. Subgrid scale stresses are represented using Yoshizawa's SGS kinetic-energy transport equation. It was found that the three-dimensional vortical structures play an important role in the heat transfer characteristics at the confining walls. For AR=1, the highest levels of temperature fluctuations occur within the free shear layer between the primary vortex and the downstream secondary eddy, similar to that observed for the velocity field. Mean and RMS velocity profiles were found to be in good agreement with published experimental data. For higher aspect ratio cases the upstream secondary eddy (USE) was found to bifurcate at high Reynolds number as observed from the streamlines of mean velocity field at the mid-span plane. Interestingly for AR=4, the bifurcations of the USE further increased to five at Re=20000 which may be attributable to the Kelvin-Helmholtz type instability at the free shear layer between the Primary eddy (PE) and USE. Profiles of u_{rms} fluctuations and v_{rms} fluctuations are studied.

Surya Vanka
University of Illinois at Urbana-Champaign

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