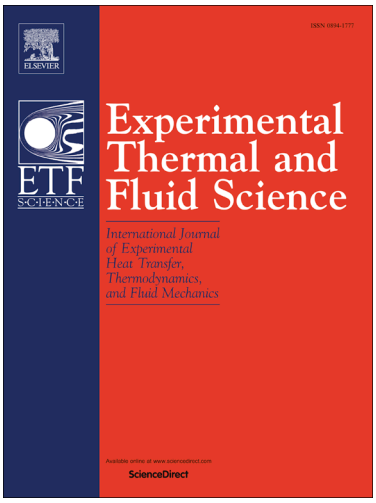

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Simultaneous Measurement of Velocity and Temperature Fields during Natural Convection in a Water-filled Cubical Cavity

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ABSTRACT

Many advanced schlieren systems have been reported in the literatures and a great number of it are associated in gas flow study, commonly air. Present research proposes an efficient use of Z-type schlieren technique for simultaneous measurement of ray-averaged velocity as well as temperature fields beside qualitative flow visualization. Experiments are conducted to study natural convective flow in de-ionized water in a differentially heated cubical enclosure. The same set of transient schlieren images has been used for simultaneous measurement of velocity and temperature field. The velocity field is also determined by using laser based particle image velocimetry (PIV) to compare with schlieren based technique. The developed schlieren system has been used to obtain ray-averaged quantities, such as, thermal and hydrodynamic boundary layer thicknesses, temperature gradient and temperature fields, distribution of local Nusselt number along the thermally active walls, average Nusselt number and velocity field. In this work, the above quantities have been simultaneously determined for the first time using halogen projector lamp based Z-type calibration schlieren system. The results inspire the use of calibration schlieren system for the study of natural convective flow in water-filled cubical enclosures. The above results also provide experimental data for benchmark for high Rayleigh numbers with water.

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