SFIV AND SCHLIERING TECHNIQUES IN COMPLEX TURBULENT FLOWS

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Abstract

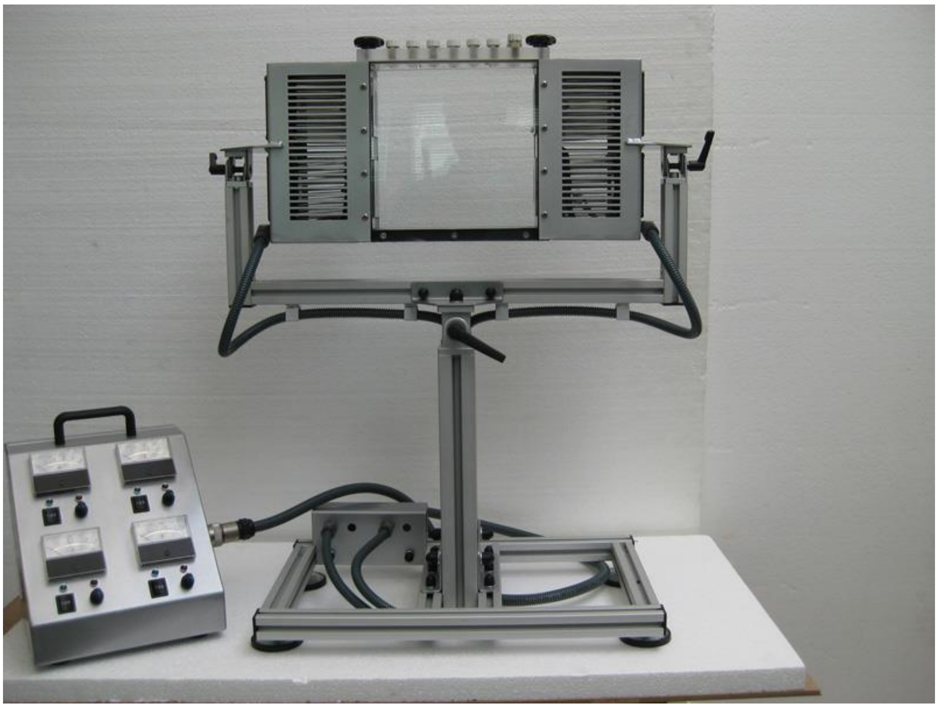
Visualization techniques such as PIV, particle tracking or Surface Flow Image Velocimetry (SFIV technique) [1] are used to investigate the transition from a homogeneous linearly stratified fluid to a cellular or layered structure in and enclosure by means of a thermoelectric generated heating and cooling device [2, 3] see figure 1.

Velocitiy distributions are compared for different convective conditions as well as investigating the non-steady transitions between 2D and 3D topology driven convection in an enclosure with several heat-cold driven flows. The geometry of the water tank used in the experimental and didactive device is of 0.2 x 0.2 x 0.1 m and the heat sources or sinks can be regulated both in power and sign [2-4]. The thermal convective driven flows are generated by the electronic use of Seebeck and Peltier effects in 2 wall extended positions of 0.05 x 0.05 cm each. The parameter range of the convective cell array varies strongly along the boundary conditions which may be of Dirichlet or Newman types, fixing either Temperature or Heat fluxes. Side heat fluxes are varied between 0 and 100 Watts and estimated as a function of Rayleigh, Peclet and Nusselt numbers, [9-10].

SFIV techniques reproduce the patterns arise by setting up a convective flow generated by a buoyant heat flux either in the base or in a side wall of the convective enclosure [3, 5]. The experiments and simulations investigate mixing using brine or sugar solutions and fresh water in order to form a density interface and low Prandtl number mixing with forced thermoelectric temperature gradients.

The evolution of the sidewise convective mixing and the topological characteristics of the merging of lateral intrusions in different configurations are presented, allowing PIV and interface tracking, that is used to perform detailed comparison of mixing within different parameter spaces. The relation between structure functions, fractal analysis and spectral analysis [6] is here very useful to determine the evolution of scales.

Considering the experiments for different combination of heating and cooling, we compare KS simulations with different spectral dependences of the scaling exponent of the energy spectra. The numerical simulation structures are compare with the experimental results for the central 2D symetry plane of the flow. Performance of 3D dimensional numerical simulation of turbulence for low Reynolds number is also compared with 2D examples of other non-equilibrium complex environmental flows [10,11].



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