ICTS Seminar

Title : Experimental studies in buoyancy-driven flows in the context of natural ventilation and reactor safety

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Date : Monday, January 14, 2019

Time : 12:00 PM

Venue : Amal Raychaudhuri Meeting Room, ICTS Campus, Bangalore

Abstract : Buoyancy-driven flows are present ubiquitously in nature and has applications in ventilation and mixing in industries. In this talk, I will be talking in detail on buoyancy-driven exchange flows across a vertical vent which is used to model natural ventilation in buildings. Additionally, I will briefly summarise my research on other buoyancy-driven flows.

Buoyant exchange flow across a vertical vent occurs when two chambers containing different density fluids, initially separated by a barrier, are allowed to interact by removing the barrier; the intrusion of the heavier fluid into the chamber containing the lighter fluid resembles an inclined gravity-current flow. The flow visualization along with PLIF measurements are used to analyse the temporal development of this gravity/intrusion current and related mixing, focusing on the small Atwood-number regime. It is found that the top interface of the gravity-current undergoes Kelvin-Helmholtz (KH) instability, resulting in vortex formation, vortex pairing and their interactions; however, the vortices are largely absent on its bottom interface which is gravitationally unstable. The mixing has been quantified via (i) the time-averaged normalised density and (ii) the fractal analysis of the scalar interface, both showing enhanced mixing with larger density differences. The cross-stream profiles of the mean velocity and density across the gravity current, along with their fluctuation/turbulent quantities, are measured using simultaneous PIV-PLIF technique. The eddy viscosity, turbulent diffusivity, turbulent Schmidt number and the production of turbulent kinetic energy profiles reveal asymmetric nature of turbulent transport across the gravity current. Using POD, modes corresponding to vortex formation and pairing are resolved.

Additionally, I will present some results on stratification erosion by a horizontal buoyant jet in the presence of an obstruction. This has applications in passive dilution of hydrogen layer formed in a nuclear reactor.