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The structure of interacting Jets and RT fronts

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The study of the evolution and entrainment of Rayleigh-Taylor and Richtmyer-Meskkov fronts has shown that the global mixing efficiency is higher than for shear induced turbulence. Considering the role of the initial conditions and the energy cascade between scales, different laboratory experiments are compared examining the topology of the mixing process and the different routes for the energy to mix at molecular scales. The role of the interaction between scales and the multi-fractal and spectral methods used in the analysis are used to explain the very different mixing effi-ciencies for different mixing processes and the possibilities of controlling overall mixing geometrically. The present work is based principally on laboratory experiments producing turbulence by means of jets and wakes to the Bachelor or Kolmogorov sub millimetre scales. Experiments were made using a rectangular tank and injecting an array of jets from a series of holes (in a line or plane arrangement) The fluid in these experiments is fresh water as the light fluid and brine as the negative buoyant fluid. From the visualization methods, the evolution of the density profiles and the point 3D ADV velocity measurements, the mixing efficiency may be masured for different initial configurations. Turbulent velocity measurements and their spectra are presented in order to obtain a basic understanding on local diffusion, mixing and mass transport in jets. We compare different coupling and boundary effects on the structure of jets. We present ADV velocity measurements and compare mean and fluctuating velocity compo-nents as well as their PDF's and spectra. The turbulent interactions between structures generated are discussed taking into account both the inverse and direct cascades of the jets as a function of their distance. The importance of the study of turbulence structure and its relevance in shocks and in astrophysical flows self-similarity is present with very few exceptions in most environmental strongly non-homogeneous flows, both vertically and horizontally. Using the concept of Extended Self Similarity (ESS) we describe a criterion to identify the inertial range in the Kolmogorov sense as well as a methodology based on the evaluation of the spectral behavior and the structure functions of the veloc-ity fields to determine intermittency. The statistical description of these complex environmental turbulent systems (jets and RT structures) is performed in the framework of ESS for non-homogeneous turbulence based on the analysis of the energy transfer hierarchy. A physical interpretation of the scale independence of the relative exponents indicates the non-homogeneity of the turbulent field, which is characterized by non-local dynamics and not only intermittency. Determining the spectral structure of the turbulence cascade and the higher order structure functions helps to determine mixing properties and relationships between these kinds of structures.