Abstract

Two-phase flows are encountered in a wide range of applications both on-ground and in space. The dynamics of such flows in the absence of gravity is completely different from that in normal gravity due to the absence of buoyancy forces. A deeper understanding of the behavior of multiphase flows is essential in order to improve the operation of devices which require the use of two-phase systems. Analytical and experimental work is still needed for enhancing the control of two-phase flows, due to the theoretical complexity and the lack of experimental data for certain configurations.

In this work, the behavior of two-phase flows has been studied experimentally in normal gravity and in microgravity conditions. In particular, the single-jet configuration has been investigated for bubbly jets and droplet jets. Dynamics of individual bubbles and droplets as well as the global structure of the jets has been considered. The opposed-jet configuration has been investigated for bubbly flows. Different separation between jets and orientation angles have been studied in normal gravity, and the obtained results have been compared to the microgravity case. A numerical model has been implemented to study single-phase jet impingement and opposed bubbly jets at different gravity levels. Good qualitative agreement between the simulations and the experiments has been obtained. The bubble bouncing process, prior to coalescence, after collision with a flat free surface has been also studied experimentally in normal gravity conditions.

The results presented in this work will help to improve the general understanding of two-phase flows in normal gravity and in microgravity conditions, with general applications on mixing devices, environmental and propulsion systems.