EXPERIMENTAL STUDY OF BUBBLY FLOW IN SINGULAR GEOMETRIES

Emrah Deniz, Turkey
Supervisors: J.-M. Buchlin & V. Kourakos

Two-phase flow, especially, gas-liquid flow is extensively used in industrial systems such as power generation units, heat exchangers etc. These systems normally have complex geometries composed by singularities like expansion, contraction, bends, orifices and valves. Another device including this kind of singularities is safety valve. Single-phase flow entering the safety valve can turn into two-phase while it is passing through different cross-sections which can be considered as singularities. Thus two-phase flow characteristics through these geometries should be identified in order to be used in designing stage of the valves.

In this project, characteristics of air-water flow through a horizontal channel having smooth expansion, which is obtained by inspiring from one of the singularities in safety valves, are investigated experimentally. In order to understand the flow behavior through the singularity, and to acquire an experience for further applications, single-phase PIV (Particle Image Velocimetry) is performed and results are compared with those obtained via numerical simulations. Two-phase flow visualization is carried out thanks to images captured with high speed camera to observe the two-phase flow before (-6D), through and after (6D) the singularity. And finally horizontal and vertical void fraction distributions are obtained by means of dual optical probe measurements (Figure 1). The effect of air flow rate, distance from the singularity, probe diameter, and air injector hole diameter on void fraction distributions are studied during the measurements. Size and velocity of the bubbles are also measured and slip velocity ratio is estimated versus mean void fraction (Figure 2).

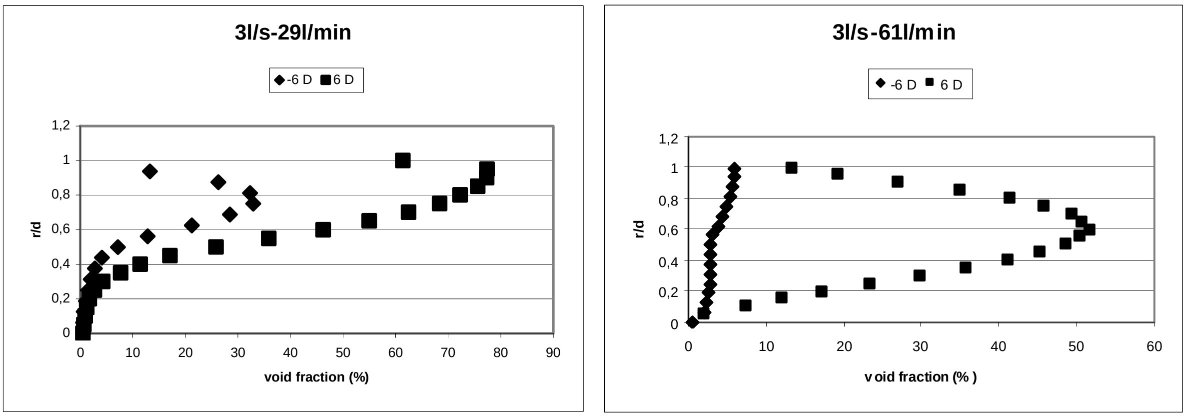

Figure 1: Vertical (left) and horizontal (right) variation in void fraction before and after the singularity

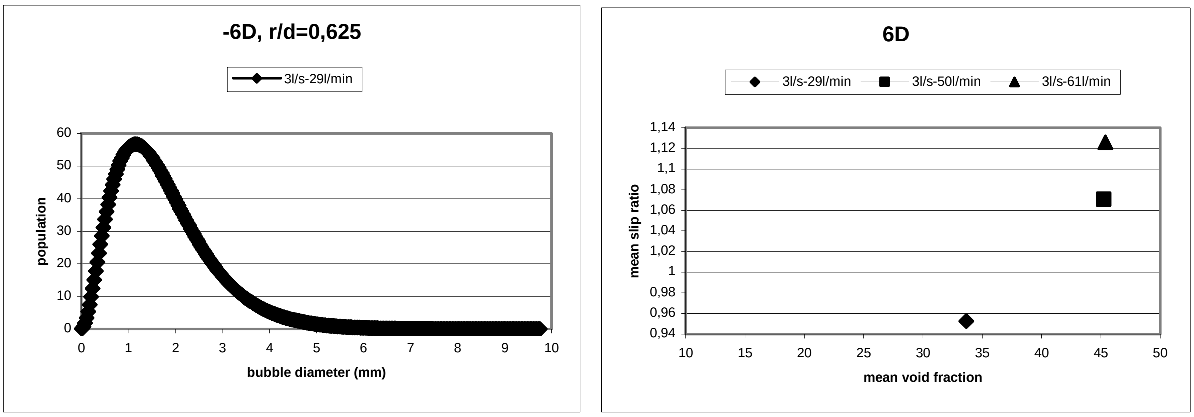

Figure 2: Bubble size distribution before the singularity (left) and mean slip ratio after the singularity (right)