NUMERICAL SIMULATION OF BUBBLY FLOW IN SINGULAR GEOMETRIES

Buğra Kılınç, Turkey
Supervisors: P. Rambaud & V. Kourakos

Two phase flow applications are some of the most difficult cases to for numerical modelling. When two-phase flow passes through a localized change of section, the topology of the flow is often drastically changed. This singularity of the section can be observed in a simple pipe section or as a part of a more complex geometry. An example of such complex device could be a safety valve which is used in the safety line of some processes such as in chemical or nuclear reactors.

In this study, the main objective is the prediction of the relationship between pressure drop and flow parameters like mass flow rate in simple progressive divergent geometries in isothermal conditions. Investigated flow regime is “bubbly flow”. In literature, we have many options to model two-phase flows. In this study, Eulerian (Two-Fluid) multiphase approach was chosen as a numerical model for our bubbly flow case. The model solves a set of balance equations for each separate phase and makes their coupling on the momentum equations using interfacial interaction terms (drag force, and the other momentum sources like lift and virtual mass force). Validation of the Eulerian (Two-Fluid approach) model using experimental data was the final step of the study. The commercial CFD code FLUENT was chosen, because of its modelling capability with “Two-Fluid Approach”. In the study, the range of investigated Reynolds numbers was between 8.85E+4 and 2.36E+5. Void fractions varied from 5% to 20% where the dominated flow regime is bubbly flow.

During the study, single phase flow was investigated at first then two phase flow simulations were performed in this type of geometries. Investigation of two-phase flow was divided two sections. First of them was dedicated to parametric study to show the relationship between pressure drop and flow parameters. The last part was devoted to the validation of the numerical model with experimental data. Figure 1 shows contour plot of air phase in the singularity. As it can be seen from Figure 2, static pressure depends on the bubble diameter. In the validation part of the study, results show that “two-fluid approach” can predict the pressure change in this type of geometries in a reasonable accuracy.

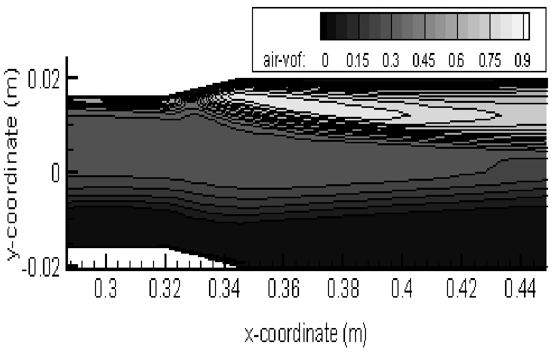

Figure 1: Contour plot of void fraction of air

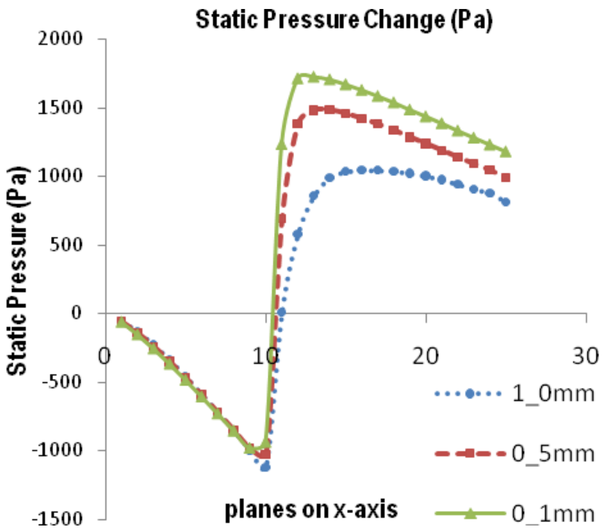

Figure 2: Static pressure changes for different bubble diameters