Volume fractions study in multiphase flows using computational fluid-dynamics, Monte-Carlo method and artificial neural networks

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This work will be performed as part of a doctoral thesis. Its objective is the development of a methodology based on gamma ray densitometry techniques and artificial neural networks to predict volume fractions in multiphase flows with the support of computational fluid-dynamics (CFD) and MCNP-X code [1].

The knowledge of the volume fraction in a multiphase flow is of key importance in predicting the performance of many systems and processes. The one great advantage of the application of gamma ray densitometry is the fact that it is not invasive. In addition, as far as the artificial neural network is concerned, it allows the prediction of flow without the need for the knowledge of its characteristics. Finally, the CFD can simulate flow without experimental necessity.

First, it was necessary to know other works and gamma ray densitometry techniques. Then, a paper, which was presented at the International Nuclear Atlantic Conference - INAC [2] was produced with that purpose.

This work will be developed in partnership with the IEN, as it has the availability of computational tools for simulation and a laboratory for the experiments proposed. The IEN has a gamma radiotracers laboratory where there is a mono and a two-phase flows installation. This laboratory has all the necessary tools for gamma ray densitometry: gamma radiation sources, NaI (Tl) detectors, pre-amplifiers, amplifiers, spectrometers, among others.

In this first stage, some simulations with the MCNP-X code and a brief training of the neural network will be carried out. In the MCNP-X, some geometries to describe the source, a transversal section of a pipe containing two phases and a detector will be used, as illustrated in Figure 1.

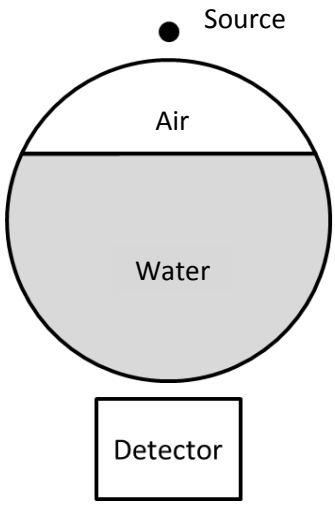

Figure 1. Source mounting and detector in a pipe template.

Because the MCNP-X only works in the steady state, simulations of cross sections of flow regimes simulated in CFD at various time intervals will be made. With these results, the training phase of the neural network will start, as a final part of the first phase of the work.

References

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