SIMULATION OF INTERFACIAL GAS-LIQUID ANNULAR FLOWS USING AN INTERFACIAL FUNCTION

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ABSTRACT

Interfacial flows are often characterised by the existence of a complex shape interface, composed by waves in a wide range of amplitudes and frequencies. An important example is the annular gas-liquid flow, composed of a gas core and a thin liquid film near the wall, with structures like "roll waves" and ripples occurring over the whole interface. A common approach in the modelling of the interaction between the two phases is to use an "equivalent roughness" of the film to determine the interfacial shear-stress [1]. In this work we generalise this idea by introducing the concept of an interfacial function.

In this approach, a transient simulation is performed in both phases (e.g., using DNS or LES), together with an interfacial function that provides the stress between the phases. The shape of the interface is determined locally from the pressure distribution in each phase, and a physically-based model is used to relate its shape with the interfacial stress. This approach allows us to perform high-resolution simulations in each phase without the need to perform a detailed simulation of the interfacial phenomena. The interfacial interaction is incorporated through a model, which also allows us to isolate the different mechanisms involved. This model can be of a "static" nature, where the stress is determined directly from the shape of the interface, or it can incorporate the dynamics of the interfacial phenomena.

An example of this approach is shown in Figure 1, where DNS is used for each phase and the shape of the interface is determined using a surface tension model. We can clearly see that the small scales associated with the pressure distribution on the interface are filtered by the surface tension, resulting in a relatively smooth interface; indicating that in this case the fine scale details are not important to determine the shape of the interface.

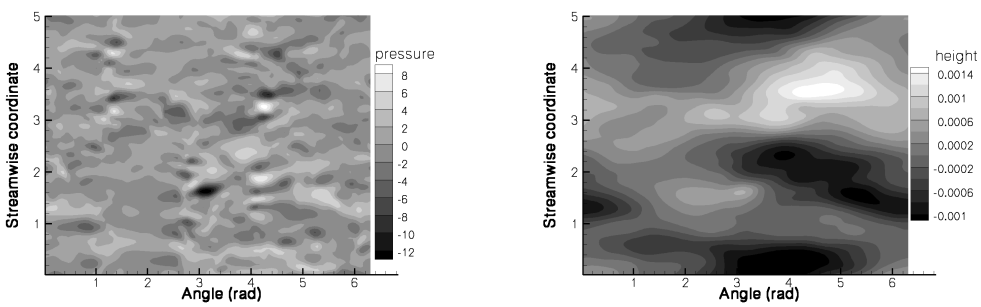

Figure 1: Left: pressure distribution across the interface. Right: interface height.

REFERENCES

[1] Belt, R.J., Van't Westende, J.M.C. and Portela L.M., Prediction of the Interfacial Shear-Stress in Vertical Annular Flow, *Int.J.Multiphase Flow*, Vol. 35, pp. 689-697, 2009.