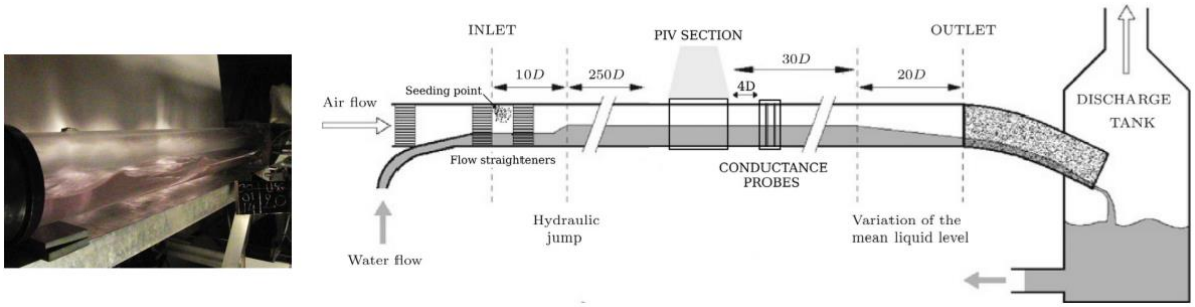
EXPERIMENTAL INVESTIGATION MICROSCALE BREAKINGWAVES IN TWO-PHASE PIPE FLOW

Vollestad Petter1, Jensen Atle1, Ayati A. Anis1

1Department of Mathematics, University of Oslo, N-0316 Oslo, Norway

Abstract

We present an experimental study of stratified gas-liquid pipe flow conducted at the Hydrodynamics laboratory, University of Oslo. The experimental setup consists of a 31 meter long, 10 cm diameter pipe, the test fluids are air and water at atmospheric conditions. Simultaneous two-phase particle image velocimetry (PIV) is used to evaluate two-dimensional velocity fields along the center plane of the pipe. In addition, wave statistics are acquired using conductance wave probes. For further details on the experimental setup see [2, 1]



(a) (b)

Figure 1. a) Wavy air-water flow inside a horizontal pipe. b) Overview of experimental setup.

Previous analysis [2] has shown that at a given superficial liquid velocity increasing the gas flow rate will eventually lead to a regime of amplitude saturation, where the rms amplitude of the wave field is independent of gas velocity. Based on visual observation in the pipe, microscale breaking of the waves is assessed to be a likely cause of the observed amplitude saturation. In the present work we analyse the possible breaking waves using PIV in both the gas and liquid phase. The goal of this study is to establish where in the U_{sg}/U_{sl} flow map microscale breaking occurs, and at what frequency. We also want to investigate whether airflow separation previously observed above waves in the amplitude saturation regime is related to the onset of microscale breaking waves.

References

[1] A.A. Ayati, J. Kolaas, A. Jensen, and G.W. Johnson. A PIV investigation of stratified gas-liquid flow in a horizontal pipe. International Journal
of Multiphase Flow, 61:129 – 143, 2014.

[2] A.A. Ayati, J. Kolaas, A. Jensen, and G.W. Johnson. Combined simultaneous two-phase {PIV} and interface elevation measurements in stratified
gas/liquid pipe flow. International Journal of Multiphase Flow, 74:45 – 58, 2015.