Experimental investigation on two-phase horizontal intermittent flow through an orifice

Abstract: Acoustic phenomena in two-phase flow enjoy particular interest from industry, since significant noise may be generated, for example, by large volumetric changes associated with flow through a control valve. In the present study, the acoustic effects of a horizontal intermittent water-air flow through an orifice are investigated experimentally. The two-phase flow is generated by injecting air at a rate of 0.01 to 3.2 [g/s] to water flowing in a pipe with diameter of 25 mm at a given rate in the range from 20 to 800 [g/s], where the pressure varies from 1.5 to 6 bar at ambient temperature. Orifice diameters of 2 mm, 5 mm and 10 mm are investigated. Unsteady pressure fluctuations are recorded to provide data for spectral analysis by pressure transducers located upstream and downstream of the orifice. The flow regime is visually recognized as slug and plug flow. The slug and plug frequency lies between 0.1 and 5 Hz and primarily rises with the higher water mass flow rate. The corresponding Strouhal number declines with the increasing air mass flow rate. The power spectral density of the pressure fluctuation increases with a growth rate, \( f^{5/3} \), in the low frequency range up to the slug frequency and then decays with
a rate of $f^{-5/2}$ up to 10 kHz. In plug flow regime a hump appears in the spectra between 100-500 Hz. This pattern is apparent downstream of the orifice.