Measurement of drift velocity of elongated bubbles in slight inclined circular tubes

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Introduction

Rising bubble is a common phenomenon that occurs in a wide variety of industrial applications such as steam heaters, boilers, nuclear reactors and offshore oil and gas flowlines. Understanding of air-water multiphase flow is directly related to the knowledge of the dynamics of the rising bubbles . One of the forces affecting the bubble dynamics is the buoyancy which can be studied by a drift flux experiment. As it expected, drift velocity in horizontal or nearly horizontal tubes was more difficult to analyze, since the flow loses its symmetry and therefore the bubble geometry becomes harder to model. For this reason, there are many experimental studies in this field [1]. In this work, a high speed ultrasonic filtered pulse-echo system was developed to study the ratio of inertial to gravitational forces in inclined tubes [2].

Experimental setup

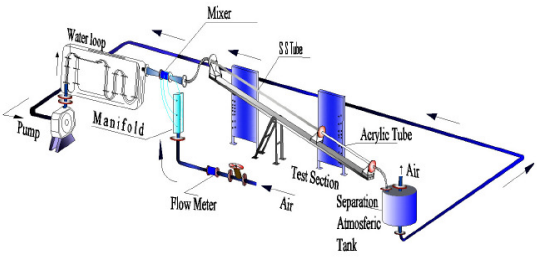

Figure 1. Test section.

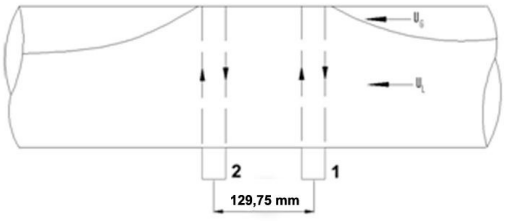

Figure 2. Positioning of two transducers.

Results

High speed filtered ultrasonic system

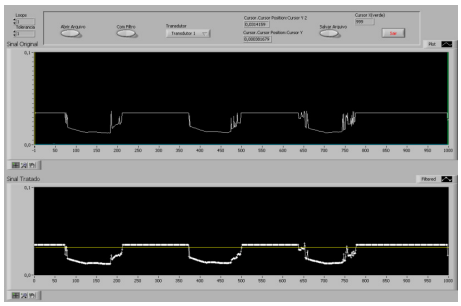

Figure 3. Original signal and filtered signal with 1 loop and 1 of tolerance.

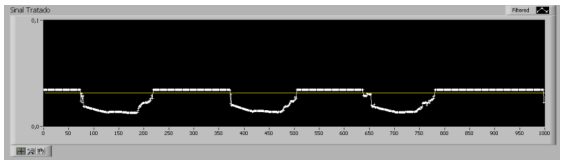

Figure 4. Filtered signal with 5 loops and 0,85 of tolerance.

Table 1. Elongated bubble parameters

Angle (°)	Number of samples	V_{AB} (m/s)	ΔV_{AB} (m/s)
2.5	94	0.188	0.0057
5.0	109	0.196	0.0061
10.0	114	0.204	0.0062

Drift velocity for different angles of inclination.

Table 2. Different parameters of bubble length.

Angle(°)	L_{AB1}	ΔL_{AB1}	L_{AB2}	ΔL_{AB2}	L_{BB1}	L_{BB2}	L_{SB1}	L_{SB2}
2.5	0.153	0.059	0.147	0.058	0.245	0.246	0.067	0.066
5.0	0.159	0.052	0.152	0.053	0.364	0.362	0.065	0.066
10.0	0.105	0.031	0.103	0.030	0.200	0.189	0.045	0.045

References

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[2] L. R. P. B. Moreno, J. S. Cunha Filho, J. L. H. Faccini, J. Su, 2011, "Measurement of drift velocity of elongated bubbles in slight inclined circular tubes using a filtered ultrasonic technique", Proceedings of International Nuclear Atlantic Conference – INAC2011, Belo Horizonte, Brazil, October 24-28.