D 1.9/ Summary of the deliverable: “Development of interface capturing algorithm for cavitation nucleation”

Provided by ESR 4 , Mandeep Saini under the supervision of Dr Daniel Fuster and Dr Stephane Zaleski, Sorbonne University.

This study is dedicated to extend the current understanding of process of heterogeneous bubble nucleation. Foundational understanding of heterogeneous nucleation includes the theory of unstable growth which is soul of current study. The fundamental understanding of heterogeneous bubble nucleation gained and elaborated. The understanding numerical method proposed by Fuster and Popinet [1] is widened and elaborated. The contact angle implementation of basilisk is extended to compressible solver and validated with a classical example. The numerical predictions for conditions for unstable bubble growth are shown and compared with theoretical results. It is also demonstrated that only particular bubble sizes are active for cavitation, depending on the amplitude and frequency of external excitation. Further, the predictions of thresholds are made for bubbles attached to walls evolving at a constant static angle of contact. The future aim is to provide more inclusive and comprehensive view of heterogeneous bubble nucleation using CFD tools.

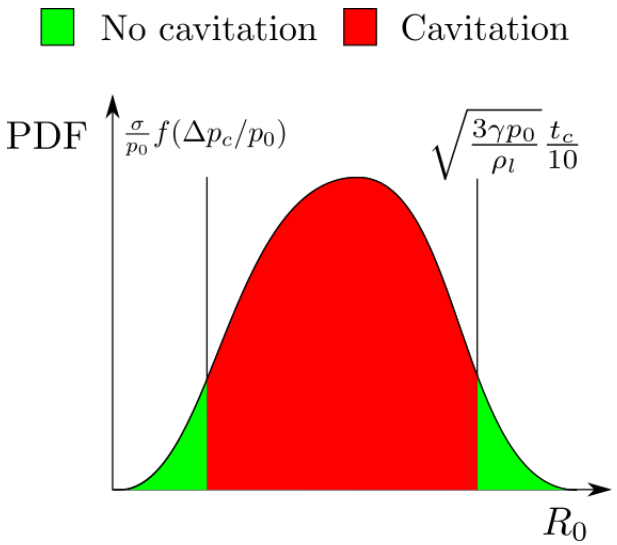

Figure 1 - The figure shows the bubble sizes present in problem on *x*-axis and the probability density function of presence of these bubbles on *y*-axis. Depending on the amplitude and frequency of external excitation, for a bubble size distribution, only a certain bubble sizes are active for cavitation which is shown by red color in the picture. The smaller bubbles do not grow because the amplitude of excitation is not high enough to overcome the surface tension forces on other hand the larger bubbles do not activate because the frequency of external excitation is large as compared with natural frequency of bubble oscillations, thus the time for which pressure is lowered is not enough to overcome the inertia of heavy liquid just outside air bubble. On increase in frequency of excitation, the upper threshold shift leftwards, when it overlaps with lower threshold no cavitation is observed and this behavior is independent of amplitude of the excitation.

[1] Fuster, Daniel, and Stéphane Popinet. "An all-Mach method for the simulation of bubble dynamics problems in the presence of surface tension."Journal of Computational Physics 374 (2018): 752-768.