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Shock wave interactions in single-bubble collapse near a corner[1]

WILLIAM WHITE, SHAHABODDIN ALAHYARI BEIG, ERIC JOHNSEN, University of Michigan — Damage to neighboring surfaces due to repeated bubble collapse is one of the most important consequences of cavitation, which can be found in a multitude of hydraulic systems. A number of experimental studies have been conducted to predict the dynamics of re-entrant jets as well as bubble migration in a corner. However, the temperatures and pressures during the collapse have yet to be investigated. In this study, we quantify the effects of bubble-boundary interactions on the bubble dynamics and the temperatures/pressures produced by the collapse of a single bubble near two perpendicular rigid surfaces. For this purpose, we use an in-house, high-order accurate shock- and interface-capturing method to solve the 3D compressible Navier-Stokes equations for gas/liquid flows. The non-spherical bubble dynamics are investigated, and the subsequent pressure and temperature fields are characterized based on the relevant parameters entering the problem: geometry, stand-off distances from each surface, driving pressure. We demonstrate that bubble-boundary interactions amplify/reduce pressures and temperatures produced during the collapse and increase the collapse time and the non-linearity of the bubble displacement, depending on geometric parameters.

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William White
University of Michigan

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