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Comparison of Detailed Bubble-Cluster Simulations with Reduced Models ARPIT TIWARI[1], CARLOS PANTANO, JONATHAN B. FREUND, Univ of Illinois - Urbana — Reduced-physics models of bubble ensembles depend on length-scale separation between the characteristic size of the cluster and the comprising bubbles. They have been remarkably successful in reproducing qualitatively the gross-scale development of the clusters. Studies based on such models, consistent with the experimental findings, suggest that the cluster collapse propagates inward, with pressure focusing toward the geometrical center (with particularly violent collapse of bubbles at its core). The bubble-scale dynamics near the focus are therefore anticipated to be particularly important in the damage of adjacent surfaces. Quantifying these dynamics is the goal of our three-dimensional simulations, which explicitly represent the non-spherical dynamics of each bubble within the cluster. We simulate collapse of a hemispherical cluster of 50 bubbles adjacent to a plane rigid wall for different initial configurations. Results show that the qualitative behavior matches predictions from the homogenized and particle-based reduced models. However, the peak pressures show strong dependence on bubble-scale dynamics. In the detailed simulations, they are typically only a small fraction of those predicted by the reduced models. A systematic comparison with these models will be presented.

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