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Reduced Order Modeling of Bubble Cloud Dynamics in a Focused Ultrasound Field KAZUKI MAEDA, TIM COLONIUS, California Institute of Technology — In order to characterize the cloud cavitation in burst wave lithotripsy, reduced order modeling of the dynamics of a spherical bubble cloud of a radius $O(1)$ mm interacting with traveling ultrasound waves of an amplitude O(1) MPa in water is presented. Bubbles are treated as spherical, radially oscillating cavities dispersed in continuous liquid phase. The volume of Lagrangian point bubbles is mapped with a regularization kernel as void fraction onto three-dimensional Cartesian grids that define the Eulerian liquid phase. The flow field is solved using a WENO-based compressible flow solver. The initial size and number density of the bubbles are critical for their coherent dynamics in the cloud, yet three-dimensional simulations of clouds with various parameters are computationally demanding. For further reduced-order modeling, a new kernel is introduce into the model to regularize bubbles onto two-dimensional, axisymmetric grids. The evolution of the void fraction and the maximum pressure in the cloud simulated using the model agree with results of three-dimensional simulations, while the reduction in computational cost is a factor of $O(100)$. Finally, the model is applied to a parametric study of the coherent dynamics of bubbles.

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