Stress and strain fields produced by violent bubble collapse

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Cavitation finds a key application in therapeutic ultrasound. For example, histotripsy relies on the rapid expansion of cavitation bubbles to fractionate soft tissue. To fully understand the mechanisms responsible for tissue fractionation, we numerically model cavitation in a tissuelike medium, focusing on the effect of its viscoelastic properties (viscosity, elasticity, and relaxation). It is hypothesized that ablation is caused by high strain rates and stresses exerted on the surrounding tissue as bubbles rapidly expand from nanometer to micron scales. The present study uses robust numerical techniques to compute the stress fields in the surrounding medium produced by single-bubble expansion. Bubble expansion is driven by a waveform that approximates a histotripsy pulse with relevant parameters, and soft tissue surrounding the bubble is modeled as a viscoelastic medium with Neo-Hookean elasticity. We will examine the stress, strain, and temperature fields produced during this process to explain potential damage mechanisms.