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Cavitation dynamics in a viscoelastic medium with nonlinear elasticity RENAUD GAUDRON, ERIC JOHNSEN, University of Michigan — Past methods for modeling the dynamics of a spherical cavitation bubble in a viscoelastic medium (e.g., soft tissue) usually assume the elasticity to be linear. In this work, we develop a general framework to study cavitation in nonlinear (visco)elastic media, which are expected to be more accurate for large-amplitude bubble oscillations. By following an approach based on deformation tensors and Cauchy stresses, the models presented here not only take into account the usual viscous, inertial, pressure and surface tension effects, but also complex nonlinear elasticity directly derived from specific strain-energy functions. The present results are consistent with past studies of linear viscoelasticity, but additional elastic terms with different exponents emerge in the bubble dynamics equation (e.g., Rayleigh-Plesset) for more complicated strain-energy functions. Key quantities in cavitation dynamics (bubble natural frequency, minimum radius, etc.) are reported for the neo-Hookean model, the simplest nonlinear elastic model. This approach also readily leads to a full description of the physical variables of the medium where the bubble oscillates (pressure, strain/strain rate, stress, etc.).

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