CONTROL ID: 2577820
TITLE: The effects of heat and mass transfer on free oscillations of a bubble in a viscoelastic, tissue-like medium
AUTHORS (FIRST NAME, LAST NAME): Eric Johnsen[1], Carlos Barajas[1]
INSTITUTIONS (ALL): 1. University of Michigan, Ann Arbor, MI, United States.
ABSTRACT BODY:
Abstract (200 words): Free oscillations of a bubble in soft tissue is of relevance to a variety of diagnostic and therapeutic ultrasound applications. Heat and mass transfer effects have been explored in the context of bubble oscillations in water; however, the extent to which they influence bubble oscillations in soft materials is presently unknown. Our objective is to use numerical modeling to predict bubble oscillations in viscoelastic, tissue-like media, while accounting for heat and mass transfer. We numerically solve the Keller-Miksis equation to compute the Rayleigh collapse of a spherical bubble in a Kelvin-Voigt viscoelastic medium with finite-strain elasticity. The energy equation is solved inside and outside the bubble, and a mass conservation equation is solved for the vapor inside the bubble; equilibrium phase change is assumed. Using linear, small-amplitude perturbation theory, we investigate the bubble response. We show how the damping and oscillatory behavior depends on the eigenvalues of the full system; in particular, the time constant does not follow a monotonic relationship with respect to shear modulus. We also identify regimes in which solving the fully partial differential equations for energy and vapor concentration is not necessary. Finally, we interpret our results in the context of ultrasound applications.

PRESENTER: Eric Johnsen
PRESENTER (EMAIL ONLY): ejohnsen@umich.edu
PRESENTATION TYPE: Contributed Submission : Lecture