Abstract Submitted
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Optimal control of the nonspherical oscillation of encapsulated microbubbles for biomedicine[1] FATHIA F. ARIFI, MICHAEL L. CALVISI, University of Colorado Colorado Springs — Encapsulated microbubbles (EMBs) consist of a gas core surrounded by a stabilizing shell comprised of lipid, polymer, or protein and are used for ultrasound imaging and medical therapies, such as drug and gene delivery. The nonspherical oscillation of EMBs is essential for their function as it can enhance the acoustic signature in medical imaging as well as the onset of rupture, which can affect drug/gene release. Therefore, the ability to control such oscillations can improve the efficacy of diagnosis and treatment mediated by EMBs, and reduce unwanted side effects. This talk discusses the use of optimal control theory to optimize the acoustic driving for a specific objective, such as maximizing the nonspherical subharmonic response to improve blood-tissue contrast, or exciting shape modes to incite bubble rupture or the formation of microjets, which can facilitate drug/gene uptake. These objectives are achieved through prescribing various cost functions that enhance the dynamic response of shape modes while minimizing overall acoustic energy input to improve patient safety. Single frequency, dual frequency, and broadband acoustic forcing schemes are explored and compared.

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