MICROBUBBLE DYNAMICS FOR DELIVERY OF NANOMEDICINE TO TUMORS

Microbubble oscillations induced by an external acoustic field play a crucial role in biomedical applications, such as targeted drug and gene delivery, as well as their use as contrast agents in medical imaging. In our work, we investigate the behavior of microbubble oscillations within microvessels and their relevance to ultrasound-based therapeutic techniques. We performed the numerical simulations by varying bubble and vessel characteristics, as well as acoustic parameters, to evaluate their impact on key outcomes such as bubble surface area and the shear stress exerted on vessel walls, where excessive shear stress (>800 Pa) may cause tissue damage. A modified Rayleigh–Plesset-type model is employed to capture the coupled effects of acoustic forcing, viscoelastic media, and elastic boundaries. Numerical simulations reveal how bubble confinement and excitation frequency modulate resonance conditions, and secondary Bjerknes forces, thereby influencing bubble stability and efficacy in drug transport. These findings support the design of safer and more efficient ultrasound-mediated drug delivery systems.