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The interaction of microbubbles with high intensity pulsed ultrasound

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High intensity pulsed ultrasound when interacting with microbubble contrast agents is potentially useful for biomedical applications such as drug delivery, cancer treatment and tissue ablation. To establish a fundamental understanding of the interaction between a microbubble with a sound wave, numerical simulations are performed using the Boundary Element Method (BEM). Bubble dynamics in terms of shape changes in time, maximum bubble radius obtained, jet velocity and translational movement of the bubble center is studied. The effect of varying ultrasound intensity and initial bubble size is examined as well. One important result is the determination of the conditions under which a clear high speed jet will be formed in the microbubble when it is hit by a specific sound wave. The jet is crucial to the success of the biomedical applications mentioned. Also, it is shown that one cycle of ultrasound consisting of a single negative part followed by a single compressive part would be the optimized wave form because collateral damage by re-expanding remnants of a collapsed microbubble by the subsequent negative pressure wave is prevented. The BEM model has greater computational efficiency in terms of speed and storage space over other full domain methods because only surface meshing is needed.