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A passive array technique for cavitation mapping during HIFU treatment

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During exposure of tissue to HIFU, cavitation has been shown to enhance the rate of heat deposition in tissue and could provide an effective means of treatment monitoring. However, cavitation activity occurring pre-focally or growing unstable around the focal region is known to impede safe and effective treatment delivery. A combined computational and experimental approach is being applied to develop a passive array-based technique for mapping cavitation activity in real-time, using a novel cross-correlation algorithm to combine single-channel information received by an imaging array co-axial to the HIFU transducer. The cavitation maps produced in this manner were validated using two single-element 15-MHz focused PCDs during continuous-wave insonation of a polyacrylamide-based tissue mimicking material by 1.1 MHz HIFU. Initial experiments have shown bubble cloud movement towards the HIFU transducer, in agreement with previously reported observations. Future work will involve applications of advanced imaging techniques to achieve a high spatiotemporal resolution, which is essential because of the unstable nature of cavitation activity and the requirement that treatment be well localized.