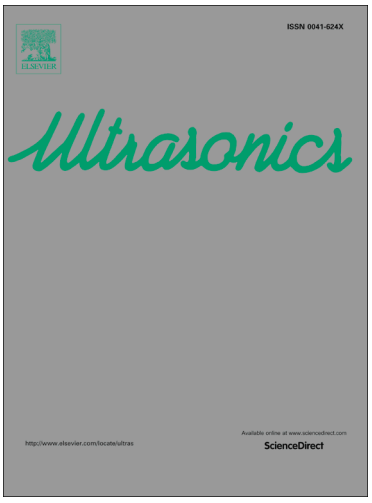

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Improvement of pulse-echo harmonic generation from a traction-free boundary through phase shift of a dual element transducer

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Abstract: The practical implementation of nonlinear ultrasonic technique has been limited to the through-transmission setup for measuring the second harmonic component induced by the nonlinearity or microstructural changes of test material. A more practical technique such as the pulse-echo testing has been ruled out because a traction-free reflecting boundary destructively alters the nonlinear generation process. A focusing acoustic beam or rigid boundary condition was often employed for biomedical imaging and fluid nonlinearity in the pulse-echo inspection. In this article, we further explore a more general and efficient method to improve the generation of the second harmonic component in the pulse-echo mode with traction-free surface. A dual element planar transdcer with optimal phase shift of the input signal in one element relative to another is proposed for this purpose. The validity of the phase shift concept is confirmed by comparing the enhanced generation of second harmonic amplitudes and the resulting nonlinear parameters with the rigid-boundary case equivalent to the conventional through-transmission setup.

Keywords: Harmonic generation, Pulse-echo testing, Traction-free boundary, Dual element transducer, Phase shift