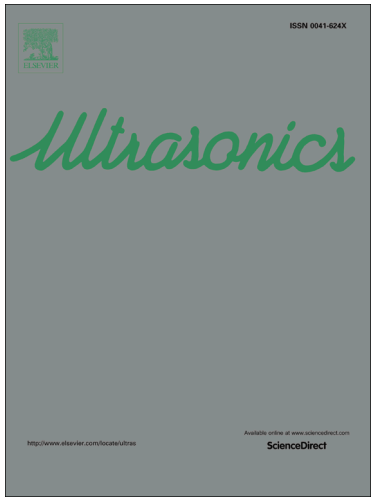

Piezoelectric nonlinear vibration focusing on the second-harmonic vibration mode

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Abstract

Resonant piezoelectric devices are driven under high power condition. In such condition, a nonlinear piezoelectric vibration becomes apparent and this nonlinearity should be taken into acount in the design procedure using the finite elemental method (FEM). The purpose of this study is to introduce the nonlinear parameter to the FEM and to establish the method for measuring the nonlinear parameter through evaluating a nonlinear model for a piezoelectric vibration. In a previous study about the nonlinear piezoelectric vibration, the third term was mainly focused on because the third mode vibration affects the fundamental vibration in the case of a simple bar-type transducer. On the other hand, we considered the second nonlinear parameter of the compliance to the piezoelectric constitutive equation. We observed that this parameter affects the vibration amplitude with each position and the velocity at the tip of the transducer with a double frequency at resonant. It was confirmed that two measured nonlinear parameters based on these two relationships were almost same. From these values, we concluded that the proposed model is reasonable.