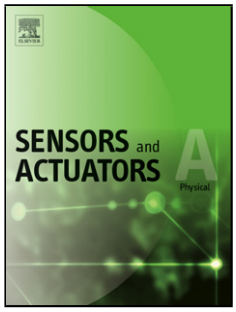


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# Optimal design of a double-vibrator ultrasonic motor using combination method of finite element method, sensitivity analysis and adaptive genetic algorithm

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## Research highlights

- Structure optimal design of a double-vibrator ultrasonic motor is introduced.
- Working principle, object function, optimization process are described in detail.
- Sensitivity analysis, FEM and AGA are successful used in parameter optimization.
- Experiment results validate the feasibility of the optimization method.

**Abstract:** Recent studies have shown that new devices with improved performance can be successful achieved by using optimization methods. In this study, an optimal design of a double-vibrator ultrasonic motor using combination method of finite element method, sensitivity analysis and adaptive genetic algorithm is presented. The finite element method is the reliable method for modal and harmonic response analysis. The sensitivity analysis is employed to determine the optimal analysis parameters having high sensitivity to optimization objectives, which can significantly improve the efficiency of the optimization. The adaptive genetic algorithm is adopted to seek the optimal values of structural parameters, which is scientific and efficient for multi-objective optimization problems. After optimization, all of the design objectives have achieved significant improvements. To verify the effectiveness of this method, a prototype motor is manufactured according to the optimization results and its performance is measured. The measured results show that this method is available and effective for the optimal design of ultrasonic motors.

**Key words:** ultrasonic motor; optimal design; finite element method; sensitivity analysis; adaptive genetic algorithm.