ABSTRACT

Structural Design of Piezoelectric Microactuator Using Topology Optimization

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A piezoelectric microactuator consists of the piezoceramic connected to a flexible mechanical structure that converts and amplifies the output displacement of the piezoceramic. Even though the structural configuration of a micro actuator plays an important role in determining the structural flexibility, it is difficult to expect the structural layout in priori. Previous works are mainly focused on maximizing performance of a micro actuator, whereas the accuracy of the motion generated by a piezoelectric microactuator is not considered and additional efforts are required to fulfill the functionality.

In this study, a general method for designing a structure of a piezoelectric microactuator is proposed to satisfy the specific mean transduction ratio(MTR). In order to analyze the response of the piezoelectric-structure coupled system, both the structural and the electric potential are considered in the finite element method. The optimization problem is formulated to minimize the difference between the specified and the current mean transduction ratio between input part and output part of an actuator and the minimization of mean compliance at output part is also considered for the formulation of objective function to have enough stiffness of a connected mechanical structure. Topology optimization is applied to determine the structural layout of a microactuator. The multiobjective optimization problem is solved using sequential linear programming(SLP).

The results of test problems including the flextensional actuator design and the flextensional gripper design show that the design of a piezoelectric microactuator with specified mean transduction ratio can be obtained.