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SIMULTANEOUS OPTIMIZATION OF ACTUATORS' PLACEMENTS, CONTROL PARAMETERS AND STRUCTURAL TOPOLOGY OF PIEZOELECTRIC COMPOSITE STRUCTURES FOR STATIC SHAPE CONTROL

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Abstract: This paper investigates the simultaneous optimization of actuators' placements, control parameters and structural topology of piezoelectric composite structures with surface attached piezoceramic patches. Considering the fragile property that piezoelectric ceramics have, only regular-shaped patch actuators are used here, which greatly facilitate the manufacturing process. Uniform electrical voltages applied on each piezoelectric patch are taken as the voltage design variables for simplifying the complexity of control system. Three kinds of design variables, i.e., the actuators' locations, applied electrical voltages and host structural pseudo-densities, are optimized simultaneously to improve the overall deformation precision. To freely place piezoelectric actuator on the host structure surface regardless of coincident finite element in classic lamination theory (CLT), the multi-point constraints (MPC) method is used here to simulate the perfect bonding between actuator layer and host layer, which inherits the advantages of avoidance of remeshing process, analytical sensitivity as well as efficient lamination description during the movement of actuators in optimization iterations. For applying to spatially complex shape control, a modified shape error function based on the relative error between computed and desired surfaces is used. The finite circle method (FCM) is implemented to prevent the overlaps among the actuators and those between actuators and boundaries of the global design domain. Finally, numerical examples with plane or curved host structure are tested and discussed to demonstrate the validity and efficiency of this method.