Level Set Method for Shape Optimization of Plate Piezoelectric Patches

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We consider a closed-loop displacement feedback control system: a thin rectangular plate reinforced with two laminated piezoelectric patches, a sensor and an actuator. The sensor senses the vibration of the plate and generates a certain signal which is amplified and sent to the actuator. The actuator can then generate a corresponding signal which causes the plate to bend in the opposite direction and therefore balances its original vibration. The shape optimization task is to find the optimal shapes of the patches (under some constraint) in order to minimize the minimum vibration frequency.

In the absence of mechanical excitations, the equation of motion of the plate with externally applied control moments is given by a fourth order hyperbolic PDE with simply supported boundary conditions. The singular behavior of the solution on the free boundaries (patch boundaries) leads to the main difficulty in handling this problem. We will present the numerical approach to this shape optimization problem using the level set method. And the numerical results will also be provided in the end.