PhD Abstract

In this dissertation, the optimal actuator design and placement problem for a linear wave equation is studied. This problem arises in many areas of application in science and engineering, for example, in seismic inversion, medical applications, and control and stabilization of waves. The unique framework for the optimal actuator design and placement problem for a linear wave equation is still at large.

The shape optimization technique based on the averaged adjoint approach is used to study the optimal actuator design and placement problem for a linear wave equation. This approach was used for determining the optimal actuator design and placement for a heat equation but not for a wave equation. Therefore, the approach is employed in this study to determine the optimal actuator design and placement for a wave equation for the first time. For numerical realization, a mixture of weighted finite difference, and finite element methods are used.

Under the given assumptions on the data, the state equation is formulated and a new cost functional together with two optimization problems are proposed. Further, an improved regularity result for the state is deduced, leading to the well-posedness of the optimization problems. The shape and topological sensitivities of the functionals are derived and two algorithms initialized by the derivatives for solving the problem are proposed.

In numerical experiments, the algorithms are tested for different cases of initial conditions. The results show that the problem admits optimal actuator locations with both functionals provided that the actuator's width is fixed in advance. Numerical results also show that the continuation strategy is less costly in obtaining optimal actuators than the one without the initialization procedure.

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