Active Time-Delayed Control of Smart Plate

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Abstract: Time delay inevitably exists in active control systems. It may induce instability of the dynamic systems and degrade the performance of the control systems. In this paper, an active control of a plate is studied using time-delayed piezoelectric actuator. The control problem is to determine optimal voltage applied to a piezoelectric patch by minimizing a given performance criteria. The performance criteria is taken as the energy performance of the plate at the terminal time with the least control effort. The minimization of the performance criteria over the voltage is subject to the equation of the motion of the plate with imposed initial and boundary conditions. An algorithm based on the modal space reduction and state-control parameterization which approximates the performance functional of the problem are used. The modal expansion approach is used to convert the optimal control problem of distributed parameter system (DPS) into the optimal control problem of a linear time-invariant lumped parameter system (LPS). A direct state-control parametrization approach is proposed where wavelets are employed to solve time delayed LPS. The operational matrices of integration and delay are utilized to reduce the solution of linear time-varying delayed systems to the solution of algebraic equations. An illustrative example is included to demonstrate the applicability and the efficiency of the proposed method and the results are quite satisfactory.

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