MecSol 2017 – 6th International Symposium on Solid Mechanics
Joinville, SC - Brazil, April 26-28, 2016

A PRELIMINARY STUDY ON TOPOLOGY OPTIMIZATION OF PIEZOELECTRIC ACTUATOR CONSIDERING A THRESHOLD TO THE RESIDUAL MODES EXCITATION

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Abstract: In this work, the topology optimization method using the solid isotropic material with penalization (SIMP) approach is employed to find the optimum design of piezoelectric actuators taking into account the excitation of the residual vibration modes. An electromechanical finite element model of the structure is used assuming a two-phase material and this structural model is written into the state-space representation. The proposed optimization formulation aims to find the distribution of piezoelectric material which maximizes the controllability for a given vibration mode while the undesirable effects of the feedback control on the residual modes are limited by including a spillover constraint term written as a p-norm of the residual controllability Gramian eigenvalues. The optimization of the shape and placement of the conventionally embedded piezoelectric actuators are performed using a Sequential Linear Programming (SLP) algorithm. Numerical examples are presented considering the control of the first bending vibration mode of a cantilever beam. Two preliminary studies are presented: the influence of the norm exponent p and the effect of the spillover constraint individually for each residual mode.

Keywords: Topology optimization, piezoelectric material, control spillover.