

عنوان مقاله:

Stress Control of a Piezoelectric Lumped-element Model – Theoretical Investigation and Experimental Realization

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خلاصه مقاله:

This contribution focuses on force- and stress-tracking of a multi-degree of freedom system by eigenstrain actuation. The example under consideration is an axially excited piezoelectric bar which can be modeled as a lumped parameter system. The piezoelectric effect serves as actuation source and the question is answered how to prescribe the piezoelectric actuation in order to achieve a desired stress distribution, or, in the lumped case, a desired distribution of internal forces. First, the equations of motion are set up in matrix notation where the state vector contains the displacement components. After some basic manipulations, the governing equation can be written in terms of the internal force vector. Now, if one intends to have a certain desired internal force distribution, it is straightforward to find a condition for the piezoelectric control actuation. The developed theory is first verified by using a continuous piezoelectric bar, where the motion of one end is prescribed. Then the theory is experimentally verified: a lumped two-degree of freedom system is investigated and the goal is to reduce the stress or the internal force in order to avoid mechanical damage. The force-controlled configuration is exposed to a sweep-signal excitation between ۱۰۰۰–۴۹۰۰ Hz, running for ۲۲ minutes without any signs of damage. Then the same system is excited by the same excitation but without piezoelectric control. After some seconds the test sample is visibly damaged, going along with a significant reduction of the first eigenfrequency. This gives strong evidence for the appropriateness of the proposed stress or force control methodology.

کلمات کلیدی:

piezoelectric control, stress control, Structural control, fatigue and damage, lumped parameter system

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