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Active Control of FGM Plates Using Distributed Piezoelectric Sensors and Actuators

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“Functionally graded materials” (FGMs) are relatively new class of composite materials which are characterized by the smooth and continuous variation of the mechanical properties from one surface to the other. Due to its superior thermo-mechanical properties, FGMs have found extensive applications in aerospace, automobile, biomedical and nuclear industries. In the present work, distributed sensing and active control FGM plates using piezoelectric sensors and actuators are studied. A nine nodded shear deformable piezolaminated plate finite element based on first order shear deformation theory has been developed incorporating the FGM material model and the electromechanical coupling constitutive relations of the piezoelectric sensors/actuators. The FGM plate considered for case study is made of the combined aluminium oxide and a titanium alloy, Ti-6Al-4V and its properties are graded through the thickness direction according to a volume fraction power law distribution. The vibration control performance is explored using constant gain negative velocity feedback and LQR optimal control law which is based on state feedback. The influence of the constituent volume fraction of Ti-6Al-4V is also studied for the static deflection, natural frequency and controlled dynamic response of the FGM plates.

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