A Nonlinear Model of Composite Delaminated Beam with Piezoelectric Actuator, with Account of Nonpenetration Constraint for the Delamination Crack Faces

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Abstract: In this work, a new approach is developed for dynamic analysis of a composite beam with an inter-ply crack, in which a physically impossible interpenetration of the crack faces is prevented by imposing a special constraint, leading to nonlinearity of the formulated boundary value problem and to taking account of a contact interaction of the crack faces. A variational formulation of the problem and partial differential equations of motion with boundary conditions are developed, and solutions of example problems for a piezo-actuated cantilever beam are presented in a form of series in terms of eigenfunctions of the associated non-self-adjoint eigenvalue problem. A noticeable difference of forced vibrations of the delaminated and undelaminated beams due to the contact interaction of the crack faces is predicted by the developed model.

Keywords: *Composite beam; delamination; nonpenetration constraint for the crack faces; nonlinear dynamics; series solution; modal analysis.*

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