OPTIMAL PARAMETERS OF A DYNAMICALLY LOADED PATCH/LAYER STRUCTURE AGAINST THE ELASTIC-BRITTLE INTERFACE DEBONDING

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1. General

During the last decades the use of piezoelectric patches for damage detection of structures based on elastic wave propagation has attracted significant attention. Elastic waves are very sensitive to changes of geometry and material parameters of a given structure. Important is that they are attractive for the quick prognosis when a detailed inspection of structures is performed. The presence of a material discontinuity between the patches and the host structure generates complicated local electromechanical fields near the edges of the patches.

The excellent performance of the shear lag method in the case of static loading of smart hygropiezothermal elastic patch/layer configurations in the present paper permits to extend this method and apply it to investigate the piezoelectric response of the above mentioned smart structures under combined dynamic and electric time harmonic load at environment conditions and with possible interface delamination along the overlap zone of the structure considered.

A one-dimensional shear lag model was developed to study the high frequency dynamic time harmonic mechanical behavior of the overlap zone of a piezoelastic patch attached to an elastic host layer and subjected to electric, temperature and moisture excitation. It was interesting to see that the change of the geometry of the overlap zone leads to different solutions after some frequency which is responsible for different dynamic behavior of the considered structure. The interface shear stress and elastic-brittle debond length were studied for a range of magnitude of the time harmonic load and frequencies. All results are shown in figures and discussed. Further the model was involved in an optimization framework in order to find the safety intervals of the model parameters of the patch/layer configuration. For this purpose a genetic algorithm (GA) was implemented and the optimal parameters of combined loading, geometry and elastic properties of the structure against the appearance of interface debonding were found.