SELECTED PROBLEMS OF DAMAGE DETECTION IN INTERNALLY SUPPORTED PLATES USING DISCRETE WAVELET TRANSFORM

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ABSTRACT

Damage detection has focused much attention in the last two decades. There are different non-destructive techniques which enables the identification of defective part of a structure. This problem is extensively investigated by scientists and some approaches based on e.g. optimization of loads, information of natural frequencies, heat transfer, inverse analysis, soft computing methods such as evolutionary algorithms or artificial neural networks are applied. Many of them are based on comparison of the response of the damaged and undamaged structures. It is a serious difficulty since the experiments on these two structures must be carried out with the identical boundary and loading conditions. Moreover, global response of a structure is insensitive to localized damage. Therefore the uncertainty following from variation of the conditions in experiments can be larger than the precision of measuring gauges. A new impact came from a modern signal processing method, namely wavelet transformation also in its discrete form [1]. Wavelet transformation (WT) can surprisingly well extract the desired detailed information from a numerous data representing the global response of a damaged structure. Moreover, the information on undamaged structure is not necessary. Combining this method with, earlier mentioned, ANN or inverse analysis [2] one can precisely identify defect (damage) details.

The aim of the presented work is to detect the localization of defects provided that they exist in the considered plate structure. Numerical investigation is carried out basing on signal analysis of structural static response. The plate bending is described and solved by the Boundary Element Method in direct form. The boundary-domain integral equations are derived in singular and non-singular approach [3]. There are considered rectangular plates resting on half-space flexible foundation with bilateral constraints and on Winkler-type flexible foundation with unilateral constraints. Defects in plates are modeled as the slots near the plate boundary. As the structural response signal influence line of deflections is taken into consideration. The data are gathered in one measurement point, in equal time intervals. Decomposition of the obtained signal is carried out using DWT and Daubechies 4 wavelet. Multiresolution signal analysis using Mallat pyramid algorithm [4] is applied. Although the considered problem is two-dimensional from the point of view of deformation description, applied one-dimensional Discrete Wavelet Transform leads to efficient results in defect detection. Considered examples, quite correctly identify the presence and position of damage.

References

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