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DEFECT DETECTION IN TRUSS AND PLATE STRUCTURES USING 1-D AND 2-D WAVELET TRANSFORM CONSIDERING STATIC AND DYNAMIC RESPONSE SIGNALS

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The work is concerned with defect detection in truss and plate structures using dyadic Discrete Wavelet Transform (DWT), while considering the influence of external static or dynamic loading [1], [2] [3]. Examined trusses are modeled as flat and spatial structures with rigidly connected bars. The Kirchhoff plate bending is described and solved by the Boundary Element Method (BEM) [4]. Defects are introduced by weakening of the bar cross-section for trusses and by the additional edges forming slots or holes in relation to the basic plate domain for plates.

The DWT is applied to detect these parts of a structure in which defects are to be expected. Measured variables are static displacements and vertical displacement amplitudes established at selected points: nodes of finite elements or collocation points inside a plate domain. Estimation of a damage position is performed using wavelet coefficients of curvature and deformation (displacements and angles of rotation) signals. Decomposition of the obtained signal is carried out while using DWT with e.g. Daubechies 4 and 8 as well as Coiflet 4 and 6 families of wavelet functions. Measurement errors are introduced as the randomly generated white noise. The Mallat algorithms [5] are adopted for both 1-D and 2-D DWT analysis.

Several examples of truss and plate girders are examined. They proved that DWT of a structural response signal expressed in e.g. deflection or curvature which are measured at a selected domain point (discrete influence line of deflection, curvatures) and deflection lines or surfaces quite correctly identifies the presence and position of defected areas.

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