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Adaptive-scale Damage Detection of Plate Structures using Wavelet FEM

Wen-Yu He, Songye Zhu*

** Presenting Author*

Corresponding Author: ***Songye Zhu***
Contact Email: ***ceszhu@polyu.edu.hk***

ABSTRACT
The human retina, with low-acuity peripheral vision and high-acuity central foveal vision, can well achieve an efficient tradeoff between a wide field of view and important image details. This study presents a bio-inspired sub-element damage detection method for thin plate structures based on multi-scale wavelet finite element method. Multi-scale dynamical equation of thin plate structure is first derived with the tensor product of cubic Hermite multi-wavelets as shape function and modal parameters can be subsequently obtained. Then model updating technique is employed to detect plate sub-element damage in a progressive manner, i.e., the suspected damage region is first identified using a low-scale structural model, and then more accurate damage detection results can be obtained using a multi-scale model with local refinement. The former is analogous to low-acuity peripheral vision, while the latter is to the high-acuity central foveal vision in human retina system. During the detection process, the scales of wavelet elements in the WFEM are adaptively enhanced or reduced in the most concerned regions. Numerical and experimental studies are conducted to verify the effectiveness of the proposed approach.

KEYWORDS: *biologically inspired, progressive damage detection, thin plate structures, wavelet finite element*