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Assessment of Delaminated Smart Composite Laminates via System Identification and Supervised Learning

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Abstract

This paper proposes the synergetic integration of system identification and artificial intelligence for the detection and assessment of delamination damages in smart composite laminates. An electromechanically coupled mathematical model is developed for the healthy and delaminated smart composite laminates on the basis of improved layerwise theory, higher order electric potential field and finite element method. A discriminative feature space is constructed for the healthy and delaminated structures via system identification from their structural vibration responses. The discriminative features are used for the training and cross-validation of various supervised machine learning classifiers and an optimal classifier is identified. The optimal classifier is employed to make predictions on unseen test delamination cases, and its predictions are validated via a dimensionality reduction tool. The obtained results show that the proposed technique could be employed as a reliable tool for nondestructive evaluation of smart composite laminates.

Keywords: system identification; artificial intelligence; smart composite laminates; delamination damage; optimal classifier

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