Machine Learning Framework for Damage Assessment of Smart Composite Laminates

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Laminated composites are structural materials that have high specific strength, high specific stiffness, high resistance to corrosion and design flexibility compared with lightweight conventional materials. Owing to their orthotropic properties, laminated composites are susceptible to a variety of in-service and manufacturing defects. Delamination is a common and dangerous defect in the laminated composite as it can occur internally without any noticeable effects on the surface of the structures. It is imperative to develop reliable quantitative techniques for the assessment (i.e., detection, quantification, localization) of delamination in laminated to ensure safe and optimal functionality of next-generation composite structures. In this paper, a machine learning framework is proposed for the assessment of single and multiple delaminations in smart composite laminates. An electromechanically coupled finite element model is solved in the time domain to obtain transient responses of the healthy and delaminated smart composite laminates. The transient responses are processed to extract discriminative features for the intact and delaminated structures and machine learning techniques are employed to process those features. The proposed approach showed satisfying results regarding the detection, localization, and quantification of single and multiple delaminations in smart composite laminates.

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