A Fatigue Damage Diagnosis and Prognosis Method Based on Strain Monitoring for 2024 Aluminum Plates with Central Holes

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Abstract

A fatigue diagnosis and prognosis method based on strain monitoring has been developed for 2024 aluminum plates with central holes. Fatigue experiments were conducted to obtain strain and crack information from the specimens. Crack occurrence was detected through a thresholding method applied to the strain measurements. A data-driven Gaussian Process Regression (GPR) algorithm was employed to establish the relationship between crack length and strain characteristic parameters. For real-time crack propagation prediction, a Dynamic Bayesian Network (DBN) was constructed by integrating the GPR algorithm with the Paris formula. An experiment was carried out to illustrate the accuracy of the method. The results indicate that the threshold method can effectively detect fatigue cracks. The GPR algorithm accurately identifies fatigue crack lengths and has higher recognition accuracy than other algorithms. Additionally, the DBN provides more accurate crack propagation predictions with reduced computational time compared to traditional mechanics-based crack growth analyses.
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