

论文

用超声导波幅度谱方法评价复合材料板材疲劳损伤的数值研究

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摘要:

基于超声导波的频散方程及位移场表达式, 对单向碳纤维/环氧复合板中传播的超声导波的幅度谱进行了数值研究, 得到了能全面、直观反映复合材料板材疲劳损伤程度的超声导波幅度谱的灰度图。数值分析表明, 当复合材料板材承受拉伸或弯曲载荷时, 其等效杨氏模量或等效剪切模量的变化率, 与超声导波幅度谱的灰度平均值之间存在单调的对应关系。采用超声导波的幅度谱方法可望能有效定征复合材料板材的初期疲劳损伤。

关键词: 复合材料板材 疲劳损伤 超声导波 幅度谱 数值研究

Numerical analyses of evaluation of fatigue damage in composite sheets using ultrasonic guided wave amplitude spectra

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Abstract:

Based on the dispersion equation and the displacement field expression of ultrasonic guided waves, ultrasonic guided wave amplitude spectra have been studied numerically for a unidirectional carbon fiber sheet. The gray images of ultrasonic guided wave amplitude spectra that can straightforwardly characterize the degree of fatigue in composite sheets are obtained. The numerical results show that, with the tension-tension or bending fatigue loading, there is a monotonic relationship between the average gray value of gray images of ultrasonic guided wave amplitude spectra and the change rate of equivalent Young's modulus or equivalent shear modulus. It is concluded that the ultrasonic guided wave amplitude spectra may be used to effectively characterize the early stages of fatigue damage in composite sheets.

Keywords: composite sheet fatigue damage ultrasonic guided waves amplitude spectra numerical analysis

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