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M. Idriss, A. El Mahi



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Linear and nonlinear resonant techniques for characterizing cyclic fatigue damage in composite laminate

M. Idriss^{1,2*}, A. El Mahi¹

¹LUNAM University, Maine University, Acoustic Laboratory of Maine University (LAUM)
CNRS UMR 6613, Avenue Olivier Messiaen, 72085 Le Mans Cedex 9, France

²University of Abeche, Faculty of Sciences and Technology, Department of Physics BP: 1173,
Abeche, Chad

Abstract

In the present work, the linear and nonlinear resonance experiments are performed on composite laminate beam with cyclic loading damage. The effect of different cyclic loading damage on the linear and nonlinear resonance response is analyzed. The nonlinear resonance studies the amplitude dependence of different modes. The frequency and the loss factor as function of the amplitude are determined for each cyclic loading damage. For the linear resonance, the specimens are tested at low amplitude excitation. The frequency and loss factor are evaluated for each cyclic damage. The nonlinear parameters are quantified as function of the damage. The linear parameters are compared with the nonlinear parameters.

Keywords: Composite laminate, Cyclic fatigue damage, Linear Parameters, Nonlinear Parameters

1. Introduction

Fiber-reinforced laminated composites have been increasingly used in a variety of industrial applications such as aerospace, marine, civil, automobile, and other engineering, due to their excellent properties such as high stiffness to weight and strength to weight ratios, and fatigue properties. However, with increase in usage, composite laminates are susceptible to damage from a wide variety of sources which include environmental, cyclic loading, and foreign object impact damage [1-3]. The presence of damage is known to cause mechanical parameter degradation, as well as changes to the vibration characteristics.

Giannoccaro and Messina [4] studied the correlation between fatigue strength and modal parameters. The results of their studies are shown that the first frequency decreases when the fatigue life is about 90%. Jia et al. [5] studied the effect of local damage on natural

* Corresponding author. Tel.: +235 99 83 79 79; fax: +235 269 88 59

E-mail address: moustaphaidriss@gmail.com

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