

Frequency Modulation in Vibro-Acoustic Modulation Method

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Abstract : The vibroacoustic modulation method is based on the modulation effect of high-frequency ultrasonic wave (carrier) by low-frequency vibration in the presence of various defects, primarily contact-type such as cracks, delamination, etc. The presence and severity of the defect are measured by the ratio of the spectral sidebands and the carrier in the spectrum of the modulated signal. This approach, however, does not differentiate between amplitude and frequency modulations, AM and FM, respectfully. It was experimentally shown that both modulations could be present in the spectrum, yet each modulation may be associated with different physical mechanisms. AM mechanisms are quite well understood and widely covered in the literature. This paper is a first attempt to explain the generation mechanisms of FM and its correlation with the flaw properties. Here we proposed two possible mechanisms leading to FM modulation based on nonlinear local defect resonance and dynamic acousto-elastic models.

Keywords : non-destructive testing, nonlinear acoustics, structural health monitoring, acousto-elasticity, local defect resonance

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