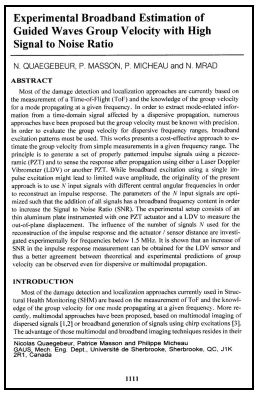
Experimental Broadband Estimation of Guided Waves Group Velocity with High Signal to Noise Ratio

N. QUAEGEBEUR, P. MASSON, P. MICHEAU and N. MRAD

ABSTRACT

Most of the damage detection and localization approaches are currently based on the measurement of a Time-of-Flight (ToF) and the knowledge of the group velocity for a mode propagating at a given frequency. In order to extract mode-related information from a time-domain signal affected by a dispersive propagation, numerous approaches have been proposed but the group velocity must be known with precision. In order to evaluate the group velocity for dispersive frequency ranges, broadband excitation patterns must be used. This works presents a cost-effective approach to estimate the group velocity from simple measurements in a given frequency range. The principle is to generate a set of properly patterned impulse signals using a piezoce-ramic (PZT) and to sense the response after propagation using either a Laser Doppler Vibrometer (LDV) or another PZT. While broadband excitation using a single impulse excitation might lead to limited wave amplitude, the originality of the present approach is to use N input signals with different central angular frequencies in order to reconstruct an impulse response. The parameters of the N input signals are optimized such that the addition of all signals has a broadband frequency content in order to increase the Signal to Noise Ratio (SNR). The experimental setup consists of an thin aluminum plate instrumented with one PZT actuator and a LDV to measure the out-of-plane displacement. The influence of the number of signals N used for the reconstruction of the impulse response and the actuator / sensor distance are investigated experimentally for frequencies below 1.5 MHz. It is shown that an increase of SNR in the impulse response measurement can be obtained for the LDV sensor and thus a better agreement between theoretical and experimental predictions of group velocity can be observed even for dispersive or multimodal propagation.

INTRODUCTION

Most of the damage detection and localization approaches currently used in Structural Health Monitoring (SHM) are based on the measurement of ToF and the knowledge of the group velocity for one mode propagating at a given frequency. More recently, multimodal approaches have been proposed, based on multimodal imaging of dispersed signals [1,2] or broadband generation of signals using chirp excitations [3]. The advantage of those multimodal and broadband imaging techniques resides in their

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Ключевые слова:

Содержание.