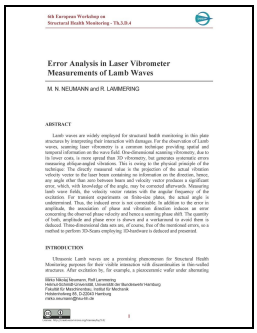

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Error Analysis in Laser Vibrometer Measurements of Lamb Waves

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Lamb waves are widely employed for structural health monitoring in thin plate structures by interpreting their interaction with damages. For the observation of Lamb waves, scanning laser vibrometry is a common technique providing spatial and temporal information on the wave field. One-dimensional scanning vibrometry, due to its lower costs, is more spread than 3D vibrometry, but generates systematic errors measuring oblique-angled vibrations. This is owing to the physical principle of the technique: The directly measured value is the projection of the actual vibration velocity vector to the laser beam containing no information on the direction, hence, any angle other than zero between beam and velocity vector produces a significant error, which, with knowledge of the angle, may be corrected afterwards. Measuring lamb wave fields, the velocity vector rotates with the angular frequency of the excitation. For transient experiments on finite-size plates, the actual angle is undetermined. Thus, the induced error is not correctable. In addition to the error in amplitude, the association of phase and vibration direction induces an error concerning the observed phase velocity and hence a seeming phase shift. The quantity of both, amplitude and phase error is shown and a workaround to avoid them is deduced. Three-dimensional data sets are, of course, free of the mentioned errors, so a method to perform 3D-Scans employing 1D-hardware is deduced and presented.

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Ключевые слова:

Содержание