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Assessment of Reflective Tapes on the Accuracy of Displacement Measurement in Laser Doppler-vibrometry

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Laser Doppler Vibrometry, LDV, is known to be a useful tool for measuring vibration and wave propagation for Non-destructive testing (NDT). Although LDV systems have many advantages, most notably they provide non-contact measurements, they often require surface enhancement [1, 2]. In order to improve the signal-to-noise ratio, reflective tapes are commonly used as a surface enhancement method in LDV applications. While accurate for low frequencies, measured displacements are not reliable once the frequency exceeds a threshold value. In this study, different tapes are mounted on the surface of an aluminum block, and out-of-plane displacements are recorded for frequencies from 0.5 to 5 MHz. Furthermore, dynamic finite element modeling was conducted, where the effect of reflective tapes on measured displacements on the surface of the tape is evaluated. Results of the finite element simulations reveal that the effective stiffness of the tape can contribute significantly to error in data acquisition during experiments. Figure 1 shows the harmonic analysis of tape under longitudinal and shear wave excitation. As evident in the figure, discrepancy between the measured displacements from the top and the bottom of the tape is considerably large at some frequencies. Moreover, finite element wave propagation simulation has been done in order to get better understanding of experimental studies.

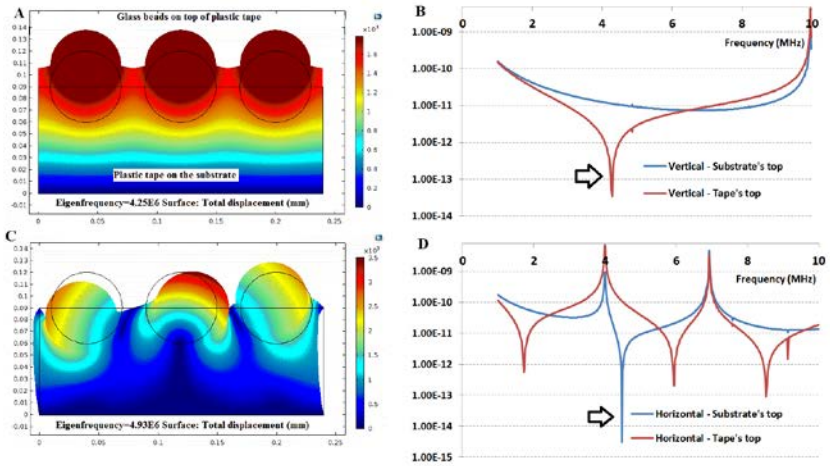

Figure 1. Modal and Harmonic analyses of retroreflective tape, with glass beads, on a rigid substrate. (A, B) One mode shape and also harmonic response of the tape to vertical excitation of substrate, (C, D) One mode shape and harmonic response of the tape to horizontal excitation of substrate.

References:

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2. P. Norman, C. Davis, C. Rosalie, and N. Rajic, "Interaction of high frequency Lamb waves with surface-mount sensor adhesives", *Key Engineering Materials*, **558**, 489-500 (2013)