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Modal Analysis of a Cantilever Beam Using an Inexpensive Smartphone Camera: Motion Magnification Technique

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Abstract : This paper aims to prove the accuracy of an inexpensive smartphone camera as a non-contact vibration sensor to recover the vibration modes of a vibrating structure such as a cantilever beam. A video of a vibrating beam is filmed using a smartphone camera and then processed by the motion magnification technique. Based on this method, the first two natural frequencies and their associated mode shapes are estimated experimentally and compared to the analytical ones. Results show a relative error of less than 4% between the experimental and analytical approaches for the first two natural frequencies of the beam. Also, for the first two-mode shapes, a Modal Assurance Criterion (MAC) value of above 0.9 between the two approaches is obtained. This slight error between the different techniques ensures the viability of a cheap smartphone camera as a non-contact vibration sensor, particularly for structures vibrating at relatively low natural frequencies.

Keywords : modal analysis, motion magnification, smartphone camera, structural vibration, vibration modes
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