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Robust vision-based displacement measurement and acceleration estimation using Kalman filter

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ABSTRACT

Structural response measurement is essential for structural health monitoring, but installation of sensors on a structure is costly and labor-intensive such that the large number and location of sensor deployment is limited. The vision-based measurement system has been recognized as good alternative because the system can measure structural responses in a non-contact manner without direct sensor installation. This paper proposes a non-contact structural displacement measurement and acceleration estimation using Kalman filter. The proposed method measures displacement using tunable structured light that is integrated with a camera. The integrated system has capable of obtaining the relative position to the structure and calculating a scale factor to measure structural displacement. The Kalman filter is adapted to estimate the structural acceleration response from the structural displacement. To validate the proposed displacement measurement and acceleration estimation methods, numerical simulation and lab scale experiment on a shaking table are conducted and the accuracy of the proposed method is compared with that of a reference laser doppler vibrometer and accelerometer, respectively.

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