Uncertainty Analysis for Large Structure Deformation Measurement System Based on Machine Vision.

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Abstract

The three-dimensional (3D) optical measurement technologies based on machine vision or close-range photogrammetry, which have the advantages of non-contact, high-accuracy, and simultaneous measurement of multiple points, are widely employed in large structure deformation inspection, such as wind blade deformation measurement, bridge deformation monitoring etc. Whereas the measurement uncertainty of those optical systems are usually difficult to determine since many factors may affect the measurement processing. Therefore, the measurement uncertainty of a typical machine vision system is analysised in detail based on the uncertainty propagation theory. First, all the influential factors, such as the geometric structure of the optical system, the perspective projection model, the resolution of the cameras, distortions of lens, noise of images, detection errors of artificial targets, the accuracy of reference bar, ambient light, and ambient temperature etc., are analyzed quantitatively, and their uncertainty are calculated. Then the function of measurement error is derived from the 3D coordinates reconstruction formula based on the uncertainty propagation theory. Thus, the influence of each factor can be estimated directly after the optical system is calibrated, and the measurement uncertainty of each 3D point in space can be calculated. Finally, a typical two camera system is built to test the effective of the proposed uncertainty analylsis method, and the experimental results demonstrate its validity.

Keywords: Uncertainty analysis, large structure deformation, optical measurement