

Application of a Universal Distortion Correction Method in Stereo-Based Digital Image Correlation Measurement

Authors : Hu Zhenxing, Gao Jianxin

Abstract : Stereo-based digital image correlation (also referred to as three-dimensional (3D) digital image correlation (DIC)) is a technique for both 3D shape and surface deformation measurement of a component, which has found increasing applications in academia and industries. The accuracy of the reconstructed coordinate depends on many factors such as configuration of the setup, stereo-matching, distortion, etc. Most of these factors have been investigated in literature. For instance, the configuration of a binocular vision system determines the systematic errors. The stereo-matching errors depend on the speckle quality and the matching algorithm, which can only be controlled in a limited range. And the distortion is non-linear particularly in a complex imaging acquisition system. Thus, the distortion correction should be carefully considered. Moreover, the distortion function is difficult to formulate in a complex imaging acquisition system using conventional models in such cases where microscopes and other complex lenses are involved. The errors of the distortion correction will propagate to the reconstructed 3D coordinates. To address the problem, an accurate mapping method based on 2D B-spline functions is proposed in this study. The mapping functions are used to convert the distorted coordinates into an ideal plane without distortions. This approach is suitable for any image acquisition distortion models. It is used as a prior process to convert the distorted coordinate to an ideal position, which enables the camera to conform to the pin-hole model. A procedure of this approach is presented for stereo-based DIC. Using 3D speckle image generation, numerical simulations were carried out to compare the accuracy of both the conventional method and the proposed approach.

Keywords : distortion, stereo-based digital image correlation, b-spline, 3D, 2D

Conference Title : ICEMA 2015 : International Conference on Experimental Mechanics and Applications

Conference Location : Paris, France

Conference Dates : May 18-19, 2015