Vision-based Measurement for Civil Engineering Structures

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Abstract

In recent years, digital cameras have experienced a remarkable evolution which provides these cameras with higher pixel resolution, faster processing and recording speed and lower cost. This digital revolution has made possible the development of novel techniques that mimic the vision perception for various applications in many disciplines. Vision can be described as proceeding from a two-dimensional visual array to a three-dimensional description of the world as output. Vision typically consists of three stages: (1) a primal sketch of the scene based on feature extraction of fundamental components of the scene including edges, regions, etc.; (2) a 2.5D sketch of the scene where textures are acknowledged; and (3) a 3D model where the scene is visualized in a continuous, 3-dimensional map. One important element of vision is the depth perception which arises from a variety of depth cues. These are typically classified into binocular cues that require input from both eyes and monocular cues that require the input from just one eye. Binocular cues include stereopsis, yielding depth from binocular vision through exploitation of parallax. Monocular cues include size: distant objects subtend smaller visual angles than near objects. In civil engineering, some vision-based techniques focused on the static and dynamic measurement of structures under various conditions have also been developed. These techniques include: (1) binocular technique for 3D deformation measurement for structures with point targets; (2) binocular technique for 2D spatiotemporal deformation measurement for structures without targets; and (3) monocular technique for 2D deformation measurement for structures with planar targets. Results show that these vision-based techniques can provide direct 3D displacement and rotation measurement with sufficient accuracy for further analysis and assessment of the target structures.

Bibliography

Dr. Chang obtained his B.S. degree from the Department of Civil Engineering, National Taiwan University in 1984. He then obtained his M.S. degree and Ph.D. from the School of Aeronautics and Astronautics, Purdue University in 1989 and 1993, respectively. He joined the Hong Kong University of Science and Technology in 1993. He is currently the associate director of the Smart and Sustainable Infrastructure Research Center. His research interests include smart structures, structural safety, health monitoring and damage assessment, dynamic measurement, signal and image processing, and vibration control of large-scale structures under wind/earthquake loads. He has participated in various projects such as the ambient vibration of the Kap Shui Mun cable-stayed bridge and the vibration investigation of the hall floors of the Hong Kong Convention and Exhibition Centre. He is a member of ASCE and HKIE.