Towards Full-Field Sensing Of 3D Deformation In Structural Components Using Muti-Camera Photogrammetry

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In the realms of structural mechanics and experimental mechanics, researchers and engineers want to achieve measure structural responses (e.g., displacement and deformation) with high precision. However, conventional displacement sensors, such as Linear Variable Differential Transformer (LVDT), have been widely used to pointwise measure local displacement with physical contact. In order to measure displacement in a full-field fashion, another method should be developed. Therefore, in this study, a key-point point detection method using fiducial markers is proposed using the multi-camera system is proposed to achieve full-field displacement measurement without physically disturbing the specimen. In order to reduce the error in quantification of overall displacement and deformed profile of structural components (e.g., beams and columns), a detection and projection algorithm has been developed to achieve more accurate measurement. Recently, some computer vision-based applications are observed used to determine damages in civil structures. While this study demonstrates the use of a multi-camera system to quantify the deformation and bending profile in structural elements. Visual fiducial marker (e.g., AprilTag) and other visual patterns (e.g., artificial speckles) are attached to the surface of the specimen before loading. With load applied on the beam, the behavior of the specimen is recorded by multiple high-resolution digital cameras with different perspectives. Theoretical studies on the proposed method have been carried out together with the experimental evaluations. Primary results show the potential of the proposed method in obtaining robust measurements.