

ON THE USE OF A RENDERING MODEL IN STEREO FINITE-ELEMENT DIGITAL IMAGE CORRELATION

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Increasing interest is being shown in Stereo Finite-Element Digital Image Correlation in the experimental solid mechanics community. This contact-free measurement method allows to retrieve a three-dimensional surface displacement field, during structural tests for instance. Prior to these displacement measurements, a calibration phase is required. First, the stereo rig position and optical systems parameters are identified. Then, the position of the rig with respect to the specimen (collected into vector \underline{p}_{ext}) and the specimen shape (correction shape field denoted $\underline{S}(\underline{X})$) have to be determined. Usually, this last step is performed via the minimisation of a functional based on the sum of the squared grey level difference (a) over all camera pairs integrated over the surface [3] or (b) alternatively between all camera to one average grey level map [2]. Then the displacement measurement is performed via the minimisation of another functional based on the sum of the squared grey level difference of a reference image and a deformed image of each camera.

In the novel framework that we propose, we investigate the possibility to reconstruct the shape of the specimen as well as its intrinsic texture, a scalar field $T(\underline{X})$, in a first step. A rendering model $R_c(\underline{X}, T(\underline{X}))$ [1] is used drawing inspiration from advancements in the computer vision community. It predicts the grey level observed by a camera c depending on its orientation with respect to the surface, the lighting conditions and T . In this manner, the same functional can be used in the extrinsic and shape calibration problem as well as in the displacement one:

$$F(\underline{p}_{ext}, T, \underline{S}) = \sum_c \int_{\Omega} V'_c(\underline{X}) [R_c(\underline{X}, T(\underline{X})) - f_c \circ P_c(\underline{X} + \underline{S}(\underline{X}))]^2 dX \quad (1)$$

where V'_c denotes a weighting function. In this case, \underline{S} and \underline{U} can be used indifferently depending only on the measurement we want to perform (shape or displacement). Shape and texture errors appear to be of the same order of magnitude as the camera calibration error and camera noise level respectively. Such a new and breaking framework opens the door for large displacement measurements for instance.

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