

Mesh based digital image correlation method using 8-node isoparametric element

Zhao Zilong, Ma Shaopeng, Wang Xian

Summary

As one of the most important photomechanics experimental methods, digital image correlation (DIC) has been widely used in various areas for displacement and deformation field measurement. The main idea of DIC is to resolve the displacement of speckle patterns by independently matching the corresponding patterns on reference and deformed speckle images. In order to add the continuity between the matching of the adjacent patterns, the mesh based DIC (abbreviated mesh-DIC hereafter), in which the whole image are matched, is proposed by Sun, et al. In mesh-DIC, the whole displacement field is characterized by a mesh which is constructed by 4-node quadrilaterals element. This kind of method could be named as Q4-mesh-DIC. Q4-element is formed by 4 straight lines and takes one-order (linear) interpolation accuracy. Therefore, the Q4-mesh-DIC could not be used to directly measure the specimen with a curve edge, and will reduce low accuracy results when using in deformation field measurement of heavy heterogeneity.

In this paper, the higher order element, i.e., the 8-node isoparametric quadrilateral element is used in mesh-DIC, and then the Q8-mesh-DIC is constructed. The solving model for the method is derived and the program is realized. Several experiments which using the computer simulated speckle images are completed to verify the effectiveness and the superiority of the Q8-mesh-DIC. Comparing with the Q4-mesh-DIC, Q8-mesh-DIC takes several advantages, which includes, 1) smaller errors on displacement measurement, especially on the situation of complicated deformation field, 2) less computational consumption on iteration because that 4 Q4-element could be replaced by 1 Q8-element, such that the number of unknown variables are decreased, and 3) the ability on deformation measurement of the specimen with a curve shaped edge.

Keywords: Digital image correlation, mesh, 8-node-isoparametric element

