A comparison of the optical and strain gauge methods for evaluating tensile test

Rastislav Ďuriš and Zuzana Červeňanská

Slovak university of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava, J. Bottu 25, Trnava, 917 24, Slovakia

In the experimental measurement of essential material properties, various contact and contactless techniques can be used to evaluate surface deformations and strains. Direct measurement techniques are mainly based on the strain gauge method. The most popular contactless methods include Moiré interferometry, holography, speckle interferometry, and nowadays the Digital Image Correlation (DIC), too [1]. Some of these methods have stringent requirements on the measurement equipment, setup procedure, or coherent light source, which make these methods more difficult to use and increase the cost of laboratory instrumentation. In recent years, more robust and effective computational correlation algorithms have been developed to track test specimen material points and estimate the whole displacement and strain fields. From this reason, the relatively simple and less expensive optical DIC method has been extensively used for displacement and strain field estimation in material characterization. The adaptability of the DIC technique in image capture technology is obtained by standard cameras to estimate the displacement and strain data from the tracking of the material points [2]. The paper focuses on the determination of deformations using the open source MATLAB based 2D DIC software Ncorr [3] as the static tensile test evaluation. Tensile tests on flat rectangular specimens were stressed, and the corresponding displacement and strain fields were estimated using Ncorr. The influence of selected parameters of the correlation algorithm on the settings of the Ncorr program on the estimation of the deformation was assessed. The results of uniaxial strains obtained by the optical method were verified by experimental measurements using an installed strain gauge and reference extensometer. The good agreement between the results attained by the evaluation of experiments using optical and standard strain gage methods was found.

This work was supported by the Slovak Cultural and Educational Grant Agency KEGA within the project No. 009STU-4/2021and by the Scientific Grant Agency of the Slovak Republic VEGA under the grant No. 1/0796/20.

[1] Lamberti, L. et al. (2018) Advancement of Optical Methods & Digital Image Correlation in Experimental Mechanics, Volume 3, Proc. of the 2018 Annual Conference on Experimental and Applied Mechanics, Springer, ISBN 978-3-319-97480-4.

[2] Eberl, C. (2010) Digital image correlation and tracking. http://www.mathworks.com /matlabcentral/fileexc digital-imagecorrelation-and-tracking

[3] Blaber, J., Adair B., Antoniou, A.(2015) Ncorr: Open-Source 2D Digital Image Correlation Matlab Software, Experimental Mechanics 55:1105–1122.