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DISPLACEMENT AND STRAIN FULL-FIELD MEASUREMENT AT OPEN HOLE COMPOSITE SPECIMEN USING THE DIGITAL IMAGE CORRELATION TECHNIQUE

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ABSTRACT

This work presents the analysis of the displacement and strain fields at open hole carbon epoxy composite specimen using the optical of Digital Image Correlation (DIC). An uniaxial tensile test with Hexcel IM7/8552 composite specimen that was previous drilled and created a random intensity pattern on its surface. During the test was captured a sequence of images using an equipment of commercial DIC system, the Aramis®. The results were subsequently analyzed and was verified the possibility of damage detection using this technique.

Keywords: digital image correlation, composites, full-field techniques, damage detection.

INTRODUCTION

The increase in energy prices has led to the development of new materials which the weight is a preponderant factor, mainly in the transports industry, where there is demanded for a superior performance to the structural elements. These elements are subject to high stresses and work near to the limit of the material strength, with high safety requirements. The new generation of composites materials can provide the mechanical properties required by the most demanding industries. However, the behavior of these new materials with stresses concentration is not totally known and, thereby, must be analyzed using experimental techniques (Launay, 2008) and numerical tools (Alfano, 2001).

The aim of this work is to present the advantages of using the Digital Image Correlation in the measurement of full-filed displacements and strain fields in composite plates with concentration stresses. The evaluation of experimental measurements is performed by comparing the results with the numerical simulation.

RESULTS AND CONCLUSIONS

The Fig. 1 shows the curve of remote stress in time obtained from tensile test. During the test, a camera of Digital Image Correlation system has captured the sequence of images, with a rate 40/100, which were used to compute the full displacements and strain fields. In Fig. 2 is represented the displacement and strain fields in the y direction for the t=90s. For this instant it is possible to observe that the maximum displacement value is 3.88 mm and the maximum strain value is 1.46 [mm/mm].

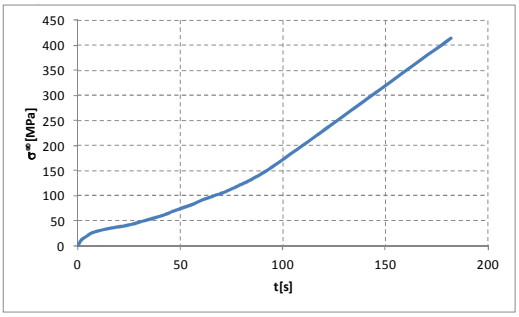
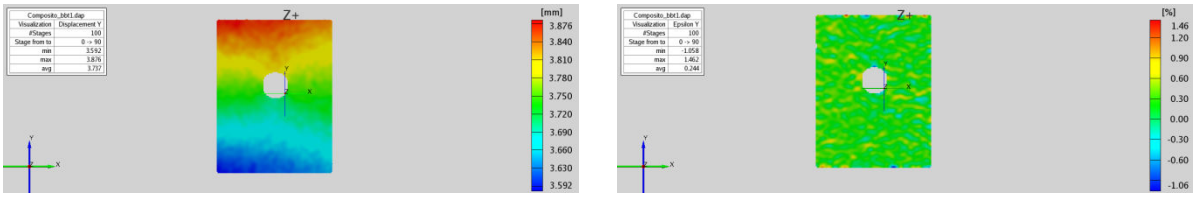


Fig. 1 - Remote stress versus time.



(a) (b)

Fig. 2 - Displacement (a) and strain (b) fields for the 90th second in y direction.

The comparative analysis shows that there is a good agreement between the measure displacements field and the numerical simulation at the hole edge. The experimental results show that Digital Image Correlation is a suitable full-field experimental technique for the measurement of the displacement field in composite materials, especially for large deformations. However, presents low sensitivity for the measurement of strain field, as result, shows a low signal-to-noise ratio, making difficult the analysis of strain field, even at the edge of the hole.

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