NON-LINEAR DYNAMIC SIMULATION AND EXPERIMENTAL VALIDATION OF SANDWICH STRUCTURES

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Abstract. Innovative designs of transport vehicles need to be validated in order to demonstrate reliability and provide confidence. The most common design approach of such structures involve simulations based on Finite Element (FE) analysis, which require reliable validation techniques, especially if anisotropic materials, such as fibre reinforced polymers, or complex designs, such as sandwich panels are to be considered. The present paper aims to integrate sophisticated numerical analysis with full-field optical measurement system data in order to improve the quality of both methods and increase reliability of the design.

Keywords full field strain; composite material ; optical system; simulation; stress analysis.

1. Introduction

During the design – analysis of products, it is the normal practice to assess the accuracy of numerical results by comparing the numerically predicted values to corresponding experimental data. However, current practice tends to focus on identifying hot-spots in the data and checking that the experimental and modeling results agree in these critical zones, while often the comparison is restricted to a single point where the maximum stress occurs. This highly localized approach neglects the majority of the data generated by full-field optical techniques and carries with it the risk that critical regions may be missed all together. To overcome this drawback, the use of whole field optical techniques, e.g. [Rastogi and Inaudi, 2000; Shchepinov *et al*. 1996], provides a number of significant advances which are emerging from the innovation process. In optical deformation measurement, these advances include digital image correlation and fringe projection techniques. Deformation, strain, or vibration modes due to defined loads are often measured by digital image correlation methods (DIC), e.g. [Siebert *et al*. 2009] or fringe techniques, such as moiré, holographic and digital speckle pattern interferometry (DSPI) or shearography, e.g. [Kästle *et al*. 1999]. The strength of full-field optical techniques is that the whole displacement field can be visualized and analyzed. By using High Speed cameras, the DIC method can easily be applied to high dynamic events and delivers quantitative information on three-dimensional (3D) displacement.