

Integration of DIC into multi-measurement system to optimise full-scale wing testing

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Abstract. Digital image correlation (DIC) is typically perceived as a stand-alone technique used to capture the deformation of components. DIC data is often post-processed in isolation and subsequently compared to stress analysis predictions, frequently only qualitatively. However, DIC hardware has been capable of synchronisation with control systems and integration with other software for some time. The Smarter Testing project is exploiting these features and is challenging current DIC system capabilities. The aim is to integrate several DIC systems, along with other measurement techniques including photogrammetry and frequency scanning interferometry, to achieve a multi-measurement system on a full-scale wing test.

Introduction

The Smarter Testing project aims to develop a novel testing and certification process for aeronautical structures through the use of an optimised test campaign that will combine virtual and physical tests. A variety of measurement techniques are required to optimise data capture from physical tests. The choice of measurement technique depends on the quantity of interest, component geometry and load profile. DIC is just one of the techniques being implemented within Smarter Testing. A key project aim is to validate simulation and increase credibility of simulation results ultimately to replace expensive physical testing. Furthermore, integration of the DIC results with those from other measurement techniques into a common environment is a key project outcome to enable efficient and informed decision making.

In preparation for a full-scale 17 meter static wing test, a suite of measurement techniques are being simultaneously deployed on a 5 meter scaled wing demonstrator at the Aerospace Integrated Research & Test Centre (AIRTeC) at Airbus in Filton. The demonstrator is being used to overcome challenges including line of sight, large specimen displacement (up to 5 meter expected deflection), access around the wing and to avoid physical or optical clashes between the different measurement techniques. Furthermore, use of a common reference system and common time stamping is being tested.

Method

Two DIC systems have been mounted above the speckled demonstrator on truss structures at the optimised stand-off distance. Point markers were positioned around the demonstrator such that they were visible by both DIC systems for multi-system post-processing. The DIC systems captured synchronised images during loading trials, using a trigger signal from the first DIC system received by the second. In addition, the first DIC system was synchronised with the control system using analog voltage signals. The initial trials have demonstrated how to overcome some challenges with the proposed DIC setup for the full-scale wing test.

Figure 1 shows the field of view from each system. An optimal stitch position of the two surface components was calculated by analysing the intersection deviation from zero-load images. This stitch location can be seen in Figure 2 along with out-of-plane displacement of the upper surface of the dummy demonstrator. The combined surface components are analysed as one surface region and any analysis, alignments or other processes are simultaneously applied to the whole surface region.

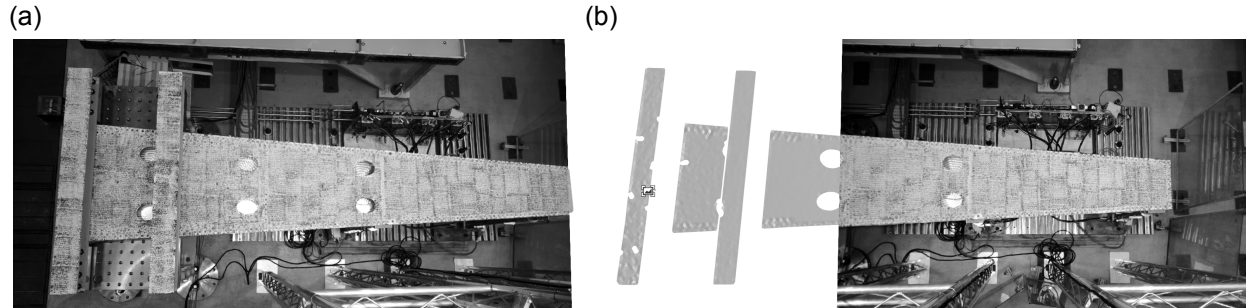


Figure 1: Camera views from (a) System 1 and (b) System 2 illustrating the extent of the demonstrator wing that lies within each field of view.

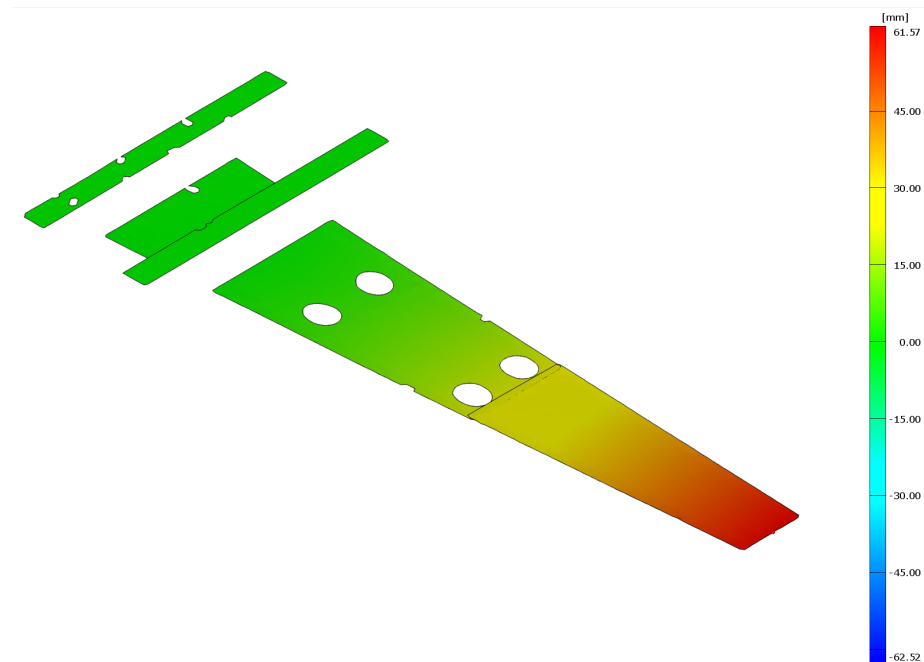


Figure 2: Surface component of entire demonstrator wing.

Future Work

The next steps are to continue to use the demonstrator wing to address the remaining challenges detailed above in preparation for the full-scale wing test. For example, more DIC systems with different measuring volumes will be deployed and synchronised. Integration of multiple volumes into a multi-system setup will allow DIC to be tailored to improve resolution in key regions whilst maintaining a common environment for results. Moving camera systems will be investigated as a potential method for overcoming large specimen deflection. Additionally, a live data stream will be extracted from the DIC data to support live decision making. These steps will enable end-to-end flow of data from simulation, test and results analysis for simulation validation.

Acknowledgements

This work was carried out as part of the Smarter Testing project (Innovate UK, Contract: D20016286).