

# **Advanced Measurement Technologies for Smarter Testing: Developing a multi-system setup for large scale testing**

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## **Abstract**

To align with future ambitions for new aircraft programmes, there is a need to develop novel testing and certification processes for airframe structures. This will be done through the use of optimized test campaigns combining both physical and virtual testing. The work outlined here aims to provide further maturation and integration of Digital Image Correlation (DIC) with other advanced measurement technologies to achieve live data fusion and enable condition-led inspection, test protection and FE validation capabilities for industrial large scale tests.

## **Introduction**

Smarter Testing is an Aerospace Technology Institute (ATI) funded project led by Airbus aiming to develop a novel end-to-end digital testing process to support the reduction of the Product Development Plan. In addition it aims to promote Virtual Testing as a validated certification means of compliance to reduce the amount of physical tests with the main focus to support the elimination of the major full scale static physical test. It is broken down into five work packages: Data Driven Platform, Advanced Measurement techniques, Advanced Data Correlation, Advanced Data Analytics and Test Optimization.

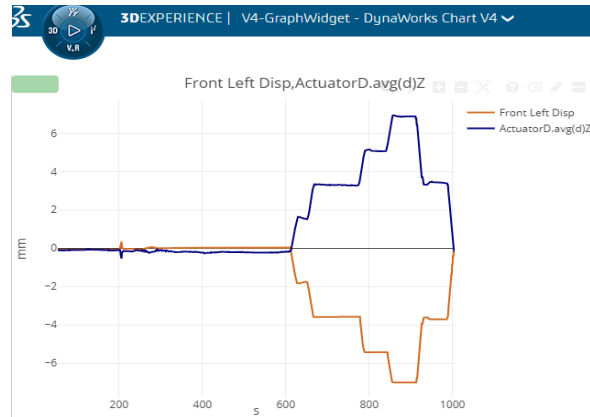
Physical tests are required to prove credibility and establish confidence of simulation methods and models. Digital Image correlation plays a significant role in enabling this, specifically through developing an integrated multi-system setup to optimize large scale testing, establish global referencing networks, improve live monitoring capabilities and advance uncertainty quantification of the technique to reduce the propagation of errors.

This work is to be deployed on a full scale 17 meter static wing test which will be conducted at the Aerospace Integrated Research and Test Centre (AIRTeC) in Airbus, Filton. For this test many measurement technologies will be deployed and integrated to provide a suite of data used for FE validation purposes. DIC will be deployed on the entire top surface to analyze full field displacement values and help identify and quantify crucial behavior. DIC of this scale is challenging and plays a significant role in achieving the Smarter Testing ambitions. Due to the scale of this test, physical constraints for the measurement systems need to be taken into account. Some specific issues include: Line of sight for optical measurements, large displacements from test specimens (sometimes ranging up to 4m) thus require moving systems, resolution, and access to the specimen and surrounding area when installing sensor heads, cameras, targets and coating / patterns. From an application perspective, further considerations need to be made to ensure DIC speckles applied do not obstruct or interfere with non-destructive testing (NDT), or other measurement techniques.

## **Method**

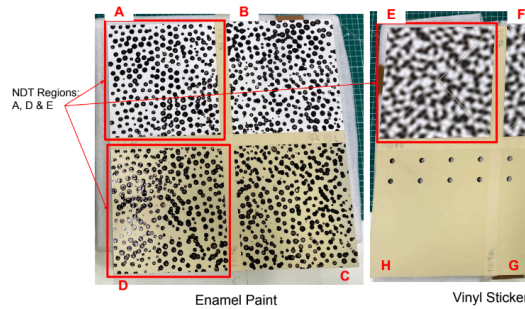
To aid in addressing some of these challenges a dummy demonstrator wing measuring 5m in length was constructed and is available for use in AIRTeC. Two DIC systems deployed above the speckled wing replicate a setup for large scale DIC coverage. They are mounted on truss structures at an optimized stand-off distance taking into account displacement values as the wing undergoes loading by four actuators placed underneath the specimen. Point markers are positioned along the front and rear spar of the wing and used to ensure visibility to both cameras for multi-system post processing. These point markers are also used to construct a photogrammetric network in the area. Images are captured using a synchronized trigger from one system and is linked to the control system using analog voltage signals. Using the intersection deviation from zero-loaded images an optimized stitch location can be

determined for images from both camera systems to ease interpretation of results. Data can be streamed live through the HBK controller and visualized within a 3Dx platform. Figure 1 shows the results plotted during a live test from DIC displacement and an LVDT.



**Figure 1:** DIC displacement vs LVDT during live test

This live streaming of data will enable key decision making to be conducted during the test. The goal is to expand this further for larger scale testing and thus help with reducing test shutdown time through terms coined - ‘condition led inspection / test protection’. This essentially means through live analysis key areas of interest can be identified and monitored while the test is running- only to shut it down if/when a critical point or threshold is reached. Many speckling trials as seen in Fig 2 were also conducted on dummy specimens to determine the optimal application method for the large scale test.



**Figure 2:** Example Speckling Trials Conducted

### Future Work

As we look to scale up this work for the 17m wing, physical constraints of the system and environment become very important. Multiple DIC camera systems will be deployed above the wing at calculated positions to optimize the setup with expected displacements. These will be attached to a large gantry / beam stretching the entirety of the wing. A moving camera system is in the process of being developed to address the significant displacements expected at the tip.

### Acknowledgements

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