Modal Testing of *In Situ* BAE T1A Hawk Wing: Benchmark Dataset

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Abstract. In the generation of digital twins for existing systems, a BAE T1A Hawk aircraft for this benchmark dataset, required reverse engineering through modelling and experimental testing. This work presents a dataset for the starboard wing that contains vibration test data including multiple repetitions (to test repeatability), excitation types, amplitudes, and configurations (to simulate damage). The dataset is freely available for other researchers to test novel damage detection algorithms, model updating, non-linearity measurements, and other various techniques that can increase the accuracy and usability of a digital twin for managing this and other similar types of systems.

Introduction

Digital twins (DTs) are radically reshaping many aspects of modern engineering systems. One of the major objectives of a DT is the pairing between the virtual and physical systems. For many ageing systems, as is commonplace in aerospace systems, there is a major lack of information regarding the physical asset. Because of this deficiency, the ability to create a DT for such a system requires reverse engineering through data measurements and modelling. However, the actual design did not utilise modern technology such as computer aided drafting and finite element analysis. To progress towards a DT of an aircraft of this age, this work focuses on the development of a benchmark dataset for a BAE T1A Hawk fixed-wing aircraft. This work is part of the main objectives of the Alan Turing Institute funded project *Digital Twins for High-Value Engineering Applications* (DTHIVE) [1].

Dataset

The testing performed to generate this dataset is focused around a dense array of accelerometers applied to the starboard wing that is excited using a single modal shaker at approximately 75% of the wing length on the bottom. There are a total of 55 accelerometers attached at selected locations with a total of six lines of sensors down the length of the wing, four on the top and two on the bottom. The remaining sensors are places at points of interest such as the root and landing gear. Figure 1 shows a picture taken during the experimental testing showing the accelerometers that are attached to the top of the wing.

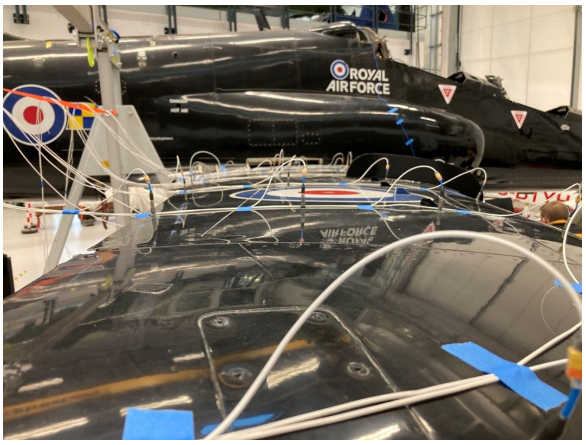

Figure 1: Experimental setup for the vibration testing of the Hawk T1A Wing

There are two main excitation types uses in this data, a burst random and sine swept. These are performed at varied amplitude levels with multiple repetitions at each excitation level to tests for experimental repeatability and non-linearity. In addition to these nominal tests, additional masses were added to the wing at specified location to mimic wing damage (an increase in mass to mimic a decrease in stiffness). The dataset is freely available to use by other researchers and can be obtained through [2].

References

[1] https://www.turing.ac.uk/research/research-projects/digital-twins-high-value-engineering-applications-dthive

[2] Bonney, Matthew; Rogers, Tim; Wagg, David (2022): BAE T1A Hawk Starboard Wing Vibration Tests. The University of Sheffield. Collection. https://doi.org/10.15131/shef.data.c.6269025