What is this data?

The data shown in this project is the experimental testing performed on the starboard wing for the BAE T1A Hawk aircraft that is hosted at the Laboratory for Verification and Validation at the University of Sheffield. Most of the sensors used for this test are accelerometers apart from the excitation force sensor that measures the force. This testing was funded by the Alan Turing Institute project *Digital Twins for High-Value Engineering Systems (DTHIVE)*. Continuation of this testing is being performed by the EPSRC funded project *Digital Twins for Improved Dynamic Design (DigiTwin)*.

What tests were Performed?

The naming convention of the file will identify the excitation type and test suite performed for that excitation type. The possibilities are:

- Burst Random (BR) – This excitation applies a pseudo-random excitation in bursts that allow for transient decay. Using this excitation doesn't require the use of windowing and allows for nonlinearity to be averaged across the multiple bursts.
- Forward Sine Sweep (FSS) or Reverse Sine Sweep (RSS) – This excitation applies a single frequency sine excitation to the system with the frequency varying through time. In the forward sine sweep, the frequency starts low and increases while the reverse sine sweep starts high and decreases. This is one common method of identifying nonlinearity in a system since many sources of nonlinearity are hysteretic. The change in frequency for these tests are done linearly.
- Forward Log Sweep (FLS) or Reverse Log Sweep (RLS) – This excitation is identical to FSS and RSS respectively with one major difference, the change in frequency is done logarithmically instead of linearly.
- Damage Simulation (DS) – While this is not an excitation type, the nomenclature includes this scenario. For these tests, a few locations are selected, and an additional mass is added to the system to simulate a decrease in stiffness. This mimicking can represent local degradation or damage such as crack initiation. The data produced from this scenario can be used for structural health monitoring techniques to identify the location and/or the severity of the damage.

In addition to the excitation type, there are multiple test suites performed with these excitations. This is identified as the second part of the name. The possibilities are:

- Amplitude Ramp (AR) – This suite performs the same testing with varied excitations levels. In general, this excitation is applied in an open loop, thus only the output voltage to the modal shaker is specified. The force gauge attached to the shaker can give physical context to the voltage by showing the force in Newtons.
- Damage Location (TLE, RLE, CTE) – These suites of tests are only for the DS tests and are typically excited using the BR excitation

For each combination of excitation and test suite, multiple repetitions are performed to gauge the experimental variability. There are 10 repetitions for each test suite and was decided at the time of testing to accommodate the specified testing schedule and investigate the testing variability.

The sensor locations are stored in a local coordinate system within the datafile. Figure 1 gives a graphical representation of the nomenclature and locations for the sensors, damage, and shaker connection.

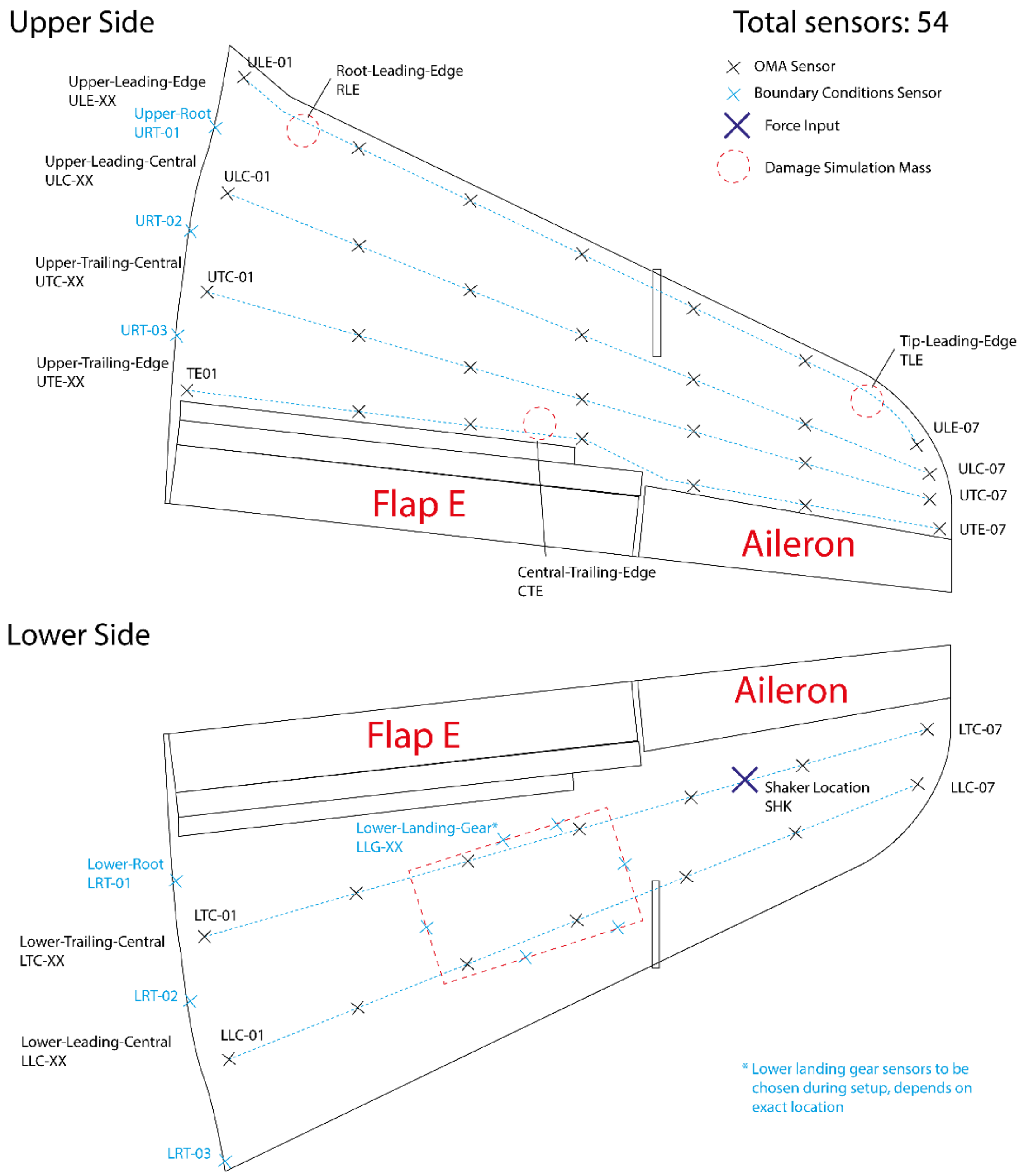

Figure 1: Sensor Layout of testing

How do I access this data?

Inside the associated .zip file are a single file per repetition. These files are stored in HDF5 format, which is an open-source data format that stores the data in binary form. Many common programming languages have methods developed for reading and searching these files for data. To demonstrate this, a python script is included to provide an easy import from HDF5 to a dictionary. This function script can be imported and applied to all the files associated with these tests. For this conversion, if a dataset (the nomenclature used for a data entry) contains metadata, the converter creates a sub-dictionary where the data is stored in the key “value” and the other keys are the metadata. Additionally, for each group (similar to a folder), a sub-dictionary is made to contain the datasets and groups within.

What is contained within the data files?

The file contains two main types of data: testing parameters and sensor data. For the testing parameters, they are stored under the group “Meta” to signify the testing metadata. This is a straightforward dictionary of key/value pairs. For the parameters that have units, they are stored in a dictionary with the value stored under the key “value” and the metadata stored under the key/value pairs.

Sensor data is stored under the sensor name key, see Figure 1. Within this dictionary, both metadata and data are stored. The metadata relates to the calibration information, physical location, and sensor information. The data contains several pieces of information, including:

- time history
- auto power spectrum
- coherence
- dynamic stiffness
- frequency response function
- spectra.

These pieces of data contain “x” and “y” data, where “x” is the time or frequency values, and “y” is the sensor data.

Can I use this data?

ABSOLUTELY. This data is presented for open-source collaborations with a variety of researchers. We only ask for proper citation for this data and the associated paper.

Cite as:

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