Web-based Processing and Automation of Test Data

Industry: Aerospace

The huge amount of data gathered in aerospace structural testing and operational loads monitoring programs can present major challenges to test labs or ground stations. Timely storage, retrieval, and usage of that data often limit the ability to get the right information to the right person, thus causing costly delays or wrong decisions. Collaboration across departments and even on a world-wide basis is now possible with a web-based system from HBM-nCode that stores information about data, enabling meaningful search and automated processing.

Challenge of Engineering Data

Engineering data retrieval can be very costly. Thousands of channels of measured flight or test data can be kept on departmental file stores, but this provides only limited access for the rest of the organization. Test departments can waste a great deal of time just looking for the right data, and the increased use of computer simulations means that a wider group of engineers is requesting measurements to correlate their models.

Additionally, finding the data is often not enough. Further analysis is required to extract useful information from gigabytes of measurements. Because aerospace manufacturers and suppliers are constantly challenged to develop and deliver products along ever decreasing timescales, the need to quickly access the right information and maximize the value of testing has never been greater.

But this need is usually not met by existing IT systems or by using a directory structure on a shared department disk-drive. This kind of storage typically has little or no associated data describing the meaning of the data, which limits the ability to search for it. Thus, even after completing a search, engineers may not be certain that they have actually found the right data. Questions such as "Was this measured before or after the wing spar was reinforced?" or "Has this data been cleaned up to remove the problem spikes?" may not be easily answered.

All too commonly, the location and meaning of the data is really known only by the test engineer who measured it. If he is no longer available, huge amounts of time can be wasted trying to answer these questions. Data measured from expensive prototypes and time-consuming physical tests can rapidly become worthless. In some cases, complete tests may have to be repeated.

Alternatively, there may be an abundance of associated data in the form of spreadsheets, photographs, videos and other electronic documents which provide invaluable information about the test. But if this data is not accessible or searchable, it is of little or no benefit to the rest of the engineering team.

When collaboration is required between departments, companies or across the globe, these problems are compounded. In the aerospace industry, many projects require teamwork between global companies and the exchange of data from U.S.

Measuring thousands of strain channels on F-35 Lightning II Joint Strike Fighter test article

Image courtesy of Lockheed Martin

companies often needs to comply with ITAR export regulations. It is also necessary to restrict access so that even within a single project, some measurements are shared with company A but not with company B and so forth. How do you quickly and securely provide the right data to your partners on the project? If you find a problem in the data, do you have an audit of who has already seen the data so you can let them know about the error? Managing this process manually is incredibly time-consuming and complex.

Often it is not the data itself that is required, but understanding based on the data. This might be, for example, to quantify the variation in a strain measurement over time to detect cracks in a long-term test, or investigate how one aircraft usage compares with another. Data must be summarized, characterized and compared. It is the result of the additional analysis that really makes the data useful. Before performing the analysis, it is also important to identify any problems with the data such as drift or flat-lines that would make the results meaningless.

To perform analysis manually requires huge amounts of data to be found, transferred, and often converted from different formats to be processed in a desktop tool or spreadsheet. At best, this manual process is inefficient and highly error-prone. Rather than developing and retaining corporate knowledge, it often relies on the expertise of key individuals whose methods may vary across an organization. One department may use one method, but another division has its own methods, giving different and conflicting results. These differences make it difficult to learn from data across the corporation or over an extended period of time. Analyses performed on the engineer's desktop are often manually converted into reports and are not easily accessible to others in the organization. If these key individuals leave the organization, the understanding and intellectual property often goes with them.

Solution: nCode Automation

One part of the solution is to enable effective collaboration between the design, analysis, and test departments; another is to use web-based technology to automate data analysis efficiently. nCode Automation from HBM provides a web-based collaborative interface for sharing test data and associated information throughout an organization and/or across the globe. It offers a complete environment for engineering data storage, analysis and reporting. Engineers equipped with only a web browser can access, view and analyze stored data. Data, together with documents, images and spreadsheets can be searched and downloaded. A wide range of engineering data

formats is supported, avoiding the need for separate translation steps and the data is securely managed so that users can access only the information they are allowed to see.

Using Automation, engineers can define over the web the server-side analysis processes to be performed rather than time-consuming data transfers and manual analysis tasks. This also helps standardize analysis processes, which improves the quality and repeatability of results. Automatically generated reports can be directly accessed via the web interface by supervisors and managers, shortening the time to communicate vital project information.

The 5.1 release of nCode Automation includes many new features that provide a higher level of flexibility for engineers needing to interrogate and learn from their test data. It features new extensible solutions to drive teamwork and inform decision making.

A new Characteristic Values capability allows users to tag data

Characteristic Values used in reporting.

with additional information that can be used for searching, trending and reporting. These Characteristic Values can be calculated using analysis routines that can be added by end users. Calculations are very flexible and even allow retrospective analyses to be performed on existing stored data. A new analysis routine can be applied to years of catalogued data, thus maximizing the value of the tests performed. This functionality ensures a 'future-proof' system that can continue to learn from data and evolve as required.

For example, let's say you are responsible for a fleet of 20 aircraft that are collecting data from each flight or mission. By

www.hbm.com/ncode

calculating Characteristic Values on each data set, you could define a trending analysis on strain gauges which indicates whether there has been a sudden, but subtle change in strain response that could indicate a crack. This ability to compare data over periods of time and understand the loading histories for different aircraft can provide extremely valuable input to condition based maintenance initiatives.

This applies some of the same concepts used in business intelligence to engineering data, enabling data to be processed for trends and identifying relationships that can be used to make better decisions. Engineers can create complex queries without having to learn the structure of the underlying database or how to write SQL. Report layouts can combine analysis tasks with database queries to create a rich, graphical summary of information. Reports can even be scheduled to be performed at recurring intervals (e.g., weekly) and users can be notified with an e-mail including a link to the latest report.

Version 5.1 offers a Workgroup edition, a cost effective system for a single group or department. Easily installed, Workgroup provides an immediate off-the-shelf solution to begin managing and learning from measured data. The larger Enterprise edition integrates with Oracle® and IBM WebSphere® products to provide a corporate solution that allows secure global data access via the Internet. Users are able to quickly answer engineering questions and then share their analysis and results with others, spreading knowledge beyond the confines of a single department.

Case Study: Lockheed Martin

Current Automation clients include leading OEMs and suppliers from aerospace and automotive industries worldwide. As an example, Lockheed Martin uses nCode Automation on the F–35 Lightning II Joint Strike Fighter program to manage and share engineering data from full-scale test articles. In addition to testing at the Engineering Structural Test Facility in Fort Worth, other variants of the F–35 are being tested by BAE Systems Structural and Dynamic Test Facility, at Brough in the UK and at the Vought Aircraft facility at Grand Prairie, Texas.

nCode Automation provides a secure system that allows these multiple project partners to both upload new data and access the data they are allowed to see, while also conforming to the required ITAR regulations. Each test article is instrumented with several thousand strain gauges and it is vital that every user of the system can rapidly find the relevant subset of channels of interest out of all this data. Engineers do not need to download a thousand channels of strain data when they only want the 20 for which they are responsible. The ability to search for stored images, reports and documents has also proved to be of immense value. For example, previously, photographs would have had to be manually located in a shared directory structure. Bob Simmons, JSF Structural Test IPT Leader at Lockheed Martin, summarized the advantages: "We are seeing real productivity benefits in the speed with which engineers can find the data they need. nCode Automation is saving us time and improving our ability to share data with our project partners."
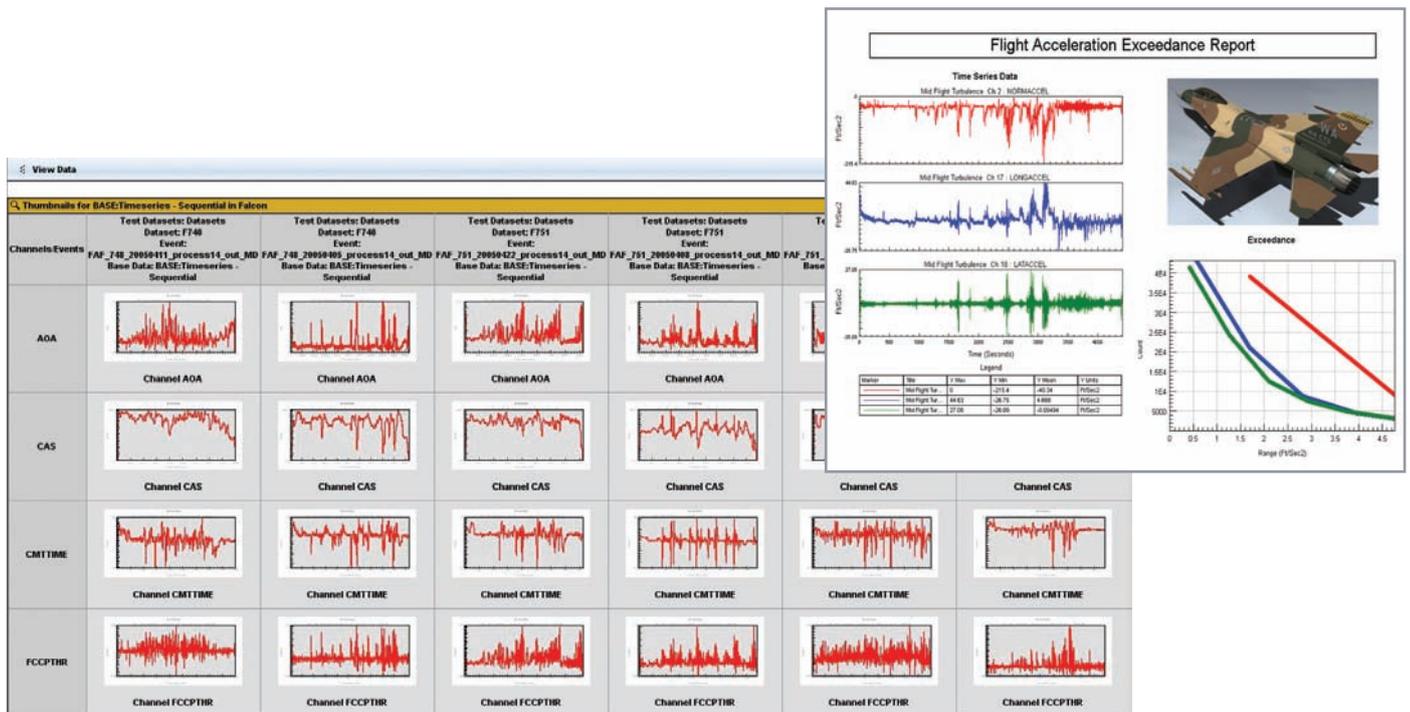
nCode Automation 5.1 enables rapid viewing of data and reports.

www.hbm.com/ncode