

U.S. Air Force and U.S. Navy Accelerate Test Data Analysis by Standardizing on MATLAB®

The United States Department of Defense's (DoD) three major propulsion test centers, Arnold Engineering Development Center (AEDC), the Air Force Flight Test Center (AFFTC), and the Naval Air Systems Command (NAVAIR) Patuxent River site, will save millions of dollars by collaborating on test and evaluation software for the Joint Strike Fighter (JSF) F-35 and other projects.

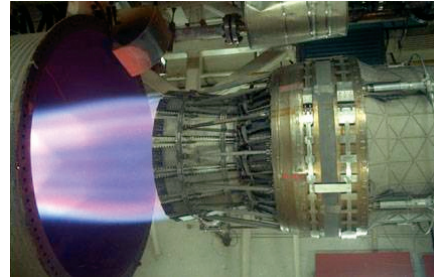
Responsible for ground-based and in-flight evaluation of propulsion systems, these centers are using MATLAB® as their primary platform for data analysis applications that enable close collaboration among the teams.

"MATLAB provides the Navy and Air Force with an affordable, reliable, sustainable, and technologically superior enterprise-wide approach to test data analysis," says Dave Kidman, technical expert, Propulsion Integration Branch of the U.S. Air Force.

THE CHALLENGE

In the past, the test centers used a variety of manual analysis techniques, evaluation criteria, software tools, and programming languages, and each team developed their own test and evaluation tools for each project. These factors contributed to duplicated efforts, low levels of reuse, and slow project ramp up times, and made it impossible to combine results into a single, coherent evaluation.

"We were looking to provide our engineers with enterprise-wide data analysis capabilities as well as a flexible technology base that will enable them to communicate their research among industry, other government labs, and the fleet," says Stephen Cricchi, deputy director, Flight Test Engineering at NAVAIR.



F100-PW-229 engine undergoing altitude testing.

The Air Force and Navy needed a proven set of analysis tools that enabled rapid evaluation of post-flight data to ensure the safety and on-time schedule of test flights.

THE SOLUTION

After an exhaustive review of data analysis software environments and programming languages, the three test centers of the Air Force and Navy standardized on MATLAB for its broad capabilities and widespread adoption in defense organizations and academia.

The test centers have signed a Test Center to Test Center Memorandum of Agreement for developing aero-propulsion post-test data analysis tools based on MathWorks products.

"MathWorks products helped lay the ground work for this memorandum of agreement," explains Jeff Corn, Chief of Engineering Projects Section for the U.S. Air Force. "Now, we meet regularly with propulsion groups from the different test centers to assign projects before developing and reusing our analysis work with MATLAB. This approach helps us greatly reduce development time. We're looking to extend this approach for other types of tests."

The test centers are using MATLAB and related toolboxes to develop post-flight data analysis

THE CHALLENGE

To eliminate inefficiencies in test data analysis caused by disparate tools and redundant development efforts

THE SOLUTION

Standardize on MATLAB to establish a shared platform, facilitating effective collaboration and efficient data analysis

THE RESULTS

- Two-thirds reduction in development time
- Millions of dollars in projected cost savings
- Immediate, shared access to test results

tools that are reused across multiple projects, including the F-15, F-16, and JSF F-35.

A propulsion test effort with the F-16 aircraft and the F-110-GE-100 engine involved evaluating engine thrust response. For this effort, the AFFTC team used MATLAB to develop event-detection logic to determine both normal and abnormal engine responses in test data. MATLAB enabled the engineers to accelerate analysis and improve the consistency of results. The AEDC and NAVAIR are modifying and reusing the AFFTC's analysis work for their own engine thrust analysis testing.

During recent F/A-22 F-119-PW-100 development testing, AFFTC engineers also used MATLAB to calculate inlet recovery and spatial and planar distortion. These tests determine inlet performance and engine-inlet compatibility. The engineers used MATLAB to read data in from hierarchical data format files. They used the Signal Processing Toolbox to remove noise and extract frequencies from time-series data.

They used MATLAB to store the results in a database for review by flight engineers across test centers. MATLAB also enabled them to create contour plots and videos for visualizing the effects of inlet recovery and turbulence. Using the recovery and turbulence measurements, they assessed air vehicle specification compliance and provided input for flight manuals.

"MathWorks products provide the versatility and strength required to develop complex applications without limiting our engineers to one field of research," notes Cricchi.

“ We need to identify the cause of an anomaly in test data to determine if we can fly the next day. We don't have enough time to conduct our analysis with C++. MATLAB helps us get answers immediately because it is quick, easy, and intuitive.”

Jeff Corn, U.S. Air Force

THE RESULTS

- **Two-thirds reduction in development time.** “MATLAB is easier to use and offers many more capabilities than our previous analysis tools,” explains Corn. “With the MATLAB development environment, debugger, profiler, and GUI builder, we can complete development projects in a third of the time.”
- **Millions of dollars in projected cost savings.** “For each test center to independently develop these aero-propulsion analysis tools would cost approximately \$15 million over the next five years—approximately \$1 million per year per test center. With MATLAB as the common analysis platform, software will be developed once, reducing development costs by up to two-thirds,” explains Kidman.
- **Immediate, shared access to test results.** “Because all the test centers use MATLAB, we can see the same results quickly and work in parallel,” says Corn. “I can now replicate test results immediately, whereas it used to take me a day or more with other tools.”

To learn more about Edwards Air Force Base and the AFFTC, visit www.edwards.af.mil

To learn more about Naval Air Systems Command (NAVAIR), visit www.navair.navy.mil

APPLICATION AREAS

- Aerospace and defense
- Algorithm development
- Data analysis
- Signal processing

PRODUCTS USED

- MATLAB
- Signal Processing Toolbox

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