Jet Engine Component Testing

An Arizona-based manufacturer of propulsion jet engines is using HP VEE to reduce the sky-high cost of test.

To verify aerodynamic, mechanical and safety performance of its commercial jet engines under nearly all operating conditions, the company must test engine components separately. Testing must be conducted early in the development process so that hardware changes can be implemented more cost effectively.

Engine parts are assembled in component rigs, which are heavily outfitted with pressure, temperature, vibration, and strain sensors. The rigs are intricate and expensive. The fan component of a turbofan engine, for example, typically requires over 400 pressure sensors and over 200 temperature sensors. To produce the horsepower and RPMs required to test the fan, compressed air and natural gas are mixed and burned at an average energy cost of over $400 per hour. Manpower and overhead add another $600 per hour to a test program that typically takes 250 to 400 hours to complete.

Sensor Function

A major challenge in conducting component tests involves the function of sensors. Pneumatic tubes that connect to the rig can leak or become plugged, thermocouple wires can fail, pneumatic tubes and lead wires can be connected to the wrong sensors, and the data acquisition equipment can malfunction. Sensors must be monitored constantly because a malfunction anywhere along the line can render an entire suite of tests invalid. So the company established a communication link between the data acquisition computer and a workstation running HP VEE. The workstation, which looks like a DecNet node, manages the data link, converts data into appropriate units, and streams data into various HP VEE programs for analysis. The system scans 600 to 900 sensors every one to six seconds.

Data Display

To analyze data, test engineers create tables that associate keywords

with sensor numbers, data channels, spatial locations, or calculated parameters. Analysis must happen in real-time, so a library of HP VEE objects and related keywords was created, allowing engineers to invoke keywords to display data in a tabular or graphical format. Displays can be customized within HP VEE using objects from the library.

Time and Money

With HP VEE, the company has dramatically improved data quality and speed, and has reduced the number of data points that need to be repeated. The improvement in data quality can potentially eliminate a component redesign costing millions of dollars. The ability to detect and correct problems immediately saves an estimated 40 hours of testing on some component rigs. This savings is achieved without increasing development time in other areas since the time required to set up HP VEE programs is equal to the setup time for conventional tabular displays.