Computers in engineering

Gearing up for F-35 assembly

Lockheed Martin Aeronautics (LMA) engineers are automating the previously tedious process of representing the movements humans make carrying out manufacturing tasks. The gains are especially important when viewed in the context of LMA's F-35 Joint Strike Fighter (JSF).

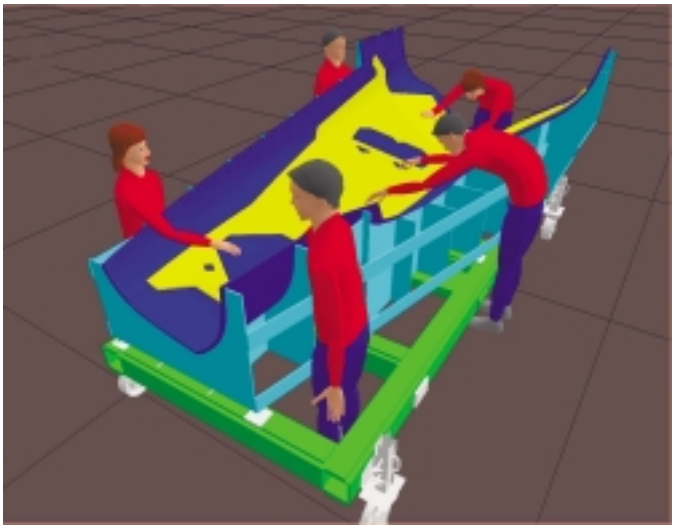
The simulations all use or are built upon ENVISION digital manufacturing software from **DELMIA** Corp. DELMIA is a unit of **Dassault Systemes**, which supplies the CATIA software that is used for virtually all F-35 design tasks.

The digital manufacturing work has been labeled Immersive Ergonomics (IE), and it relies on new display technology in the Visualization/Immersive Display System (VIDS) laboratory. The hemispherical concave displays are several times bigger than a conventional workstation monitor.

"The [monitor] size allows for groups of people, not just two or three at a time, to see crisply displayed simulations as they work through problems," said F-35 Virtual Maintenance Lead Mike Barron. "Gaining comprehension happens much faster and so does achieving consensus on how to solve problems." Barron manages the VIDS lab, and most of his work is funded by and specific to the F-35.

"We are looking for better ways to do repetitive tasks," said Kevin Abshire, Managing Lead for much of LMA's ergonomics work. "We use ENVISION as the enabler." Abshire's work is funded with LMA corporate funds rather than from JSF appropriations.

ENVISION is being used as an enabling technology and as an ergonomics visualization platform. Significant progress in replicating human movement has been achieved by combining digital-motion capture techniques with proprietary software that automatically generates optimal "paths" between the start-point and end-point of any given task. Six ceiling-mounted digital cameras and optical motion-capture software from **Vicon Motion Systems**, Inc., gather the posture information. The path-generating software is being developed at **Sandia National Laboratories** as part of a LMA Shared Vision initiative.



ENVISION Software from DELMIA Corp. is being used at Lockheed Martin Aeronautics to ensure that production workers can comfortably reach all areas of a component such as this forward fuselage section of the F-35.

"Basically, we are still putting human postures and movement into the ENVISION simulations, but we are doing it faster by about a hundred times or two orders of magnitude," said Abshire. "Inside the simulation, the Sandia software finds a path for the mannequin [ERGOman or ERGOwoman in ENVISION] to move through. Each path is collision free, such as [moving] or putting in a component that is being replaced. The Sandia software searches through thousands of possibilities and finds a path within a couple of minutes. The path is usually somewhat random, so it has to be edited and cleaned up, but that is done in a few minutes."

The Sandia software analyzes movements of the joint groups, singly or in combinations, to find or create the most efficient path for a given task. Mannequin paths can be copied to other ENVISION ERGO mannequins, and be edited to represent similar tasks. As work progresses on new simulations, libraries are created of commonly used work paths, hand tools, jigs, fixtures, ladders, protective clothing, carts, worktables, *etc.* The Vicon cameras pick up movements that are grouped by joint: hands, wrists, arms and elbows, shoulders, torso, neck, and head—singly or in combinations. Hands can be locked for a two-handed grasp.

The Vicon system automates the capture of joint movement via 22 "targets," which are reflective white plastic balls on a lightweight jacket, on gloves, and on ordinary clear goggles worn by a test subject. The Vicon output is streamed in real time to the VIDS lab to be read into the ENVISION simulations, where it is integrated with ENVISION using the DELMIA Open Architecture/Virtual Reality functions.

"The interactivity of Vicon and Sandia software with ENVISION, and the ability to drive the ERGO mannequin and CATIA geometry, is very important to making the F-35 program a success," Abshire said. He added that the goal is to be able to digitally create the step-by-step written work instructions that govern every task in a defense plant.

David Alexander

Briefs

Two aerospace companies have recently expanded usage of virtual product development tools from **MSC.Software** through the MSC.MasterKey license system. **Saab Aerostructures** has upgraded from individual software licenses, and German satellite manufacturer **EADS Astrium** has increased its investment. The license system is a renewable token-based model that provides access to all MSC.Software's simulation tools.

MTU Aero Engines has selected Teamcenter, from **UGS PLM Solutions**, as its product lifecycle management (PLM) backbone for global collaboration. The PLM solution will cover management of more than 10 million documents and files accessed by more than 5000 users. A number of legacy systems will be replaced and the remaining applications such as Unigraphics NX, CATIA (from **Dassault Systemes**), and **Microsoft** Office, will be integrated into the new system.

BAE Systems Regional Aircraft has purchased the configuration software Pacelab Cabin from **PACE Aerospace Engineering and Information Technology** GmbH, to optimize the customization of its leasing fleet's interior layouts. Pacelab Cabin streamlines the cabin configuration process with PACE's Knowledge Based Engineering (KBE) technology, to provide validated and customized cabin layout proposals at short notice.

Quantum3D has established a Center of Excellence for Synthetic Environment Development at its Orlando, FL, location. The new center represents a merger of the Facets 3D Model Group with the Synthetic Environment Group. The new organization will focus on development of Quantum3D Facets 3D models and Catalyst SE databases, along with integration of the two products into packages that support both military and commercial flight training activities.

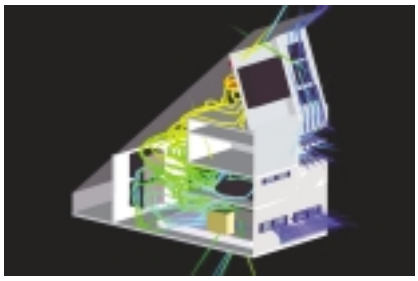
Northrop Grumman Integrated Systems has purchased FiberSIM software and services from **Vistagy**, Inc., for use by the F-35 Center Fuselage Integrated Product Team to optimize composite parts, analyze producibility, and automate manufacturing tasks. FiberSIM 4.1 will be integrated with the CATIA V5 computer-aided design tool from **Dassault Systemes** to design laminates and assess their characteristics, generate 3-D engineering documentation, and verify that complex shapes can be made. Resulting data will be available to personnel in the material department and on the manufacturing floor.

Flomerics certifies design

An early version of an understair video control cabinet (VCC) design from **Thales Avionics** had been used on several of one of its customer's new aircraft. After seeing how the systems had performed on the new aircraft, the airline decided to retrofit the system into four of their existing **Boeing** 747 aircraft. The installation had to work within the boundaries of current cabin conditions, accommodate older interfacing equipment on the existing aircraft, and meet the ventilation requirements specified by the aircraft manufacturer.

The system dissipates approximately 240 W in total and is cooled with forced air provided by an external source. Air is drawn into the VCC through five inlet vents in the front panel of the unit and exhausted through a single outlet plenum in the bottom face.

Using their software product FLO/MCAD, the Thermal Design Services (TDS) engineers from **Flomerics** were able to quickly build an analytical prototype of the system. The electronic geometry, provided by Thales in the form of IGES (Initial Graphics Exchange Specification) files, was imported into Flotherm. The analytical model was used to investigate the overall thermal performance of the system by predicting the overall temperature rise through the chassis, the general airflow patterns, and the partitioning of flow between various intake vents. The analysis showed that the VCC design was able to meet the ventilation required by the aircraft manufacturer.



Analysis with Flotherm showed that the Thales Avionics video control cabinet design was able to meet the aircraft manufacturer ventilation requirements.

Flomerics TDS was able to deliver the requisite compliance with Federal Aviation Administration regulations from a designated engineering representative, while the TDS analysis confirmed the thermal integrity of the Thales VCC.

David Alexander

Keeping in touch

In the U.S. military, at least 750,000 radio network elements are being replaced with Software-Defined Radio (SDR)-enabled equipment. SDR devices will allow an operator to communicate with forces on different frequencies by downloading a protocol in real time. **Boeing** is developing the JTRS (Joint Tactical Radio System) Cluster 1 for the **U.S. Army** and the Family of Advanced Beyond-line-of-sight Terminals (FAB-T) for the **U.S. Air Force**. The FAB-T system is a group of airborne satellite radio terminals with similar software-based flexibility to the JTRS. Boeing has selected INTEGRITY real-time operating system and MULTI Integrated Development Environment (IDE) from **Green Hills Software** for both projects.

JTRS radios are based on the Software Communications Architecture (SCA), which requires POSIX programming interfaces for software portability. INTEGRITY supports the current SCA POSIX v2.2 standard. SDRs require an efficient, low-overhead operating system for maximum system throughput and low-power consumption.

JTRS radios must also be reliable and secure. INTEGRITY's memory-protected architecture can detect and handle faults to help prevent total system failure. Its unique partitioned design can isolate classified data and processes to defeat malicious attempts to compromise the radio's security.

The intent of the JTRS design is to create a networked communications architecture that will revolutionize the use of tactical information on the battlefield. The ability to invoke waveforms as needed, coupled with the JTRS' capability to interoperate with current field radios, will allow battlefield commanders to maintain direct communications with other units equipped with either JTRS or legacy radio systems. A multi-channel JTRS radio can also serve as a repeater to bridge communications between two otherwise incompatible radios.

David Alexander