

# Computers in engineering

## Virtual prototyping helps Bombardier

In the early stages of development of the Continental, their new business jet, **Bombardier** engineers created a virtual prototype of the complete flight-control system using MSC.Adams from **MSC.Software**, Inc. The centerpiece was a detailed model of the complete system that included cables, hydraulics, and aerodynamic forces. "We were able to evaluate more potential flight conditions and design configurations than ever

non-stop range of 3100 nmi at Mach 0.80 with a full load of eight passengers. Its top cruise speed of Mach 0.82 offers the ability to cross the U.S. in less than five hours, and land and take-off at the smaller runways of local and regional airports.

The primary flight-control system is one of the most critical aspects of any aircraft design, consisting of the components that control the elevators,

time, other engineers created a detailed model of the power control unit (PCU) using the MSC.Easy5 hydraulics simulation tool. Aerodynamic aircraft model performance derived from wind tunnel test data was analyzed using MatrixX control systems design software from **National Instruments**. Specific flight conditions were then extracted from MatrixX and brought into MSC.Adams. To further enhance the capabilities, a real-time hydraulic circuit of the PCU model, developed in the C programming language, was then integrated via a user subroutine within MSC.Adams.

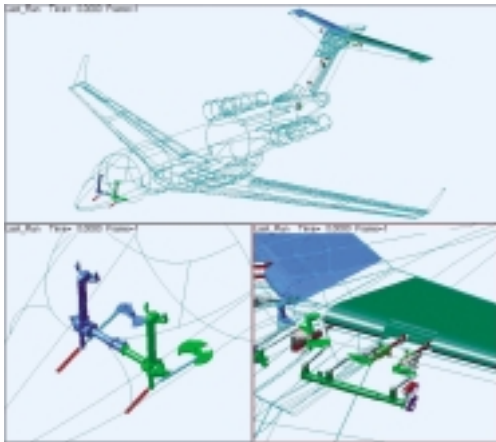
The completed model provided engineers with the ability to validate the performance of the flight-control system under the complete flight envelope, and the process included verifying the ability of the system to meet many fixed requirements based on aerospace regulations. Every single potential failure—a rod that disconnects, a cable that snaps, etc.—had to be evaluated from a reliability standpoint to ensure that the pilot would be able to recover the aircraft. On the Continental, engineers ran through these tests manually, but on future programs they intend to automate the complete set of tests so they can be run as a batch process with MSC.Adams.

"The virtual prototyping approach makes it possible to evaluate many more design alternatives to improve the flight-control system characteristics, and pilot comfort flying the aircraft, while increasing the robustness of the design," Godin said. The virtual prototype is also used to produce a simplified point-mass, real-time model that is used in the pilot in-the-loop flight simulator. The real-time hydraulic circuit PCU model is also used to drive the flight simulator. Using the same code in both the virtual prototype and the flight simulator ensures that the model performance is consistent for the required studies.

This article was written by **Doug Peterson**, Vice President MSC.Adams Product Development, MSC.Software, Inc.



The Continental is the latest addition to Bombardier's line of business aircraft.



The complete flight-control system for the Bombardier Continental was modeled in MSC.Adams.

before, which gave us confidence that we had a valid and robust design," said Tony D'Amore, Simulation Section Chief, Bombardier.

The Continental is the latest addition to Bombardier's line of business aircraft, aimed at the super-midsize market, which can fly eight passengers and three crewmembers non-stop from Europe to North America. The Continental business jet features a target

ailerons, and rudders. On previous programs, Bombardier has used virtual prototyping software to model certain aspects of the system in quasi-static conditions. "Additional tools or processes were used to analyze the different aspects of the design," said Francois Godin, System Simulation Design Engineer, Bombardier. "This design often involved multiple iterations across disciplines. Starting with the Continental program, we decided to make every effort to integrate these processes into a representative virtual version of the flight-control system so we could verify that our design assumptions were correct and make adjustments if necessary."

D'Amore and Godin developed a unique modeling approach that drew on their earlier efforts in creating kinematic and dynamic simulations of various aspects of the flight-control system, using the actual design geometry, mass properties, and kinematics from the CATIA CAD system. Engineers at Bombardier imported this information into MSC.Adams to verify the kinematics of the control system and validate the basic operating parameters. At the same

## Bridging the CAD gap

Systems integration can be a major impediment in a complex engineering program. **Smiths Aerospace**, a first-tier subcontractor working in partnership with U.S. company **Hamilton Sundstrand**, selected the CADverter software from **Theorem Solutions** to be used to bridge different CAD systems during development of integrated electrical power and remote input/output systems for the **Lockheed Martin** Joint Strike Fighter (JSF) program. UK-based Theorem Solutions' STEP CADverters convert data from CATIA, Unigraphics, and other CAD systems into the standard STEP AP203 format, taking the assembly and attribute information as well as the geometric and topographical data.

Smiths have the task of designing and developing the JSF's electrical power management (EPM) system and remote input/output (RIO) system. EPM reduces pilot workload via fully automatic monitoring of aircraft electrical loads under normal and emergency conditions, including automatic load shedding and restoration, to make the best use of available power. The RIO is the latest in a range of general-purpose remote units providing interface with an integrated avionics architecture. The



Smiths Aerospace chose Theorem software to convert design data for the JSF F-35 program.

interface units can be used in various ways, including as remote data concentrators or controllers for power distribution panels. The first units developed by Smiths Aerospace for the JSF program are soon to be tested on Lockheed Martin's rigs.

Stuart Birch

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## Briefs

**Ansys Inc.** has announced the release of CFX-TurboGrid version 2.1, which provides analysts of rotating machinery with a mesh-creation tool that delivers hexahedral mesh while preserving the underlying geometry. A customized mesh topology for the blade geometry being studied can now be created automatically. **CFX** was recently acquired by **Ansys, Inc.**

**LMS International** is supplying The European Space Research and Technology Centre (**ESTEC**) with a test solution that will form the core of their vibration qualification tests. **ESTEC** will integrate **LMS Test.Lab** Environmental software and **LMS SCADAS III** hardware.

**NASA's** Kennedy Space Center used **iGrafx FlowCharter** software from **Corel Corp.** to meet ISO 9001, and in doing so, were able to improve process management, increase employees' understanding of activities, and reduce the amount of paper used. Typical process documents were reduced from 50 pages to fewer than a dozen diagrams.

**Rex Composites**, a French aerospace supplier specializing in advanced composite components, has purchased software and training services from **Vistagy, Inc.** The **FiberSIM 4.0** software is being delivered on the **CATIA V5** platform from **Dassault Systemes**, and will enable engineers to design composite parts, analyze producibility, and automate manufacture.

**Altair Engineering Inc.** has launched **PBS Pro** version 5.3. Originally developed to manage aerospace computing resources at **NASA Ames** Research Center, the software intelligently queues and schedules computation workload across complex networks to optimize hardware and software use while minimizing job turnaround times.