Air Force Uses VisSim for Weapons System Design

Dynamic Simulation of a 6-DOF Munitions System

Using VisSim, the Air Force Research Laboratory Munitions Directorate at Eglin Air Force Base in Florida developed a high-fidelity, 6-degree-of-freedom (6-DOF) modeling system, named MSTARS, that simulates the flight dynamics and performance of a state-of-the-art weapons system. MSTARS, which stands for Munition Simulation Tools and Resources, allows engineers to rapidly prototype advanced concepts in guided bombs and missiles, as well as evaluate the performance of new technologies.

MSTARS comprises a library of VisSim-based munitions subsystems representing accelerometers, rate gyros, autopilots, seekers, inertial navigation systems, control surfaces, and air vehicles with complete 6-DOF flight dynamics. Simplified models of launch aircraft and threat targets are also incorporated into the components library. With over 70 VisSim models and DLLs in the library, engineers have been able to develop numerous air-to-air and air-to-ground 6-DOF simulation scenarios.

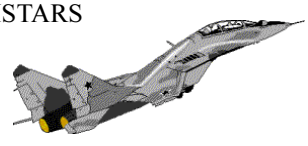
According to Larry Lewis, munition flyout team leader and chief architect of the MSTARS modeling system, numerous VisSim features were essential in building the MSTARS modeling system. “Embed blocks allowed us to build a truly reusable library of components,” said Lewis. “And path aliases tied to the embed blocks let us easily specify and modify complete simulation configurations, eliminating the use of lengthy file specifications.” Lewis emphasized that this modular approach to system design not only saved valuable time during the design and debugging phases, but also allowed engineers to quickly test the effectiveness of new subsystem component designs. “Whenever we came up with a new design, we just changed a single file name to swap the new component into the simulation.”

Reuse of legacy code written in Fortran and Ada was facilitated by VisSim’s DLL capability, as was the creation of new models and special utilities. “Our ability to reuse existing code and create special-purpose code via DLLs shaved months off our development schedule,” said Lewis. New DLLs, written in C++, Fortran, and Ada 95, are continually being added to the library.

In large model design, the dynamics of the system generally demands multi-rate simulation. In the MSTARS modeling system, discrete transfer functions, unit delays, and automatic DLLs were used to achieve different update rates. “This allowed us to dramatically reduce computation time and speed up the simulation,” explained Lewis.

The current MSTARS modeling system is the culmination of a yearlong effort by Lewis, which started when he created a prototype 6-DOF simulation using VisSim. “We had been using another modeling system, but it was slow and relatively inflexible,” said Lewis. After looking at numerous simulation packages, Lewis decided that VisSim best suited his needs, particularly in the areas of multi-rate simulation and interoperability with existing code. “It was a scary prospect to re-do our previous work, but with VisSim, we accomplished more in one year than we had in the previous three.”

Within the Eglin AFB community, VisSim and the MSTARS modeling system have received favorable reviews. Lewis plans to present and demonstrate the VisSim-based MSTARS system at the Joint Avionics, Weapons, and Systems Symposium in Las Vegas in June of this year.



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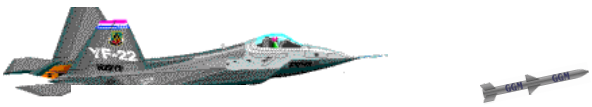

Application: Aerospace and Weapons System Design