



Mike Dinsmore (left), and Tim Kehoe work on a REACT scenario.

A REACT Scenario: Tracking African Pirates

Air Force Col. Richard Rice is tasked with monitoring the movements of oil tanker pirates operating off the coast of Kenya. He knows that the pirates are planning to hijack an oil tanker in the near future, and he needs to plan his own force's surveillance activities and optimize the use of available aircraft and sensors. Entering MITRE's ACME Laboratory, he sees two laptop computers next to each other.

A large monitor for the scenario director sits on a table a few feet behind the laptops. The director starts the program, and the laptop on the left shows a life-like animation of a Raven unmanned aerial vehicle (UAV) flying over a coastal region. The laptop on the right shows a bird's-eye view of what the video camera in the Raven sees: three vehicles converging at a safe house on a north-south road. Vehicle number one is a white SUV that carries the pirates' leader; the objective is to follow his movements.

REACT Fine-Tunes Air Force Capabilities Before Live-Flying

When MITRE's Mike Dinsmore and Tim Kehoe play computer games, it's serious business. They're researching how gaming technology can help evaluate new military operational concepts and save the government money, time, and personnel. They're taking advantage of commercial flight simulation games that cost less than \$99 to provide fast, flexible capability testing for new operational missions. One such game is the basis for a MITRE-developed concept simulation capability called REACT (Resources for Early and Agile Capability Testing). And thanks to REACT's initial success, the researchers have begun expanding the capability for use over the Web with REACT Online.

Dinsmore and Kehoe are the co-principal investigators for REACT, a research project for the U.S. Air Force that's based on the popular X-Plane flight simulator. They use REACT as a tool to evaluate new military concepts in an operational context and to discover any problems early.

"Modern warfare requires new and innovative mission concepts to defeat the enemy," explains Dinsmore. "Exploring these concepts in meeting rooms with whiteboards doesn't provide satisfactory feedback because the presentations are static. There are high-fidelity simulation tools, but they're expensive to run and aren't designed for fast experiments. So there's a need for a simple, 'good-enough' simulation capability that can expose issues early in the development of a mission or process."

Using X-Plane's software development kit, the REACT team developed several new plug-ins to extract and translate X-Plane data as well as to control the simulated vehicles and program their internal systems.

New Capabilities for Collaboration

Dinsmore points out that modern simulation games provide new capabilities for collaboration. "These games allow you to use realistic formats and locations in key areas such as flight modeling and team operations," he says. "Many realistic aircraft models are available free online and include unmanned aerial systems, fighters, air tankers, and command and control aircraft. By using Web 2.0 technologies, users can build active scenarios quickly and easily."

REACT is not intended to replace high-fidelity simulation or live-fly experiments. "Our aim is to help users prepare for the more expensive live-fly war games by giving them a first-look at finding potential bugs or conceptual problems," says Dinsmore. "Too much time, money, and manpower are involved in live simulations to deal with problems that can be discovered in the lab. You can use REACT early and often because it's inexpensive."

An example of a REACT scenario was recently developed in one of MITRE's labs—the Agile Capability Mashup Environment. The scenario showed an evacuation involving air, water, and ground operations. As a Predator surveillance aircraft circled in the sky, ground vehicles carried evacuees to the coast for transfer to an aircraft carrier. "We put the scenario together well within the customer's timeframe because we're using such flexible tools," says Dinsmore. "But there's really not a typical REACT scenario. Each customer requires a different list of airborne assets, some available free off the Internet. Sometimes we'll 'build' an asset, such as a Predator with special capabilities. Once we build simulations and combine them with ones that are free off the Internet, the user can generate more new scenarios." (See another scenario, Tracking African Pirates, left.)

(continued...)

The script, written by MITRE's Bruce Czulada, emphasizes joint military service operations, cross-service collaboration, dynamic sensor retasking, and sensor cross-cueing. Col. Rice can change the script and adapt it to suit his needs.

The scenario allows Col. Rice to look at different points of action and communication between the aircraft and ground targets. He can view the actions almost simultaneously over a wide geographic area. He can also practice coordinating a variety of aircraft and synchronize their actions to accomplish a specific mission. If something doesn't look right, Col. Rice can stop the action and reposition the Predator for a better view.

He speeds up the action so that the vehicles leave the safe house. The Raven follows vehicle number two, which goes south, but the pirate leader's white SUV heads north. How are the white SUV with the pirate leader and the third vehicle going to be tracked? This job requires orchestration of several systems. The Predator hasn't had time to fly to its surveillance position. Miles away, there's an E-8C Joint Surveillance Target Attack Radar System that is tracking all the targets but it can't identify them. Col. Rice can use an FA-18 strike aircraft that's returning to base to identify the white SUV. The E-8C then hands off the white SUV to the Predator when it gets in range. (Scenario continues . . .)

REACT relies on open standards widely used on the Internet today for information sharing. Because many flight situations are well documented by vendors, or even individuals, just about any flying activity can be emulated by REACT. "As a result, you can use flexible data for your own experiment and make your system better," Kehoe says.

Customers React: They Want More

During 2008, REACT performed well in a number of Air Force risk-reduction exercises for a wide variety of aircraft. For the U.S. Special Operations Command Warfighter Workshop, the team provided track and imagery data for scenarios involving unmanned aircraft, U.S. Coast Guard cruisers, and oil tankers. Another simulation involved in-flight re-tasking for fighters in an Air Force Center Weapons System study. Reaction to these exercises and others was so positive that the sponsors want to use REACT's flexible technology to enhance and extend their experimentation events in 2009.

But using REACT or any simulation game on a network can be a problem if there are too many users. In a typical simulation, players send messages to other players and synchronize themselves so they know where each other is and what they look like. With too many players, the network becomes flooded with information and slows down. Even in a dedicated lab with high-speed networks, the number of simulations can be limited by the number of players.

The Solution to Network Overload: REACT Online

Kehoe solved the network capacity problem by inventing a software plug-in that expands REACT's capability for use over the Internet. Its name also expanded to REACT Online.

"Corporate firewalls have been a notorious barrier to collaborative simulation experiments because this type of data can be blocked by policy," says Kehoe. "Internet protocols, on the other hand, pass through freely. This can be leveraged to change the way system experimentation is accomplished and allow sponsors, contractors, and users to collaborate on ideas much more easily." Says Dinsmore: "Tim's plug-in is a pretty big innovation. We can have a number of collaborators working at different locations, and they can access a variety of plane information from all over the Web. REACT Online can access tools on the Web so that users can visualize, control, and work on different processes. If you wanted to see my plane while I'm flying it, for example, you can grab its latitude, longitude, and fuel level—just as if you were going to a website."

REACT Online lets sponsors explore new and evolving mission requirements that cross traditional domain boundaries. "A flexible, cost-effective experimentation environment enables sponsors to look at the complex interactions among capabilities, systems, and personnel within their domain," explains Kehoe. "With the ability to create 'good enough' simulations of new concepts in hours rather than months, customers can then confidently direct additional resources at other major issues."

Kehoe notes that REACT Online will allow the Air Force to experiment with new warfighting concepts involving large numbers of aircraft. For instance, is it possible to manage 100 Predators or is 20 the limit? "We can try both ways in the simulation," says Kehoe. "REACT Online will also help the Air Force learn how to manage assets when there's no real predictability. When the number of elements in these scenarios scales up, it helps users forecast unanticipated reactions."

Empowering Sponsors

Dinsmore and Kehoe are also anticipating the future needs of MITRE's sponsors. "We're really emulating the net-centric world before our customers get there," says Kehoe. "With REACT Online, we're making everything available through the standards they want to use. A website with a suite of tools will be set up so users can design their own scenarios. They'll have a command and control center and be able to monitor what's going on. We're trying to empower our customers and other researchers to carry out the simulations themselves."

—by David A. Van Cleave

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