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Military Training Technology
ONLINE EDITION

Learning to Fly … UAVs

The Army's increased use of unmanned aerial vehicles in the war on terrorism has led to a dramatic increase in throughput at its Unmanned Aerial Vehicle Training Center.

By Patrick Chisholm

Sitting far from the rugged area of Afghanistan being monitored, a UAV operator spots something strange on the terrain below. From high above, the UAV has captured a herd of cattle crossing a field. Then, explosions start going off among them. The operator tells his partner flying the U.S. Army Shadow UAV to swoop in for a closer look. The camera spots people walking behind the herd. The implication to the UAV operators is clear: The animals are being used to clear a minefield.

But the explosions, cattle and people on the ground aren't real—at least not in that instance. They are digital images, generated by a state-of-the art UAV simulator at Fort Huachuca, AZ. The U.S. Army Unmanned Aerial Vehicle Training Center there, which recently opened a 25,000-square-foot annex to its existing center and has 32 simulators—22 for the Shadow and 10 for the Hunter.

The UAV Training Center provides all of the training for the Army's UAV system operators and maintainers. Roughly 600 students graduate from the school each year. And they are in high demand: there are four critical military intelligence specialties that are particularly needed to support the war effort, and UAV operators—96 Uniforms, as they are called in the Army—are among them (the others being intelligence analysts, interrogators and counterintelligence agents). Commanders are using UAVs to a greater and greater extent. The Army intends to field 48 Shadow UAV systems. Each of those systems requires a total of 22 people to operate.

The Hunter, manufactured by Northrop Grumman, and Shadow, manufactured by a team lead by AAI Corp., is a reconnaissance aircraft. By or during fiscal 2007, training is expected to commence for the Warrior system, also known as the Extended Range Multi-Purpose System, which will have very similar capabilities to the Air Force's Predator UAV. In addition to the ability to attach new systems in a "plug and play" fashion, such as a signals intelligence system, the Warrior, made by General Atomics Aeronautical Systems, will have ordinance delivery capabilities as well.

The UAV Training Center's simulators are said to be so realistic that it would be difficult to distinguish, without previous knowledge, between them and the actual ground stations. The simulators looks similar to an airplane cockpit, although conspicuously missing are the aircraft yoke—the steering wheel of the aircraft—and throttle levers. It has all of the same functionalities, albeit simulated, as an actual ground station.

Two operators control the aircraft. One flies the aircraft from the left seat, and the one in the right seat manipulates the sensors and gathers the information. Trainees are taught to do both jobs.

"Obviously, the good part of simulation is that should the student make a mistake, we don't crash aircraft. We just push restart and are able to do after-action review by actually pointing out to the student what it is they did, and be able to explain to them where they may have deviated from the prescribed procedure and how to make corrective action," said Mark Farrar, director of the Army's UAV Training Center.

In years past, in order to train for UAVs, students would have to fly actual UAVs. For example, the Pioneer training system that was used during Desert Storm did not come equipped with a simulator, so it made the training significantly more expensive and costly, not only from a financial standpoint, but from the Army readiness standpoint. The Army only had so many assets available, and if it crashed a training asset, it potentially left the warfighters short. So the simulator does all the things that manned aviation simulators do. "The first one was with Hunter and that was a light-year step ahead for us from Pioneer. And now with the Shadow system, again, it's another big leap forward," commented Farrar.

Each simulator, running 1 terabyte of memory, replicates actual terrain and actual locations of the world, such as Afghanistan and Iraq. There are several different terrain scenarios that simulator operators can bring up for different types of training, depending on where the students are going to be deployed. The simulators use digitized satellite imagery from actual locations, and users can input simulated targets or items of interest.

There are two 10-inch monitors and two 6-inch monitors on each of the operators' sides, and there is a large 19-inch screen in the center, called the observer bay, which is basically a moving digital map containing a small icon of an UAV. "You can move the icon around the screen, and know how long it has been there," explained Farrar. "Or you can have the icon stay in the middle of the screen and have the terrain move around it. Everyone is observing where you've been, where you're headed and where you are. So that's put in the middle for both operators to be able to utilize."

The simulator can replicate anything that can occur on actual missions, such as enemy ground fire. There are many choices of scenarios, such as people massing with firearms, improvised explosive devices on the side of a road near a convoy, or tanks moving around. "If you can conceive it, then we can simulate it," said Farrar.

A training procedure typically begins with requests for information for a particular coverage area, directed at the students. They then carry out mission planning, overseen by a more senior noncommissioned officer. They make a list of items of interest, based on information provided to them by their intelligence officer; those items are called "targets of opportunity," which does not necessarily mean targets to be fired upon. So as the mission is flown, targets of opportunity along the way are collected and the information is reported.

Crew coordination is very important. For example, it is important how the pilot positions the aircraft in such a manner that the payload specialist collecting the information can have the best opportunity to get a good product, and vice-versa. And by flipping a switch, one operator can transfer control of the aircraft over to the other operator.

The UAV training missions involve what center personnel refer to as the three "Ds": missions that are dull, dirty or dangerous. "Dull is pretty self-explanatory," said Farrar. "I was in the Army during Desert Storm with the Pioneer system, and we were tasked to do things like 'OK, here's a huge grid

of what the battlefield looks like. We want you to go through and fly all through these boxes here.' And we would plot out those boxes and actually go out and fly through these boxes for six to eight hours at a time, and that's pretty dull."

Dirty could be anything having to do with nuclear, biological or chemical contamination, whereby commanders do not want to risk sending out a manned aviator. "As for dangerous, we can fly low, we can fly slow, we can fly high, we can fly fast. We can loiter over targets. We can put the aircraft in harm's way where we would not otherwise put a man or woman in harm's way."

In the Army, UAV trainees are not required to have previous schooling in aviation. Unlike the Air Force, where the trainees are typically rated aviators, Army UAV trainees are often right out of high school. They are initially put through the Federal Aviation Administration ground school. Subsequently, after 21 weeks and two days at the UAV Training Center, graduates are certified by the Army to fly UAVs.

The center also trains mechanical technicians and electronic technicians for UAVs, and offers an instructor pilot course as well.

After a minimum of 10 simulated flights as the air vehicle operator and 10 flights as the mission payload operator, students fly about the same number of flights with actual UAVs. Of course, instructor pilots are standing by to correct any mistakes, in order to prevent the potential loss of any aircraft.

The recent expansion of the UAV Training Center consists of four new buildings. They include roughly 10,000 square feet of additional simulator facility. A 2,520-square-foot maintenance office facility was also added, as well as an 8,000-square-foot hanger, which doubled the hanger capacity. There is also a 4,000-square-foot operations-and-ready building, which provides space for mission briefs as well as office space for safety and standardization.

The center is the Army's only UAV training school, said Farrar. It is three times larger than the next-largest training center in the world, run by the Israeli military.

Fort Huachuca, located 10 miles from the border with Mexico, is particularly conducive to UAV training. It enjoys about 350 "visual flight rule" days, i.e., 350 good weather days per year. And it has 400 square nautical miles of restricted air space—roughly the size of Rhode Island. It is the only place in the world where unmanned aircraft training has priority over that of manned aircraft; the air space was designated by the FAA in 1953 for that purpose.

The terrain makes the area favorable to UAV training as well. Within the special-use air space there are mountains with elevations in excess of 9,000 feet. There are pine-covered rough mountains to very sparsely populated desert sand areas, and small towns to cities of about 50,000 people. "So just about everything we've been tasked to recreate, while in the actual flight phase of instruction," remarked Farrar, "we've been able to accommodate."

Predator Trainer

The Air Force's Predator UAV systems, which are larger than the Shadow or Hunter and are capable of ordinance delivery, are based at Creech Air Force Base, NV. Scheduled for delivery to the Air Force in late 2006 is the Predator Mission Aircrew Training System (PMATS), developed by Link Simulation and Training, a division of L-3 Communications. An upgrade to be delivered in early 2007 will enable the unit to participate in the U.S. Air Force's distributed mission operations simulation exercises.

The aircrew training system will enable pilots and sensor operators to undergo initial qualification, mission qualification, continuation and mission rehearsal simulation-based training in support of the MQ-1 Predator. "The system will look and feel exactly like the actual ground control station that the pilots and sensor operators use today," said Dan Kelly, Link's program

manager for the PMATS program. “If you were to unplug the simulator and plug in an actual aircraft, it would be virtually transparent to the student.”

PMATS also incorporates concurrency, allowing for the training systems to be easily modified as the actual Predator system is upgraded. Eventually, this trainer will be upgraded to also train the MQ-9 platform, which is the larger and more capable next generation of the Predator UAV.

“With UAVs, you go through configuration changes quite rapidly—numerous configuration changes a year, which is almost unheard of for a manned aircraft,” Kelly explained. “And the challenge for a trainer is how you maintain concurrency with the ever-changing field. You now have numerous versions out there of the Predator. You want to be able to train the students on the latest version, or on the version that they may be using at a certain base that’s different than what would be used in another theater of operation. So that concurrency capability really is the significant discriminator in our simulator versus what’s currently there today.”

Another unique aspect of PMATS is that pilots can be trained to operate more than one UAV simultaneously. “So multiple Predators could be controlled by one pilot station,” Kelly said.

Also of note is that unlike the Army’s Shadow and Hunter, Air Force Predator controllers are rated pilots. “Since Predator is able to fly in controlled air space, the FAA requires a pilot at the controls.” said Jon Foster, Link’s director of business development for Air Force programs.

Post-Schooling

In addition to providing maintenance support for the Fort Huachuca UAV Training Center, AAI Corp., a subsidiary of United Industrial Corp., provides training that occurs post-schoolhouse, known as “brigade integration team training.” It involves some classroom training, simulated flights and live flights.

The Shadow 200 UAV system has a training system embedded in its ground control station. “That provides simulation capability that allows operators to sit at their normal work stations and train like they would fight. They train sitting in the same chairs, looking at the same screens, and pushing the same buttons as the actual workstation,” said Steve Harris, senior Integrated Logistics Support manager, AAI.

In addition to providing instructors, AAI provides field service representatives for maintenance of the Shadow 200.

AAI is also developing the ground control stations for the Warrior and will be participating in the training as well. In a separate development, AAI has selected MetaVR VRSG as the 3-D synthetic payload visualization system for its Tactical Unmanned Aerial Vehicle (TUAV) ground control station embedded trainer and for the institutional mission simulator used at the UAV schoolhouse at Fort Huachuca. The MetaVR Virtual Reality Scene Generator (VRSG) system is a real-time computer image generator that enables users to visualize geographically expansive and detailed virtual worlds on commercial off-the-shelf PCs. Using Microsoft DirectX commercial standards, VRSG provides real-time, single- and multiple-channel visualization of virtual environments, dynamic moving models and special effects.

Unmanned Aerial Helos

As with manned aircraft, helicopters can do a lot that fixed-wing aircraft cannot, and vice-versa. Tactical Aerospace Group (TAG) of Beverly Hills, CA, develops unmanned helicopters. Depending on the model, these aircraft measure up to almost 8-feet-long from nose to tail, can carry payloads in the range of 30 to 60 pounds, and fly for up to six hours. Among the advantages of the UAV helicopter, “It can hover in the proximity of a point of interest or remain in a stationary position over a specific coordinate,” explained Jei Wheeler, director of unmanned aircraft systems for TAG. “You can fly it in any direction into a desired position and altitude as required

by the mission or circumstances."

He explained that it is especially useful for hazardous jobs such as monitoring nuclear, biological or chemical contamination or for ISR and high-risk war-fighting missions.

Whereas with fixed-wing UAVs most of the flight is automated, that is not necessarily the case with a helicopter UAV—although preprogrammed fully autonomous flight modes or remotely piloted control is common, a more complex visual flight range mode is the most challenging for simulation and training. "The helicopter experience is closer to the ground and closer to the action so it has to be flown differently."

Regarding training, "In the process of developing the helicopter, we generated a virtual environment where we can simulate or program pretty much any situation desired. That's as realistic a scenario as possible on a screen in front of you," he remarked. "TAG offers training for all flight modes as well as special courses developed for specific tactical or special operations."

In fact, in addition to a stand-alone simulator, there can be extensive simulation functionality embedded into the ground control station itself. "There you have moving maps, satellite imagery, downlinked data and video telemetry all overlaid and integrated on the screens before you. Of course you have your location and, in the case of military applications, you've got targeting and other things going on."

"Realistic geo-spatial 3-D terrestrial images are created," said Wheeler. "We can preprogram any set of flight data on our simulators and the mapping company we've partnered with can create the entire area of interest in all three dimensions down to centimeter accuracy, which is an incredible tool for both simulation and pre-staging actual missions."