@ Engineers are designing camera-carrying unmanned aerial vehicles that may be able to alert their operators when they find something of interest.

Free Birds

Researchers are helping unmanned aerial vehicles be more independent.

Camera-carrying unmanned aerial vehicles, or UAVs, are useful for military surveillance tasks. The trouble is, they're also demanding — they require a human being to constantly monitor the visual information they radio back.

Now, Georgia Tech Research Institute (GTRI) researchers are pursuing a program supported by independent research and development funds to make these unpiloted aircraft more autonomous. The idea is to have them alert their operators when they find something of interest, rather than simply sending back a video stream.

"What we're trying to do is put the intelligence on it," says Mike Heiges, a senior research engineer in GTRI's Aerospace, Transportation and Advanced Systems Laboratory (ATAS). "That means mounting some advanced sensors on board the aircraft, rather than just a video camera."

Typically, Heiges explains, a UAV operates via global positioning system (GPS) technology. An operator will program a series of waypoints, and the aircraft will automatically fly that route. As it goes, it sends back images — video during the day, infrared at night — to enable route surveillance ahead of advancing troops. The craft surveys the terrain, peeks over hilltops and examines rooftops, constantly looking for danger.

In a combat zone, this approach can mean problems for the UAV operating team, Heiges says. They must devote their full attention to monitoring the video feed rather than keeping track of their own situation.

"You've got snipers and other things all around them," Heiges says. "These guys are in danger because they can't watch what's going on — they're busy watching their UAV."

GTRI scientists believe that adding the right sensors to a UAV could increase its usefulness by letting operators tailor their approach to the tactical situation.

Doppler radar is the most immediate candidate for adding smart-sensor capability, Heiges says. When this radar detects ground movement, it can trigger a high-resolution camera that will relay back photos or video of the situation.

Gene Greneker, a research scientist in GTRI's Sensors and Electromagnetic Applications Laboratory, has tested Doppler radar on the electric-powered Dragon Eye UAV used by the Marine Corps. Using off-the-shelf components, he found that the small Dragon Eye didn't have the payload capacity to carry components powerful enough to be effective beyond 1,000 feet from a target object.

Greneker then turned to the gasoline-powered Banshee, designed and built by ATAS engineer Stephen Williams. The larger Banshee could handle more-powerful, off-the-shelf radar components, which were able to detect a moving ground object and then trigger an onboard camera.

"The radar serves as a very valuable information source and cuing device for any kind of image-processing system," he says.

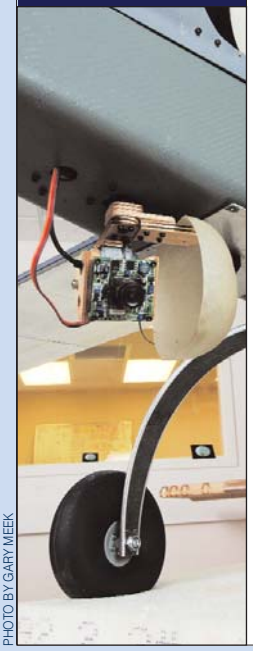
In a combat zone, radar could sense a moving object and cue a video camera to turn on and take a few frames, Greneker says. Then an onboard processor could process those frames to find the moving target and send the results home.

By contrast, streaming video creates multiple problems, he says. Searching for moving objects by sending back reams of video consumes massive bandwidth, tying up military radio frequencies needed by other combat units. And if all that steaming video were monitored onboard the UAV to conserve bandwidth, the aircraft would have to carry highly sophisticated — and heavy — computing power.

Greneker plans further test flights, perhaps with a custom-built radar device optimized for UAV use. He may add an antenna with a broader beam to cover more ground, and onboard pre-processing equipment to improve signal-to-noise ratios.

By Rick Robinson

***BELOW:** When Doppler radar on the Banshee unpiloted aerial vehicle detects ground movement, it can trigger a high-resolution camera, shown here, that will relay back photos or video of the suspicious situation.*



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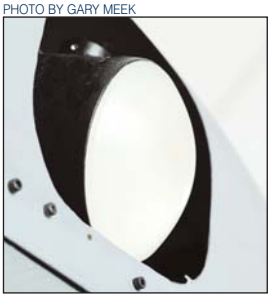

Infrared sensors could also help make UAVs more autonomous, Heiges says. A UAV carrying such sensors could relay an alert if it detected warm objects, such as human bodies. Alternatively, the UAV's infrared sensor could be programmed to send an alert only if it found very hot objects, such as moving vehicles.

Other potentially useful sensors are those that detect enemy chemical or biological agents, or detect movement by simulating the human vision process. Synthetic aperture radar, which allows aircraft to create high-resolution images of wide areas even in bad weather or at night, also could be useful.

Heiges believes less high-tech approaches could also allow UAVs to function more independently. For example, a high-resolution camera on a UAV could simply take pictures at locations pre-programmed into the GPS guidance system. Ground personnel could review such photos at their convenience, unlike streaming video.

ATAS is also using a technology called fuzzy cognitive controllers (FCCs) to assist in development of autonomous UAVs. Using fuzzy logic, FCCs help connect a UAV's control and guidance systems to its sensors to help the craft operate on its own.

For example, Heiges says, FCCs could help a UAV know when and how to change course and follow a target picked up by its sensors. Or they could enable the craft to watch its fuel and head back when levels get below a certain point.

Ultimately, Heiges says, the aim of the GTRI program is to help UAVs do their job better.

"You're trying to be flexible here because you want to meet the needs of the war fighters," he says. "Sometimes they do want to see streaming video, other times they just want to know if there has been a change — and if there has been, then they want to take a look at it."

@ Read online at: **gtresearchnews.gatech.edu/reshor/rh-w06/uavs.html**

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PHOTO BY GARY MEEK

LEFT: Georgia Tech Research Institute researchers are working to make unpiloted aerial vehicles, such as the Banshee shown here, more independent. Equipped with Doppler radar (inset above) and a video camera, the idea is to have them alert their operators when they find something of interest, rather than simply sending back a video stream. Researchers Gene Greneker and Mike Heiges are among the developers.