Successful Flight-Tested Research at AFIT’s Advanced Navigation Technology Center
Brings Us One Step Closer to Automated Air Refueling

Last month, the Advanced Navigation Technology (ANT) Center at the Air Force Institute of Technology (AFIT) celebrated a big success. The ANT Center project, sponsored by the Air Force Research Laboratory (AFRL), flew at the Air Force Test Pilot School (TPS), and the results were exceedingly positive.

The test consisted of performing precision formation flight in a refueling position as a proof-of-concept for automated air refueling of Unmanned Aerial Vehicles (UAVs). The ANT Center staff, along with AFIT/TPS student Capt. Chris Spinelli, designed and built the navigation system, which determines relative position between the aircraft at a 20 Hz rate to an accuracy of one centimeter. This information was fed into a control algorithm, developed by AFIT/TPS student Capt. Steve Ross, which drives the autopilot on the trail aircraft. The actual flight tests were conducted by TPS as part of the joint AFIT/TPS program.

Says Dr. John Raquet, ANT Center Director, “To the best of our knowledge, this is the first time that full 6-DOF precision—i.e., with an accuracy of a few feet—close-in formation flight has been accomplished entirely on autopilot. By the final flight, all of the bugs were worked out to the point that they flew in autonomous precision formation for almost the entire two hour flight, including multiple banks and up to 30 degree turns.”

The ANT Center’s focus is on solving navigation problems for the Department of Defense and other government organizations. Says Raquet, “Many organizations rely heavily on navigation to achieve their mission, but their core mission is not navigation. For such organizations, the ANT Center is able to step in and provide much-needed navigation expertise.”

The ANT Center has three research thrusts: Robust GPS navigation (increasing GPS accuracy and jamming immunity), multiple-vehicle navigation and control, and non-GPS precision navigation. The development of feasible non-GPS navigation capability is crucial to ensure that the DoD always has access to quality navigation, a requirement for achieving its missions.

While GPS is of great value, it does not solve every navigation problem. For example, it does not work well under trees, indoors, in urban high-rise areas, or in locations with interfering signals. The ANT Center is focused on developing ways to navigate with GPS-level accuracy without using GPS, so that we can navigate in these more difficult environments.

One promising approach involves using “signals of opportunity” for navigation. Raquet describes a signal of opportunity as any type of signal—such as radio, television, satellite broadcasts, etc.—that was not originally intended for navigation. “However,” he says, “if we are smart about how we do things, we can actually use these signals to determine our position or velocity. The good thing about such signals is that they are often more prevalent and stronger than GPS signals, so they are able to be used indoors or in other places where GPS currently doesn’t work. For the military, using such techniques ensures that we have reliable, accurate navigation at all times and locations.”

In the past two years, the ANT Center has worked on more than 50 military navigation problems. As technology moves us into the future, the Advanced Navigation Technology Center at AFIT will continue to lead the way, ensuring that we are able to navigate anywhere at any time using anything.