Hands on > No pilot? No problem! -- Students custom design an unmanned air vehicle

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Sander Geophysics Limited, an Ottawa-based company specializing in airborne surveys for petroleum and mineral exploration and environmental mapping, wants a small unmanned air vehicle (UAV) for challenging missions close to the ground, autonomously following terrain contours and avoiding obstacles. The UAV system must be modular, robust and low-cost, and need only a two-person ground crew for launch, recovery and control.

And they want Carleton students to design it.

With no onboard pilot, unmanned air vehicles like the GeoSurv IIII modeled here with Jason Hochstein and Paul Straznicky, can operate in diverse environments and high-risk roles ranging from surveillance and search and rescue to oceanographic and atmospheric research. They offer a cost-effective alternative to manned aircraft operations and no risk to flight crews. (Photo: Chris Strangemore)

"Sander could buy an existing UAV system and modify it for their needs," says Paul Straznicky, professor in the Department of Mechanical and Aerospace Engineering and project manager for the UAV. "By choosing to invest some time, expertise and finances into this project, the company ensures from the beginning that the UAV is designed for its particular needs while giving students a unique design opportunity."

The multidisciplinary UAV system project provides fourth-year students from all streams of aerospace engineering and their colleagues from mechanical, electrical, and systems and computer engineering with an opportunity to integrate all the knowledge and skills learned throughout their program into one professional-level activity.

The project began with GeoSurv, a large UAV that, with a wingspan of 14.6 metres, takeoff weight of 1,542 kilograms and a 230 horsepower engine, exceeded the Faculty's physical capacity to build at full-scale. The goal for the smaller GeoSurv II, begun in 2004, is to build a prototype at Carleton and demonstrate that it can fly high-resolution, smaller area survey missions.

The requirements dictate a well-integrated design of the air vehicle and a state-of-the-art avionics system including significant onboard intelligence.

A challenging work plan has been developed in order to start flight testing a proof-of-concept demonstrator system in 2008. This year's team of 27 students is evaluating, refining and testing a propulsion system, avionics systems such as autopilot and telemetry, and control surface actuating systems. In addition to working on methods of launching and recovery without an airstrip, construction of the aircraft will start and wind tunnel testing is scheduled.

“This is a really interesting stage to join the GeoSurv II project because we’re making the transition from the concept design to manufacturing,” says Jason Hochstein, a student in the aerospace structures, systems and vehicle design stream. “We’re moving from finalizing the design on paper to hands-on manufacturing, so we see the best of both sides.”

The team is also benefiting from the involvement of two graduate students who have been integrated into the design team in technologies crucial to the success of the development:UAV autonomy, obstacle detection and avoidance, actuators with low magnetic signature, and low-cost composite structures.

“I hope to see more graduate student involvement in the future,” says Straznicky. “Their longer involvement in the project provides continuity and the focus of the graduate research can elevate the work of the undergraduates.”

Project continuity, a challenge with a fresh team each September, is achieved with the incoming project team touring the client facility, a briefing on the project and a review of the system requirements document. Students have one month to get up to speed on the project’s status, using the documentation—calculations, test reports, presentations—of the previous year’s team. Each aspect of the design must either be agreed on and adopted, or challenged and reworked, before further development continues.

“Students come in green, but with the help of faculty and lead engineers from the industry, they can assess and build on the work of the previous group,” says Straznicky. “It is the same situation students will encounter as young engineers hired onto a project. They will have the ability to come up to speed quickly, assess and make recommendations.”

Despite the steep learning curve and challenging fourth-year work load, Hochstein finds the experience rewarding. “In one small project, we’re applying all types of engineering. We don’t just have our heads in a book, we’re putting everything we’ve learned into practice” he says. “People are passionate about this project.