Australian Research Centre for Aerospace Automation

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The Australian Research Centre for Aerospace Automation (ARCAA), is a joint venture of between the Queensland University of Technology (QUT) and the Commonwealth Scientific and Research Organization (CSIRO) ICT Centre. Australia has an expansive land mass with the third lowest population density in the world. This has required government and industry to be innovative when solving triple bottom line problems.

Unmanned aircraft systems (UAS) are a maturing technology that can contribute to these innovative solutions by providing cost-effective broad area aerial surveillance - well suited to Australia's expansive and sparsely populated regions. The purpose of ARCAA is to remove the impediments facing routine civilian operations of UAVs through the development of advanced ICT technologies.

Civilian applications for UAS technology in Australia are quickly emerging as a large and lucrative new aerospace market – underpinned by recent maturity in the information communication technology (ICT) industry. Examples of civilian applications of particular interest in Australia include: coastal surveillance, powerline inspection, bush-fire monitoring, precision farming and remote-sensing.

In December 2009, ARCAA's new $6M research facility will be completed. This 1000 sqare metre facility will house up to 35 researchers with specialised laboratories. Researchers will focus specifically on aerospace automation research.

ARCAA Airborne Systems

ARCAA has five airborne platforms that help us in our research:

- Airborne Systems Lab (ASL): A Cessna 172 aircraft fitted with specialised navigation avionics, and multiple redundant, high bandwidth, communication links. This aircraft has successfully performed separation management experiments with Boeing PhantomWorks in Seattle.
- A Flamingo and Shadow UAS instrumented with a Micropilot™ autopilot, Iridium and 3G communication links, onboard flight computer based on PC104 and IEEE1394 camera system. This platform has been used in separation management flight trials and also for computer vision based sense and avoid experiments.
- Several Boomerangs UAS instrumented with a Micropilot™ autopilot, communication links, onboard flight computer and cameras. These aircraft have been used mainly for prototype software and avionics testing, before before being integrated in the Flamingo and/or Shadow. Additionally, these platforms are used for preliminary test of applications for power line, forced landing research, and vegetation and spores research.
- A Search and rescue 1/3 scale Piper C UAS instrumented with a Micropilot™ autopilot, infrared cameras and payload deployment. It is used for research related to search and rescue using UAS. It has logged more than 4 hrs of autonomous flight.
- A helicopter based on the Vario platform. This platform has been fitted with an array of sensors and is a research test-bed with the objective of developing an aerial inspection robot. Applications of interest include high-voltage transmission towers, bridges and cooling towers.

Recent & Ongoing/Upcoming UAS-related R&D

The centre's research focus is on increasing the level of dependability on UAS. Research areas include:
Air traffic and separation management approaches for airspace automation: Smart Skies, vision-based see-and-avoid systems for UAS, forced landing research programme for UAS, vegetation management and infrastructure inspection using UAS, spores research, and energy efficient UAS.

Air Traffic and Separation Management Approaches for Airspace Automation: Smart Skies

In conjunction with Boeing Research and Technology, ARCAA is developing technologies to automate components of the air traffic management process through the integration of information and communications (ICT) technologies. The aim is to develop automated separation management technologies (which maintain safety, whilst increasing density and mix type) allowing greater utilisation of the National Airspace System (NAS) by manned and unmanned platforms.

Vision-based See-and-Avoid Systems for UAS

One of the greatest challenges that stifles the introduction of

UAS into civilian space is the ability to demonstrate see-and-avoid capabilities with a level of equivalence to human pilots. In conjunction with Boeing Research and Technology, ARCAA is investigating the use of computer vision to provide a level of situational awareness (see-and-avoid) suitable for UAS. Currently, this program is performing the initial experiments of a real time onboard see-and-avoid system based on Graphics Processing Units (GPUs)

Forced Landing Research Program for UAS

This research investigates the feasibility of automating the emergency forced landing procedure for a unmanned aircraft. This project encompasses methods for making the initial landing site selection after a failure has occurred, based on machine vision techniques, planning dynamically the best landing trajectory accounting to wind changes and how to assess multiple attributes (multiple) that can lead to multiple decision. A number of algorithms have been proven to identify appropriate landing areas - large open spaces, free of obstructions, suitable for landing purposes.

Vegetation Management and Powerline Infrastructure Inspection Using UAS

This program brings academia and industry together to develop new technologies and processes for inspecting infrastructure that spans large geographic distances - in this case powerlines networks. This project is co-funded by Ergon Energy and the CRC for Spatial Information. The novel aspect of this project is to model the cost-benefit of the use of small unmanned aircraft and to determine the optimised sensor configuration to automatically detect Ergon's high priority fault conditions.

Flying Spore Trap Research

In conjunction with the CRC for Plant Biosecurity, Queensland Department of Primary Industries and Fisheries, ARCAA is currently developing an flying spore trap UAS concept. This aircraft will be able to fly to difficult to access agricultural areas and detect unwanted spores or other plant pathogens. The UAS, fitted with a spore trap to detect and monitor spores and plant pathogens, will replace the current stationary monitor methods, which are not as effective, nor as reliable as this new flying robot. The project will reduce the risk of pest introduction from international trade and, at the same time, will capture a wide range of plant health information in a cost-effective way so as to cover international and domestic market demands.

Energy Efficient UAS

The aim of this research is to investigate alternative technologies for optimal energy used on UAS, these include hybrid (electric ICE power plants, fuel cell powered UAS, solar powered UAS as well as the development of optimal path planning algorithms to minimise power consumption.

The centre also engages with the broader UAS community in Australia.

Coordination & Cooperation Relative to Creating Rules & Regulations: UAS Australia

Since August 2007 ARCAA is coordinating meetings to discuss the regulatory issues that face the UAS industry in Australia. Key stakeholders with representatives from CASA, CASA OAR, DITRA, ADF, ADF DGTA, ADF ACPA, DSTO, CSIRO, Boeing, BAE Systems, Raytheon, National Air Support, Aerosonde and a number of other SMEs and universities etc. are cooperating for the establishment of a representative body which would: «*support the timely progression of UAS standards, regulations and general safe practices, appropriate to the interests and needs of all Australian UAS stakeholders.*» http://www.uasaustralia.org

The UAV ARCAA Challenge

The *UAV Challenge Outback Rescue* offers students, hobbyists and film makers the opportunity to participate in an international high-tech aerospace competition. The 2009 UAV Challenge will be held on 28 September - 1 October 2009, Kingaroy, Queensland Australia.
http://www.uavoutbackchallenge.com.au

ARCAA website: www.arcaa.aero

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