

ACTIVITIES AT FADA-CATEC AND THE UNIVERSITY OF SEVILLE IN THE RESEARCH AND DEVELOPMENT OF UNMANNED AERIAL SYSTEMS December, 2011

The Joint Research Unit integrating efforts of the Center for Advanced Aerospace Technologies FADA-CATEC (<http://www.catec.aero/en>) and the GRVC Group of the University of Seville (<http://grvc.us.es/en>) has devoted, in the last 10 years, significant efforts to the Research and Development (R&D) on Unmanned Aerial Systems (UAS). This Unit currently has more 100 researchers with strong expertise in UAS. It has been leading or participating in more than 30 R&D projects in UAS funded by the European Commission, Spanish Programmes and companies with a total funding of more than 12 Million Euros. The researchers have authored more than 120 publications in UAS technologies and applications.

The participation in the European Framework Programmes is significant. Thus, Professor Anibal Ollero, Scientific Director of FADA-CATEC and Director of the GRVC Group, was the scientific and technical coordinator of the COMETS (<http://grvc.us.es/comets>) FP5 project (2002-2005) on the coordination and control of multiple heterogeneous unmanned aerial vehicles with demonstration in the detection and monitoring of forest fires (see Figure 1). He has been also the coordinator of the AWARE (<http://grvc.us.es/aware>) FP6 project on the integration of multiple UAS with ground sensors and actuators. AWARE, demonstrated for the first time the joint transportation and deployment of a load by several autonomous helicopters (see Figure 2), developed the first fully electrical autonomous helicopter capable of transporting a load of 7 Kg, and different techniques for the distributed cooperation of multiple autonomous helicopters and ground wireless sensors and actuators networks. These results were awarded with the second EURON –EUROP European Technology Transfer Award (2010) and are being successfully commercialized by companies.



Fig.1: COMETS FP5 project: Unmanned helicopter with visual and infrared cameras monitoring and obtaining measurements of a fire.

In FP7 FADA-CATEC is the coordinator of the Integrated Projects EC-SAFEMOBIL and ARCAS in which the University of Seville is a partner. Prof. Ollero is the coordinating person of both projects. EC-SAFEMOBIL includes as objectives the autonomous landing of UAS (rotary wing and fixed wing) on mobile platforms, the deployment of small UAS from manned aircrafts, and the simultaneous tracking of multiple ground targets with multiple UASs involving collision detection and avoidance between the aircrafts. The ARCAS project is devoted to the development of a system of multiple aerial robots cooperating in assembly tasks. This project includes the

development of autonomous helicopters and quadrotors with robotic arms for cooperative manipulation in missions such as maintenance and assembly of structures in inaccessible sites.



Fig. 2: AWARE load transportation with one (left) and multiple (centre) unmanned helicopters. Deployment of the load on the top of a structure simulating a building.

Both University of Seville and FADA-CATEC are partners of the CONET Network of Excellence, where multiple cooperating systems are researched, and of the PLANET FP7 Integrated project on the deployment of wireless sensor networks by means of UAS with two applications scenarios: environment (flora and fauna) monitoring in the Doñana Biological Reserve, and the simulation of a fully automated airport by using unmanned aerial and ground systems. Professor Ollero is the associated coordinator of both CONET and PLANET. These projects also consider collision detection and avoidance in multi-UAV systems.

Moreover FADA-CATEC is a partner of the FieldCopter project on the application of UAVs to precision agriculture (water stress, monitoring, detection of nutrient deficiencies and crop diseases), and will be the leader of the PEOPLE project MUAC-IREN on long endurance UAV missions with DLR (Germany) and the University of Sydney (Australia) as partners.

The GRVC group of the University of Seville led also a long list of UAS Spanish projects including CROMAT (2003-2005) on the coordination of unmanned aerial and ground vehicles (see Fig. 3), AEROSENS (2006-2008) on the integration of UAS with wireless sensor networks (see Figure 4) and ROB AIR (2009-2011) on the safety of UAS and aerial robots. Furthermore, GRVC University of Seville will lead the project CLEAR (2012-2014) on long endurance cooperative UAS missions with the participation of FADA-CATEC. The GRVC University Group also participated in the PLATINO UAS initiative working in the HADA (Helicopter Adaptive Airplane) project and the SATA (autonomous landing) project.



Fig. 3: CROMAT project on the coordination of aerial and ground unmanned aerial vehicles. Left the autonomous helicopter HERO being transported by the unmanned ground vehicle ROMEIO 4R. Right, landing of HERO on ROMEIO 4R.



Figure 4: Fixed wing UAV developed in AEROSSENS with a node of the wireless sensor network.

GRVC also participated in the ATLANTIDA CENIT Spanish project on automation of air traffic management with demonstrations by means of UAS, and in many contracts with companies for the development of autopilots, collision avoidance methods, autonomous landing methods, human-machine UAS interfaces, integration of UAS in SWIM, Mobile Ad hoc Networks using UAS, and many UAS applications including building inspection (HELINSPEC, Figure 5) and environment monitoring (SADCON project).

FADA-CATEC is also participating in many Spanish UAS projects including the above mentioned PLATINO initiative, the CENIT project SINTONIA on UAS with Zero Environmental Impact, the PROMETEO project on the application of multiple UAS to forest fire fighting and many other contracts with companies including the development of UAS autopilots and control systems for autonomous helicopters and fixed wing UAVs, UAV communications, and UAV applications for inspection.

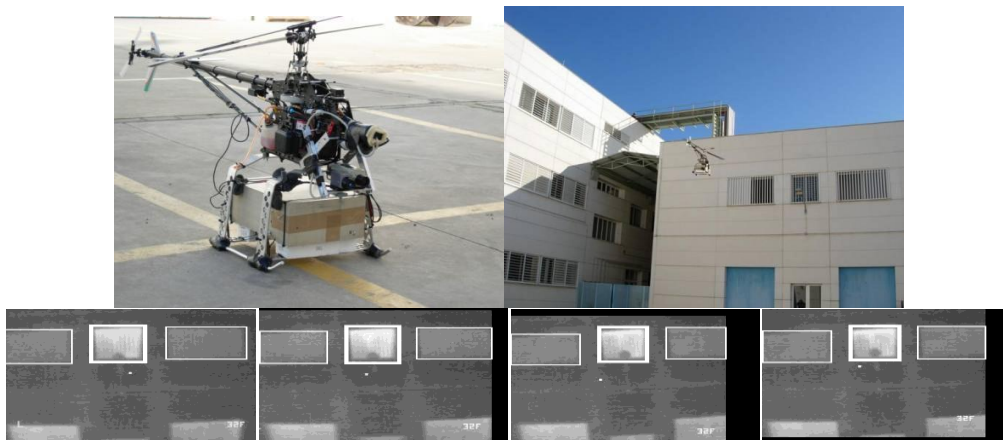


Fig. 5: HERO 3 helicopter performing thermal inspection of a building of the Engineering School in the HELINSPEC project.

Both FADA-CATEC and GRVC University of Seville are participating in the new ADAM (automation of autonomous mobility) and PERIGEO (research on space technology on a UAV platform) which are two of the seven projects recently approved by the Spanish INNPRONTA Program.

FADA-CATEC has a fleet of fixed wing (Figure 6) and rotary wings (Figure 7) UAS from 2 Kg to 35 Kg. payload. The CATEC facilities include an indoor testbed (15x16x6 m), one of the largest in the world, with the VICON system for positioning of 20 aircrafts and ground mobile objects. Moreover FADA is constructing the ATLAS facilities (800m x 18 m runway and hangars) for UAS development and testing with an aerial space of 35x30 Km and 5000 ft. height.



Electrical 2Kg payload



Combustion 5 Kg payload



Combustion 30 Kg. payload

Figure 6: CATEC fixed wing UAVs



2 Kg payload



Electrical. 5/7 kg payload



35 Kg payload

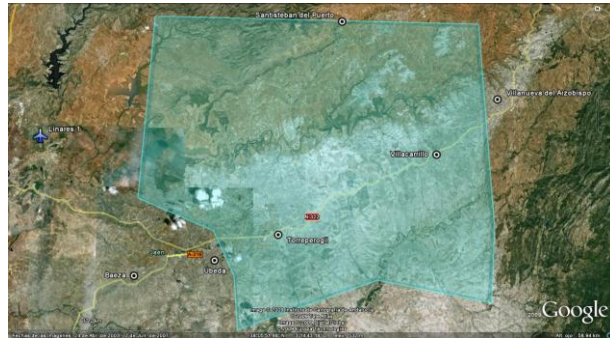


Quadrotor 0.3 Kg payload

Figure 7: CATEC rotary wing UAVs



Indoor testbed with the VICON system



ATLAS location near Villacarrillo (Jaen, Spain).

Figure 8: CATEC indoor testbed and ATLAS laboratory for UAS experimentation and testing