ASTRAEA

By Nick Miller, Council Member

ASTRAEA is a pioneering aerospace programme which is addressing key technological and regulatory issues in order to open up non-segregated airspace to unmanned autonomous aircraft.

The ASTRAEA consortium includes BAE Systems, EADS, Flight Refuelling, QinetiQ, Rolls-Royce, Thales, Agent Oriented Software and the Universities of Cranfield, Leicester, Loughborough, Sheffield and Lancaster. In addition, a number of the most innovative small companies and leading academics are also involved.

ASTRAEA is supported by the Technology Strategy Board (TSB), UK Industry and at regional level to ensure that the aerospace industry maintains its global strength and develops world class technologies in line with the National Aerospace Technology Strategy.

Background

For Unmanned Aircraft Systems (UAS) to be routinely used for common operational missions, autonomous systems technology will require significant development. The current regulatory framework (as defined by the UK Civil Aviation Authority and EASA) will also need to be interpreted to enable UAS to operate alongside manned aircraft.

ASTRAEA is initially a three-year £32 million programme (2006-2008) and it is intended that it will pave the way for commercial UAS to operate autonomously in non-segregated airspace within the next decade.

There are numerous potential applications for UAS. There would be obvious benefits for 'blue light' services tasked with patrolling motorways or needing an aerial perspective of major incidents, and also for environmental organisations wanting to systematically monitor coastlines, waterways and large tracts of land. In fact, autonomous UAS carrying sophisticated imaging or sensing equipment could be used in any situation classed as 'dull, dirty or dangerous,' including air-sea rescue and disaster relief.

The technology being developed by ASTRAEA will address issues such as Ground Operations and Human Interaction; Communications & Air Traffic Control; UAS Handling; Routing; Collision Avoidance; Multiple Air Vehicle Integration; Prognostics & Health Management; and Decision Modelling.

The programme also incorporates 'demonstration' projects: Propulsion & Power; Affordable Technologies including a UAS engine; and finally the verification and demonstration of technologies, either singly or as integrated systems.

Regulations

If UAS are to be accepted into UK airspace, not just by regulation and design - but by other airspace users, then the established European-wide principle of 'Equivalence and Transparency' (e.g. CAP722 and the JAA/Eurocontrol Task Force) needs to be unequivocally held up and demonstrable. Notably there are instances where the concept of 'Equivalence and Transparency' becomes difficult - because a UAS cannot be anything but different to a manned aircraft. Current rules and regulations governing routine manned flights have evolved over more than 100 years and this knowledge, learning and confidence cannot be ignored in introducing a new technology. Clearly, it is for the technology to demonstrate its applicability to the existing framework and argue that it can be considered at least 'as safe'.

ASTRAEA has four regulatory projects:
- Good Airmanship - Assessing acceptable levels of UAS Good Airmanship to ensure adequate safety levels and a framework for developing Certification and Operational Rules
- Route to Compliance - Investigation of the means of achieving clearance of UAS system designs
- UAV Operations and Procedures - Framework for UAS operation, with reference to current manned aircraft rules
- Integration with the Operating Environment - Analysing the issues of integration of UAS into the existing and emerging Air Traffic Control infrastructure.

Technologies

Replacing the pilot with automated and increasingly autonomous systems requires certain areas of technology to be developed substantially beyond the current «state of the art». Often this development is concerned with putting together a certifiably safe system with current technology and in other areas this involves technology development itself.

ASTRAEA has 8 eight projects in the technology arena:
- Ground Operations & Human System Interaction - looking at technologies and procedures that will be required on the ground;
- Communications and Air Traffic Control - examining what data a UAS will need to send and receive and is researching the communications technology needed in the context of WRC 2011 requirements;
- UAS Handling - researching and developing technologies for autonomous handling;
- Adaptive Routing - developing the technology to enable an aircraft to modify its own flightpath and adapt its route in response to a variety of situations;
- Collision Avoidance Systems - verifying the merits of enabling technologies and system capabilities that could be used by UAS for collision avoidance;
- Multiple Air Vehicle Integration - researching technology, procedures and protocols to enable formation of multiple aircraft (UAV and/or manned aircraft) ;
- Prognosis & Health Management - providing technology and systems to enable UAS to monitor their own state, and to make decisions on how best to maintain optimal mission performance;
- Decision Modelling - developing a robust and certifiable system that will provide an on-board decision-making

capability replicating all the reasoning functions of the pilot;

Demonstrations

Demonstrations are a key part of the ASTRAEA programme and are a driver behind increasing the technology readiness level (TRL) of relevant technologies as well as providing the basis for resolving system integration issues and assessing overall performance.

Experiments and demonstrations are being performed both for individual technologies and for integrated systems. Demonstrations can be simulated using developed modelling capabilities or physical flight trials.

Progress so far

ASTRAEA has been successful in increasing the Technology Readiness Levels of a number of technologies and has allowed the consortium members and its allies to better understand the technology requirements and system integration issues associated with UAS operation in non-segregated airspace. In particular ASTRAEA has had major influence on the recently released version of the UK Civil Aviation Authority guidance document for UAS, CAP722.

The conclusion of ASTRAEA so far is that UAS flight in non-segregated airspace is technically feasible by 2012, but that the challenge remains in proving this fact.

Further Information

For more information and details of ASTRAEA conferences and activities see the web site: www.projectastraea.co.uk

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