



**ROYAL
AERONAUTICAL
SOCIETY**
Loughborough Branch

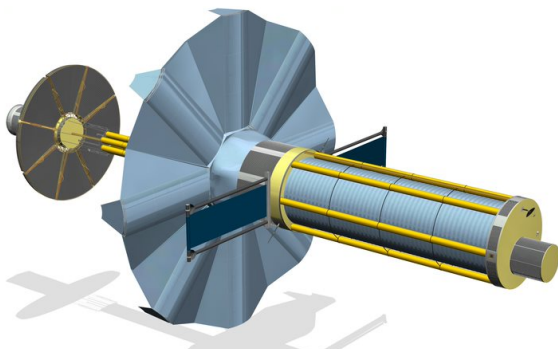
12 June 2018
Group Design Project Presentations
Joint event with Loughborough
University
Department of Aero and Auto
Engineering

This now regular annual event introduced the branch members to a wider range of projects than ever. Seven projects, all concurrently run as team design exercises in the final year of the Aeronautical Engineering MEng degree course, were introduced at a pre-presentation exhibition in the Edward Herbert Building.

To balance overall time, and time available per team, the presentation session was limited to five projects. The two projects not presented involved hardware designed and built to be tested. They had demonstration trials that were to take place imminently – so their final ‘presentations’ were to be practical and competitive, and in the ‘field.’ We hope to add feedback on their performances in due course. A brief description of each is included here.

Each team comprised typically 8-10 students and was allocated typically 15 minutes, plus around 10 minutes for a Q&A session. In this review there is a summary of the project (boxed text) with an illustration – each provided by the team: plus a brief critique based on the reaction of branch members in the Q&A sessions and in summing up.

Amplius – stationary X-ray laboratory



Amplius is an orbiting X-ray observatory, designed to investigate the formation of black holes and the distribution of hot gas clusters in deep space. Amplius is part of the ESA's Cosmic Vision programme, which runs from 2015-2025. The planned mission lifetime is 5 years, with an option to extend to 10 years, orbiting at the Sun-Earth L2 Lagrange point. Amplius has the largest focal length of its kind, 25m, allowing it to see further than ever before

There was fascination regarding the Lagrange point (check descriptions on the web – no explanation attempted here). The team showed that the L2 point (one of the five possible mathematical solutions) is the one that will mask the X-ray telescope from Sun and Earth influences. The presentation impressed with its array of disciplines, from orbital mechanics through sensor specifications, power consumption needs, details of how the large structure would unfurl and be lightweight and stiff, plus mass, timescale and cost estimates.

Mako – wing-in-ground effect vehicle



The MAKO is an exciting, new recreational water sport vehicle that brings the fast-paced thrill of flight to the marine watercraft market. Utilising the Wing-in-Ground Effect, the MAKO is able to fly close to the water at speeds up to 85 kilometres per hour, achieving a total endurance of 1 hour and 24 minutes and a maximum range of 121 km. The MAKO operates within the legislation of the International Maritime Organisation, permitting it to be operated without a pilot's licence. The craft will be sold to private owners and rental companies around the world, bringing a novel water sport experience to the masses.

It was fascinating to witness the configuration development of this lightweight one-seat design, and to note that a 65hp Rotax engine outperformed a more eco-friendly battery-electric propulsion system. It will cruise low – typically over water – at barely 2-2.5m altitude. Flying-boat legacy was apparent when the team pointed out that a 'step' in the under-surface was a small but vital design feature to reduce take-off length by about 30 per cent. Expected to vie for market share with jet-skis, the design was costed at 31,000USD, compared to 10,000USD for a jet-ski.

Andraste - attritable UAV



The Andraste aircraft provides a novel solution to the idea of an attritable aircraft – a low cost, semi-expendable autonomous system. This versatile airframe could increase capability of air forces across the world. Specifically designed with the Royal Air Force in mind, the Andraste provides an aerial platform for intelligence gathering and the capability to be easily converted into a strike configuration at the end of its service life thus fulfilling both Intelligence Surveillance Target Acquisition and Reconnaissance (ISTAR) and Suppression of Enemy Air Defences (SEAD) roles.

The design team had taken on-board a modern military requirement – and the jargon too: the Chairman's summing-up ratified 'attritable' in a web search. The choice of a bespoke engine revealed a justification for a small (0.33m diameter, 0.815m long) design, and the systems integration aspects illustrated potential 'tablet'-style interfaces for in-the-field users. Multiple roles were proposed and reuseability explained – but expendable when used as a weapon. A video of a 'skyhook' recovery system showed two dummies snagged from the ground and into an aircraft on cables. (That must never be shown to a Ryanair executive!)

Amp-air – hybrid electric airliner



AmpAir is a Hybrid Electric Airliner projected to enter service in 2030. It has a stage length of 1000 nautical miles. The high aspect ratio folding wing allows efficient flight whilst maintaining CAT C airport span requirements. The aircraft utilises two two-spool high bypass geared turbofans to produce 75% of the flight thrust. The remaining 25% of the thrust is produced by six 0.5MW ducted fans. These are powered by a DC Turbo-generator located in the belly of the aircraft. Using this method offers a significantly reduced SFC as well as a lower noise signature compared with competitor aircraft.

This was a 100-seat airliner for the future that sought to show advantages over conventionally-powered similar-size aircraft. The configuration presented was justifiable and commendable, but a range of less conventional-looking options did tease the innovative spirit. The concept addressed operational and environmental issues in a tradeable manner: give and take with some pragmatism. It fell short of what press reports extol and exemplifies what must be regarded as a fairer expectation if sights remain set on early acceptance of the new technology. Positively – it would certainly reduce CO₂ and NO_x emissions and present a significantly smaller noise footprint than existing aircraft.

HEGAAsas – hybrid-electric general-aviation aircraft



The HEGAAsus family of aircraft brings the latest development in hybrid powertrain technology to the 4 and 6 seat general aviation market, carrying its passengers up to 1000nmi at speeds in excess of 200kts. Thanks to its hybrid powertrain, which optimises energy utilisation through two electric motors and a diesel engine, fuel burn is reduced by up to 50% compared to its nearest competitors. The HEGAAsus is due to enter into service in 2028 and aims to mark a step change in air travel.

An eco-general aviation aircraft project added emphasis to the intense pressure on aviation to find more energy-efficient product options. This joint project with Virginia Tech was based on an AIAA requirement for a design with 75% compatibility of a 4-seat/1000n.m. (EIS 2028) and a 6-seat/750n.m. (EIS 2030) that was also compliant with existing FAR performance criteria. Again, novel configuration options gave way to a degree of conventionality, but what looked to be a three-engine aircraft proved to be an aircraft that took-off and climbed using a conventional engine, and used electrical power delivered through two stowable propellers on the wing. The team had to face issues such as the mass distribution of the large electrical power storage requirement and chose a fly-by-light flight control system. It was a refreshing finale to the presentation session.

... The two practical design projects follow ...

“MediFetch” Medical Express UAS

There has been a long-standing need for rapidly accessing remote locations with limited infrastructure, particularly transporting medical supplies in large and less developed countries. Medifetch is a fully-autonomous Unmanned Aerial System (UAS) that aims to fulfil this need. The 6kg tail-sitter aircraft can deliver or collect a small amount of medical supplies between several locations within a 60km radius, in under one hour. A vertical take-off and landing capability enables operations from constrained environments, such as residential gardens, which can be visually indicated with a ground target. The Medifetch system is the future of emergency medical logistics.



This project has been under scrutiny for use in remote locations for several years, and the poster notes (above) indicate a requirement now for a low-cost and yet versatile method of providing prompt assistance/support to medical teams that cannot carry or necessarily store vital supplies. The tail-sitter configuration seems to be novel and very sensible: we wish the team well in any trials.

“Phoenix” Unmanned Aircraft System

Team Newton Works is the Loughborough University entrant to the 2018 IMechE Unmanned Aerial Systems Challenge for which teams are to design, build, and demonstrate an autonomous humanitarian disaster relief aircraft. The system must autonomously air drop packages onto ground targets and identify alphanumeric ground targets. This year, the team aims to double the previous payload capacity to 4kg and utilise on-board independent image recognition system. With these key innovations, a highly modular and competitive system has been produced with a view to uphold Loughborough University's high standing within the competition.



The Branch has followed previous models developed and entered into the annual IMechE UAS challenge, and been delighted to record successes in the various categories against which entrants compete for prizes. This poster notes suggest that the current team is almost on a clean-sheet this year, with higher payload and more capable target recognition capability. We wish everyone involved a set of successful and prize-worthy performances.

This was, once again, a very satisfying way to conclude the Branch's annual programme.

*Presentation notes by Mike Hirst
(with kind support from the LU Aeronautical and Automotive Engineering Department)*