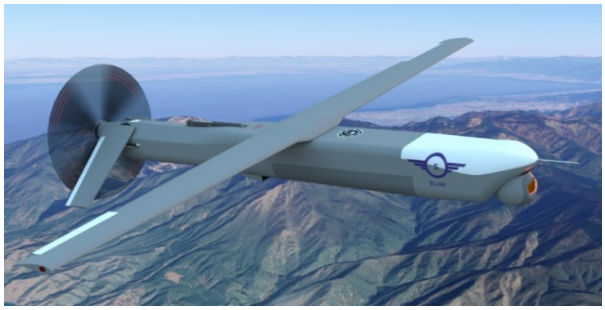
ROYAL AERONAUTICAL SOCIETY
LOUGHBOROUGH BRANCH

11 June 2019
Group Design Project Presentations
Joint event with Loughborough University
Department of Aero and Auto Engineering

As another academic year came to an end, the design skill of A&AE department students revealed yet again a proliferation of activity that spans an enviable range of air vehicles. They varied from simple to sophisticated, and between large and small. Ordinary traditions seemed to have been side-lined, as there were neither airliners nor military manned role-specific types. Even so, the variety of projects was wider than ever. Environments ranged from an example that started its profile from a sub-maritime vessel, to one that could cruise in a hostile environment 1,450 million km from Earth: the atmosphere of Saturn's largest moon, Titan. Three of the five projects were unmanned, and only two were configured to carry human payloads. One of these was a terrestrial aircraft, and the other was for lunar-orientated applications.

The presentations were conducted in what has become a traditional style, each team allocated a nominal 20-minute period sub-divided into two stages. First was a presentation handled by a subset of the project team acting as specialists to address topics or discipline, and this was followed by the whole team facing the audience to answer questions.

SLUAV - Submarine Launched Unmanned Aerial Vehicle



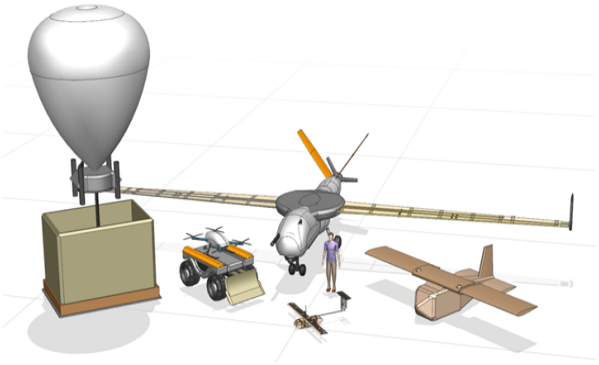
Design team description (pre-presentation)

Launching from the torpedo tube of a submerged UK/US submarine, SLUAV is the first of its kind. The system can penetrate up to 100km into coastal regions to support submarine staged Special Forces missions. SLUAV provides battlefield intelligence and communications link capabilities to troops on the ground and commanders at home, boosting troop safety and mission success rates. A modular design allows the already state-of the art on board systems to be configurable and ultimately replaced with upgraded technology. Multiple recovery mechanisms ensure that SLUAV can meet the needs of the most dynamic and demanding missions.

The project was based on UK and US strategic plans. In presentation and debate the team explained the constraints of using a torpedo cross-section, with mass and mission expectations. Especially as this was to be a reusable device a mixture of novelty and pragmatism was essential. A mass target of 136kgs had to be balanced with a mission that involved launch, deployment, transit, mission, and recovery for re-use, and a realistic unit cost. They assessed $840K initial cost and $16K cost per re-use. They showed physical design and propulsion solutions with descriptions of reasoning.

Attendee questions were often looking for detail that the team answered fairly. They were consistent with showing that their trade-off options were very demanding –their reasoning was supported by good justifications.

Airborne Disaster Relief System (ADRS)



Design team description (pre-presentation)

Natural disasters occur at unpredictable intervals across the globe. Despite increasing technologies, humanitarian disaster relief continues to be challenging due to a lack of intelligence reporting, precision aid delivery capabilities, and local communications infrastructure. ADRS will represent the future lead element of a UK response to natural disaster, acting as a rapidly deployable capability to be held at Very High Readiness. It consists of a palletised, modular system comprising of five platforms, each of differing capabilities aiming to provide what current disaster relief efforts cannot: reliable intelligence reporting, communication links for survivors, and precision aid delivery.

An initial impression can be misleading, and the apparent menagerie of indecision seen on the illustration was revealed in presentation as five well-justified and requirement-related elements that met demanding humanitarian mission criteria.

The elements: revealed as ECAN, RHINO. AIRSHUTTLE. PATHFINDER and SHERPA were not only role-specific but also suited to container deployment in RAF-operated C17 and A400 aircraft. The system was designed with the 2010 Haiti earthquake disaster as a benchmark, and aimed to be compatible with the 'strategic lift' and 'last mile' stages of plans used in such missions.

The team revealed a determination to balance humanitarian, logistical and commercial needs with a justifiable solution that addressed owner, operator and customer requirements. This was not idealism on paper. It avoided a 'one-size fits all' solution – and had commendable and unique qualities.

Project SkyRide Hybrid Air Taxi

Design team description (pre-presentation)

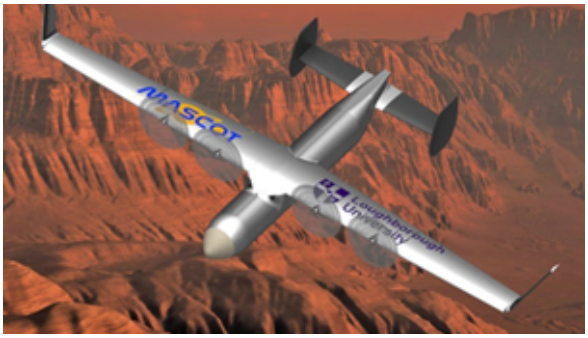
The Project SkyRide Hybrid Air Taxi, the S270, is a small aircraft designed to increase regional mobility and ease traffic congestion in US. The S270 can transport up to 4 passengers over a standard distance of 135 nm, with a total journey time of 65 minutes. Operating costs are minimised through the use of an innovative hybrid electric propulsion system, which provides fully electric take-off, climb and landing, minimising harmful carbon emissions and noise. Low noise reduces the risk of complaints from the public and hence increases likeliness of commercial success. The S270 also benefits from a spacious cabin, designed to enhance passenger experience.

As US air-taxi demand for commuters (who have long surface journeys and face high road congestion) grows, this project aimed to create an environment-friendly solution. A benchmark was the Cirrus SR22 that is already used by many commuters.

The most significant improvement was the selection of a hybrid propulsion system, with low noise levels a leading design commitment. A fly-by light (fibre-optic) flight control system was aligned to a low-set wing and V-tail surfaces.

Attendees expressed concern about operational capability in icing conditions. This is understandable, but such a design objective is not regularly addressed for this aircraft category. It does seem a sensible necessity for current aircraft in similar usage, so more a warning for users overall than a criticism of the project.

"MASCOT" Titan Aerobot



Design team description (pre-presentation)

MASCOT is a project that has designed an Orbiter, UAV and Atmospheric Entry Vehicle (AEV) to explore Titan. MASCOT's objectives are to analyse the atmospheric composition and piece together a detailed 3D map of the surface to enhance the scientific findings already found from past flybys and missions to Titan. The design of the UAV makes use of a high aspect ratio configuration with a wing span of 7.5m to utilise Titan's high density and low gravity atmosphere. An expected lifetime of 5 years and capability to map 5.5% of Titan's surface, MASCOT could provide insight into whether extra-terrestrial life could exist on Titan.

This was a more complex vehicle design task than the team description suggests. It looks a familiar configuration, but it had to be compact for the journey to Saturn. It used folding wings, and a H-tail to limit space. The designers could not use an ISA chart – their knowledge of the atmosphere on Titan was almost a lesson on its own.

It was an engaging presentation and might have benefitted from a clearer structure, but I will blame that quantity of necessary content, and the limited time allocated.

Overall this was a project that needed clear thinking to find viable and robust solutions. The processes used cannot be faulted. Asked to fit a gallon into a thimble about sums up this audacious task. The team did a fine job of presenting a credible solution, and deserve to be commended for reaching a credible solution.

Reuseable Lunar Surface Access Vehicle

Design team description (pre-presentation)

The LSAV is a reusable lunar lander concept, designed to meet NASA's requirements for a vehicle to travel between an orbiting lunar space station and the lunar surface autonomously. The vehicle operates in separate cargo or crew modes, carrying a 15-tonne payload down and 10 tonnes back, or supporting a crew of 4 for up to 8 days. The vehicle is a two-stage modular design, consisting of a 'booster' stage to transfer from a halo orbit to a low lunar orbit, with the lander stage then completing the journey to the surface.

Based on a NASA requirement, this was to be a capsule that would maintain the replenishment of consumables, and the carriage of personnel to/ from a lunar site. The cargo and crew modules were shown to be compatible with a core services unit that could dock to transfer payload in orbit. The vehicle could also land on the Moon too to transfer loads directly.

The presentation of any space-related project, and in a limited period of time, is a challenge for a team that is concentrating on presenting their prowess at balancing vehicle properties in their design studies.

For these projects it may be appropriate that a timescale is proposed that will allow more time. In the cases addressed this year, had the space projects received extra minutes would have been less constrained in mixing essential scientific content, and the detail their design work can justify.

This was the sixth, and almost certainly most diverse, set of student design presentations presented annually to the Branch. To the academic staff who attend, there should be pride in seeing the quality and quantity of work that is revealed each year, and take credit for their part in contributing as mentors. To those from the wider local community, the message surely has to be that Loughborough University is well aware of how technology, science and learning is being integrated using capabilities that enable progress to be achieved year after year. The audience, in excess of 100, was evenly spread across RAeS branch members and university students.

Session notes by Mike Hirst

This year the session hosted a special guest, Sir Brian Burridge, CEng, FRAeS, and Chief Executive Officer (CEO) of the Royal Aeronautical Society. He attended the full length of the sessions and addressed everyone present at the end.

Regarding the student presentations he stated:

"….those presentations and the activity that underpinned them was just superb. I thought that the creativity that was on show, the sense of inquiry, and the clarity with which that came across was absolutely first rate …. my thanks, congratulations and admiration to all the teams."

He expressed his beliefs in the need for the RAeS to have, and to support, branch activities,
and took the opportunity to express his desire that they deliver insights into emerging technologies to students and the public. He stressed the diversity of new avenues, ranging from artificial intelligence to quantum physics, and was pleased to see various examples of these gathering capabilities attributed in the session he had just attended.

He reflected on how aeronautical progress prospered in earlier years, that many older engineers can recall being amongst, and his belief that we may be on the cusp of equivalent changes and see these opportunities anew for emerging talented engineers. They need to be ready to face questions and to offer solutions. The questions that need to be answered … why, when, how much, and most of all is it safe?

His words rounded off our final meeting of the Branch 2018-19 programme. His positive words of support will contribute to the resolve of the Branch and to its members, friends and other supporters.