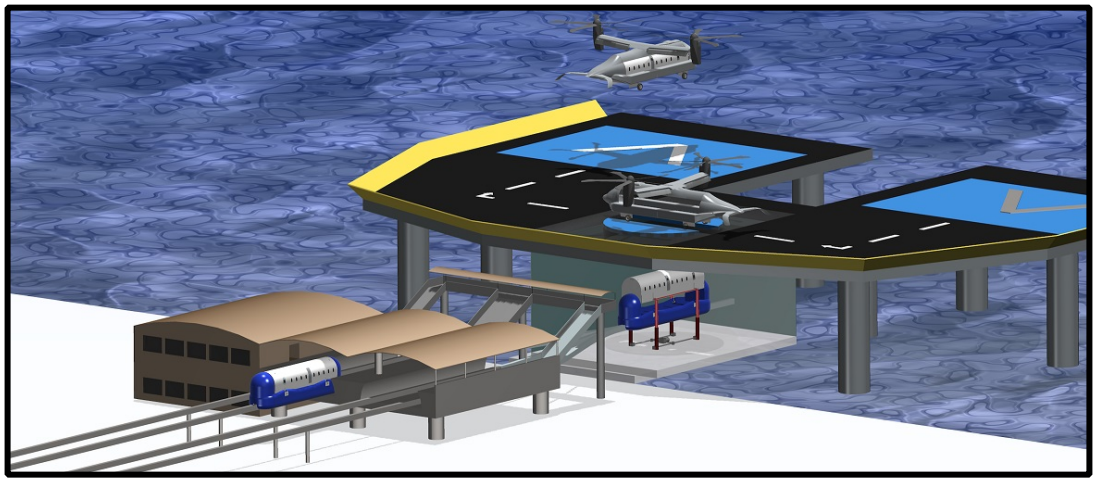
Presentations by Loughborough University final year students on the MEng Aeronautical Engineering programme

This was an additional meeting on the annual Branch programme, and which is now planned to become an annual event. It was held on the university campus, and open to all members and friends of the Branch and the general public. The university has a long-standing aim to incorporate a design project within its programme, and in year 2013/14 a class of 55 students considered the challenges posed by requirements for four diverse air-vehicle applications. The work conducted represents one-quarter of their final year assessment, and the applied tutoring objectives encourage the exploration of design to conceptual design stage, the selection of a configuration and further work into preliminary design to generate evidence that justifies the project's claimed technical and financial viability.

Presentations were made by each of the four student teams (the presenters were four in number, selected by their colleagues) and each team was allocated 20 minutes for their presentation and 10 minutes for question and answers. This report provides a brief summary of the presentations, and an illustration of each project.

ODYSSEY – high-speed transport



This project addressed the fact that travel door-to-door is often a race between the fast aeroplane and slower surface transportation options, and sought to eliminate time lost in inter-modal transfers by using a tilt wing/rotor air-vehicle that used small land space, and which required minimal infrastructure as passengers arrived/departed in 'pods' which were railway compatible when on the ground, and integrated into a self-contained air-vehicle element when airborne. The ground system delivering pods to/from the airport was to be monorail-based and allow 'no seat change' rapid transport between a large combination of departure and arrival monorail stations. The aircraft was state-of-the art, but unique.

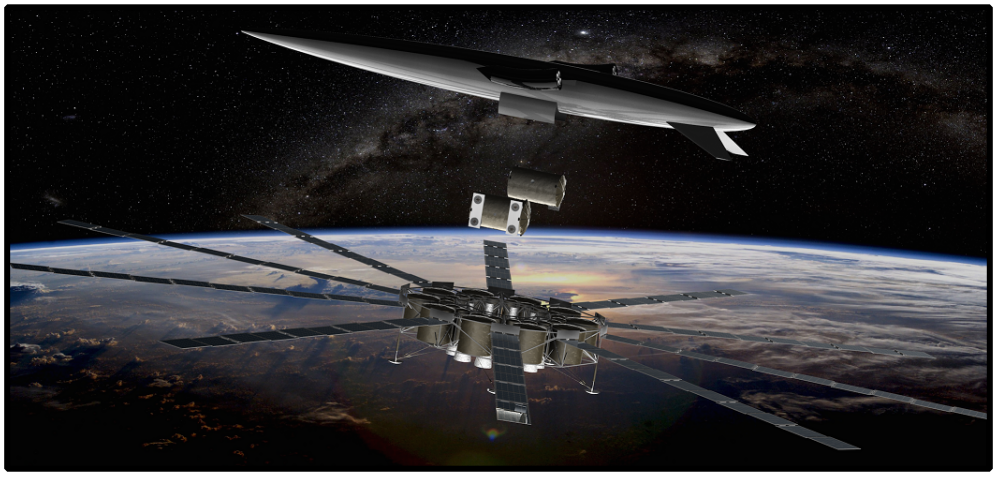
Presentation showed analysis of the system in the US north-east region, with staged development of the infrastructure and aircraft/pod fleet and provided a comprehensive illustration of the challenge that aviation can present to equivalent surface-transport options. They showed that high-speed rail projects are more land-hungry, less flexible (in evolution and service options) and more expensive to create and maintain.

AIRCRAFT FOR AFRICA

Currently providers of humanitarian services in Africa face logistical problems created by poor ground transportation and changeable weather conditions. They utilise conventional aircraft to provide low-volume services, but these are relatively expensive to operate, require considerable airport provision, and are sourced from non-African industries. The project sought a way of developing a low-cost air-vehicle that would fulfil needs, and could be sourced and supported from a factory in Africa.

On concluding the conceptual stage they chose an autogyro, and designed a two-seat vehicle that used modern materials (in the rotor especially), and off-the-shelf (OTS) engine (VW 'boxer') and landing gear items (used motor-cycle components) to minimise cost and parts count. They attained a 115-part (95% OTS), £7,900, aircraft with 577kg gross mass which met 'ultra-light' certification requirements. Presentation data showed it attained adequate performance to meet the proposed application needs, and they illustrated an outline plan for a factory that was to be based in South Africa.

VIPER – lunar resource exploration



This was a far-reaching project that aimed to show how high-value resources mined or created on the Moon could be conveyed to the Earth, and how the necessary support facilities could be configured, and manpower moved between locations. It envisaged a

three-part vehicle system; central to it was the transporter module, associated to an Earth to low-earth orbit (LEO) aircraft - HORIZON: and an Earth LEO to lunar vehicle – ENVOY.

The transporter module had two levels: primarily carrying passengers (2 to 6) on the top deck, and up to approx. 3 tonnes of cargo on the lower deck.

ENVOY was designed to be constructed and maintained/refuelled in space. It used existing liquid oxygen and hydrogen fuelled engines and was based on a 25m-diameter frame with fuel tanks around a central area. This accommodated the ten rocket engines that surrounded the transporter module. The frame periphery had a large solar panel array.

HORIZON was 'Skylon'-like (emphasised to be very different airframe, but based on the same SABRE engine concept) which would carry the transporter module internally. Its ground-based needs were outlined, and the typical orbital-insertion trajectory explained.

The concept was summarised as offering much more economical performance than existing support systems, as used by the International Space Station (ISS) programme.

OVERWATCH – swarm and search

This project was packed with innovation aimed at addressing the problems facing a mountain rescue organisation. They need to scour large areas rapidly, often in inclement weather, and against a timescale that determines the survivability chances of those being sought. Having selected a configuration the team developed a full-scale proof-of-concept vehicle, and catapult-launch mechanism, and showed film of trials conducted during the study period. It was also capable of being hand-launched, and they had mounted and used a camera on the prototype.

An innovative aspect was the need to use several aircraft so they investigated a 'swarm' of between 6 to 10 units covering the search area attributable to a conventional search team with two Landrovers. The 10 swarm units fitted on the Landrover roof-racks, and assembly of each unit on-site took 2 minutes.

Matlab models had been used to investigate dynamic performance of the swarm: this confirmed coverage capability and the ability to included contingency for completing search even in the event of a unit failure. The simulation suggested that a search normally requiring 4.5 hours could be completed 74 minutes. In their summary the team pointed out extra work still necessary – such aspects as target recognition and collision avoidance.

The event attracted about 80 regular RAeS Branch attendees. The Branch Secretary, Colin Moss, expressed his own pleasure at the quality and substance of the presentations, and could well have said more without fear of contradicting the majority of the audience. On behalf of the Branch he wished the students well in their subsequent careers, and expressed the desire that the presentation will become an annual event on the Branch calendar.

Meeting notes by Mike Hirst