QUB- Mechanical and Aerospace Engineering

PhD Project 2021-22

Hybrid titanium–CFRP thermoplastic laminates for bolted joints of high-performance maritime vessels

Project Background:

Artemis Technologies is developing a zero-emissions maritime vessel (Fig. 1) based on e-foiling technology developed as part of its America's Cup campaign under its previous name, Artemis Technologies. The maritime structure makes extensive use of carbon fibre composites, in particular, the vertical fins and foils which are assembled with mechanical fasteners.

Fig 1: concept of a high-performance vessels

Mechanical fasteners in composite laminates have low efficiency (about 30%) and the corresponding joints are vulnerable to numerous failure modes. This often entails increasing the thickness of the laminate around the joint, to reduce stress, which has the undesired characteristic of increasing weight.

One strategy (used for the Ariane 5 payload adaptor (Fig. 2), for example) is that of local hybridisation of the composite laminates. Local hybridisation consists of substituting some of the composite plies with metallic (e.g titanium) foils.

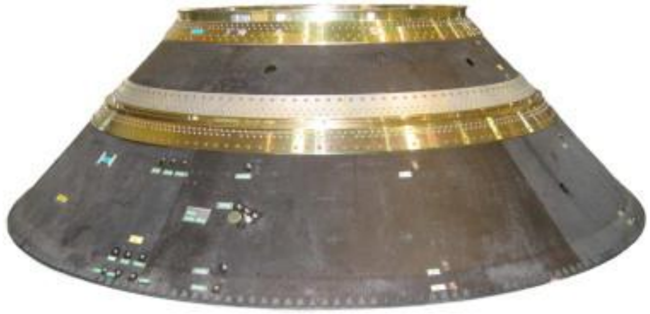

Fig. 2: Ariane 5 payload adaptor.

This technology, developed for the aerospace industry, will be adapted for use on the Artemis vessels. It is envisaged that the composite will not be a thermoset, but a thermoplastic to exploit its advantages over thermosets. Titanium is very resistant to corrosion (including galvanic corrosion) and it is thermally stable.

This PhD programme will encompass aspects of structural design, material characterisation in maritime environments, including fatigue testing, computational modelling and structural testing.

Project Description:

The successful candidate will work in close collaboration with a PDRA and will focus on:

- Investigation of the manufacturing process and methodologies to improve adhesion between the dissimilar materials.
- Experimental determination of strength and fracture properties.
- Numerical modelling of the joint in close collaboration with Artemis Technologies
- Full-scale test of the joint and correlation with experimental results.

Key skills required for the post:

Applicants should hold or expect to hold a 2.1 Hons (or equivalent) degree in a relevant discipline such as Mechanical Engineering, Materials Science or in a related field. Students who have a 2.2 honours degree and a Master's degree may also be considered, but the School reserves the right to shortlist for interview only those applicants who have demonstrated high academic attainment to date.

It is essential that the candidate has an enthusiastic attitude towards undertaking research in the field of polymer composites and is willing to travel to both academic and industrial collaborators for placements, training courses and dissemination activities.

Key transferable skills that will be developed during the PhD: These will include an ability to effectively communicate research outcomes to academic peers and industry, independent analytical thinking and problem solving, time management, and leadership.	
Supervisory team:	Prof Brian G. Falzon School of Mechanical & Aerospace Engineering, Queen's University Belfast, b.falzon@qub.ac.uk, 028 9097 5640 Dr Giuseppe Catalanotti, School of Mechanical & Aerospace Engineering, Queen's University Belfast, g.catalanotti@qub.ac.uk
Funding mechanism:	UK nationals only.
Application closing date:	31st July 2021
Guaranteed stipend	£15,285 tax free. PhD students in the School may have the opportunity to apply to be demonstrators on undergraduate modules. Compensation for this can amount to in excess of £2,400 per year.

Queens University Belfast is a diverse and international institution which is strongly committed to equality and diversity, and to selection on merit. Currently women are under-represented in research positions in the School and accordingly applications from women are particularly welcome.