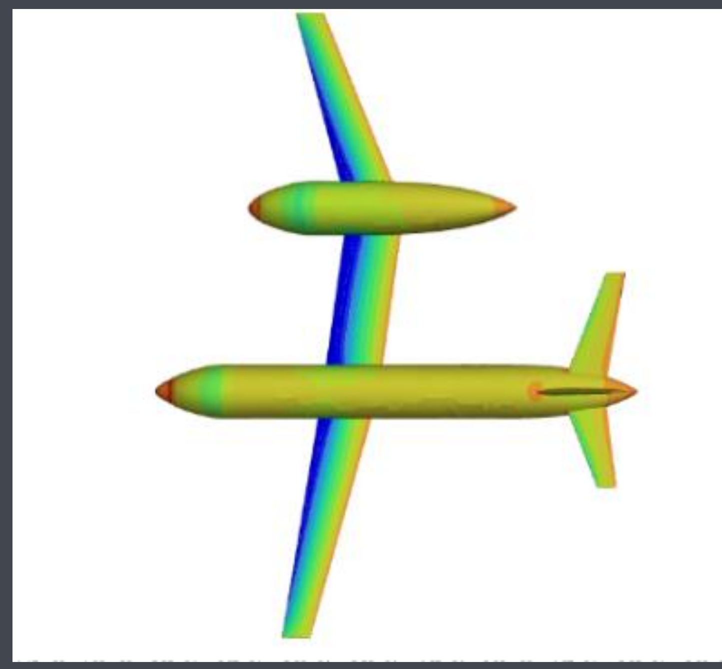
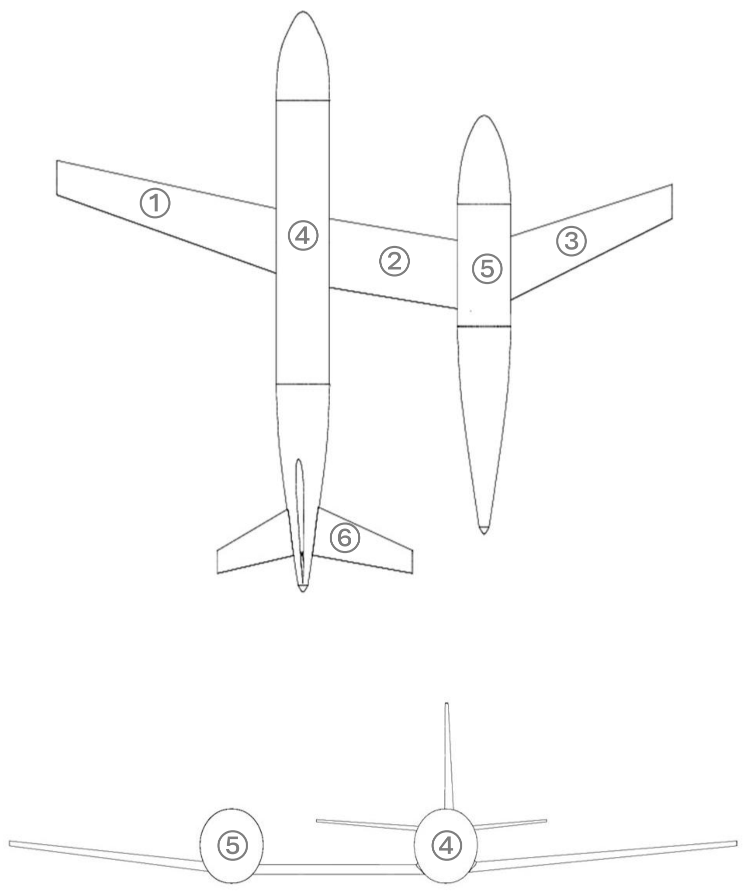
# Next Generation Sustainable Aircraft – Hydrogen Powered.



Dr. Raj Nangia, Matthew Wernham, Glade Suderman, Andrew Shepperd, Dr. Samson Annapureddy, Mr. Doug Nash, Dr. Chris Toomer
Contact: Nangia@blueyonder.co.uk, Chris.Toomer@uwe.ac.uk

## Research Overview



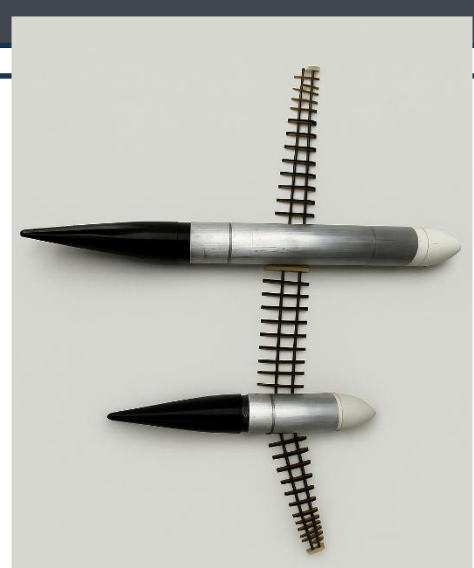
In the move towards more sustainable aircraft, liquid hydrogen will provide a less polluting fuel. The downside to hydrogen is that it is dangerous and must be contained. Proposed designs for hydrogen aircraft have the fuel in the same fuselage as the passengers and crew. However a recent design by Dr. Raj Nangia, a Visiting Professor at UWE, separates the hydrogen in one fuselage from the people in another. This double fuselage offers the first design in which there is a high chance of survival in the case of any forced landing or fire in the hydrogen fuselage.

As such a hydrogen powered aircraft is an ambitious and futuristic aircraft. But there are sizeable rewards in attaining an aircraft which has strong sustainability credentials by reason of no aviation fuel and thus no NOx emissions.

In this project we tackle the complicated aspect of an asymmetric double fuselage aircraft. With the design set; aerodynamic simulations are undertaken to predict the performance and stability of the aircraft. Investigations are also undertaken on the most suitable materials and manufacturing techniques for constructing a model for testing in UWE's large low speed windtunnel.

## Methods & Technologies

- High and low fidelity CFD methods (panel codes, OpenVSP, ANSYS Fluent) were used to explore the aerodynamics of the design space by varying the angle of attack, speed and mesh.
- Manufacturing techniques involving the wood and metal inner construction of the 3 wings, metal fuselages, 3D printed tail and nose cones were tested. The model is fully modular enabling different wing shapes, control surfaces and tails to be studied. The connections between each of the parts was investigated to ensure connectivity during wind tunnel experiments with ease of replacing the parts.



## Innovations

- The asymmetric nature of the aircraft accommodating the different requirements for passengers and propulsive equipment.
- The use of different materials to ensure the required flexibility between the different components when under test.
- The modular connectors that will ensure ease of replacement but secure connectivity in the windtunnel

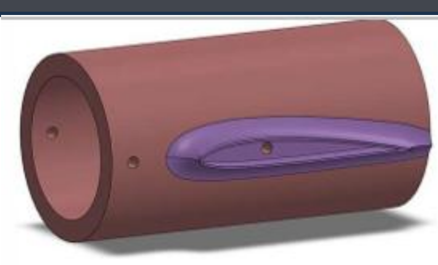


Figure A8 – wing-connection solution

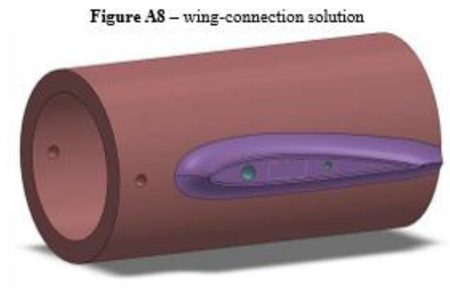


Figure A9 – Improved wing-connection for later iterations

## Opportunities

- Seeking collaboration and support with an industrial partner as we move through the TRL levels: design refinement for performance & stability, windtunnel testing and on to prototype drones.
- Opportunity for joint research in aerodynamics, aeroelasticity, flight, manufacturing and control.
- Investigations into the hydrogen supply, containment, refuelling and propulsion

## Acknowledgements

The authors appreciate the support from HEIF & UWE for summer internships to enable this research to progress.

RISE WITH US

UWE Bristol