



Adaptable physics models for wide design space exploration

The urgent need for environmental preservation is widely acknowledged, with the United Kingdom aiming to become net zero in 2045. The Centre for Modelling and Simulation (CFMS) collaborated with aerospace experts and academia in a feasibility study aiming to assess the viability of a low emissions aircraft to serve the Scottish Highland and Islands and provide a significant export market opportunity.

Within the study, CFMS rapidly modelled a variety of sustainable energy powertrain systems that could be retrofitted to existing aircraft. Our private, on-site high performance computing (HPC) resources enabled wider design space exploration within the study.

Challenge

The UK aspires to create a sustainable, inclusive and economically viable transport system that aligns prosperity with sustainability. Achieving the net zero targets poses monumental engineering challenges across aerospace, and therefore the necessity for industrial innovation has rapidly increased. Attaining the most optimised and efficient solution for a given set of requirements is an essential objective for any organisation. Given the high development costs for complex aerospace products, getting it right the first time is more critical. Failure to achieve this will increase rework, cost and timescales.

With the aim of the study to find a viable aircraft solution, the need for adaptable and versatile digital engineering capabilities was evident. With digital technology a vast design space of potential configurations could be explored, greater than what is practicably achievable otherwise.

Solution

Collaborating with Rolls-Royce UK, Logan Air, and the University of Strathclyde in a feasibility study, CFMS leverages adaptable and dynamic modelling capabilities to rapidly simulate concept digital prototypes through high performance computing (HPC) power.



Using **digital prototyping** reduces the need for **extensive costs** of unnecessary physical prototypes.



Our on-site HPC resource allowed CFMS to **simulate 1000s of configurations** during the 5 month project.

Due to our expertise and digital tools, CFMS was required to develop a system model of a sustainable aircraft, which could be easily adapted as a result of its extensive range of parameters. CFMS used this versatile physics model along with data analysis techniques to assess alternative fuel sources, including electric batteries, hydrogen electric and hybrid fuel.

Over the 5 month project, CFMS harnessed the computational power within our on-site private data centre to take a truly model based approach to concept design. Within minutes, through HPC, CFMS generated representative models and analysed the data required for the study.

These niche capabilities allowed the study to investigate an expansive amount of potential product options beyond what would have been possible without digital prototyping, ultimately identifying a potentially viable solution. This provides decision makers with a deeper understanding of the possibilities when considering the design of a sustainable aircraft and its feasibility.

Benefit

The Eilean project highlights how CFMS' niche expertise in digital modelling and simulation enhanced the exploration of the design space. Using digital prototyping within the early stages of the design process not only accelerates the development cycle but also reduces the need for extensive costs and time scales of unnecessary physical prototypes.

Our agile capability to connect industry and research, along with our versatile modelling capabilities, enables us to complete bespoke modelling combined with accurate data analysis whilst delivering

comprehensive research before a product is built. This empowers the customer to attain a deeper understanding of the feasibility and make informed decisions based on market opportunities and the scale of technical challenges. Without our expertise in digital prototyping and systems modelling, this would not have been possible.

Feedback

Sir Iain Gray, Director of Aerospace, Cranfield University, Member of JetZero Council & CFMS Chairman said:
"This study correctly identifies the opportunities and challenges associated with zero carbon aviation solutions in the context of the very different geographical and social needs of Scotland compared to other parts of the UK. Electrification seems some way off but the report encourages further technology work around other options and draws out the practical implementation benefits which comes with a phased conversion approach before an all new aircraft..."

"The project has drawn out important conclusions on the most viable technology solutions associated with the different powerplant options and integrated this into the wider questions around a more holistic approach to integrated zero carbon transport solutions."

Sir Iain Gray, Director of Aerospace, Cranfield University, Member of JetZero Council & CFMS Chairman