# Airbus Quantum Computing Challenge Problem Statements

5 distinct flight physics problems with varying degrees of complexity

## Aircraft Climb Optimisation

Aircraft follow several flight phases during their ‘mission’ from take-off to landing. Cruise is the longest segment and is considered most important from a fuel and time optimisation perspective. Yet for the ever-increasing volume of short-haul flights, climb and descent are more critical. Fuel optimisation during these segments is very valuable for airlines. This problem focuses on the climb and how quantum computing can be applied to arrive at a low-cost index (the relative cost of time and fuel), which is central to climb efficiency.

## Computational Fluid Dynamics

The efficiency of aircraft design relies heavily on the aircraft’s overall aerodynamic shape. This design is performed using Computational Fluid Dynamics (CFD), demonstrate airflow behaviour around the aircraft and reveal the aerodynamic forces acting on its surfaces. However, accurate CFD simulations are a resource- and time-consuming task.

This challenge aims to show how established CFD simulations can be run using a quantum computing algorithm or in a hybrid quantum-traditional way for faster problem solving and how the algorithm can scale in line with the problem complexity including computational resources.

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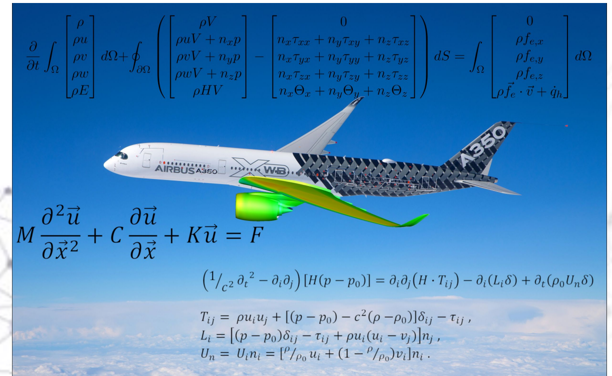
## Quantum Neural Networks for Solving Partial Differential Equations

Solving Partial Differential Equations (PDEs) is a major challenge when solving aerodynamic problems. Today, their resolution requires complex numerical schemes and high computational costs. Traditionally PDEs were solved in a deterministic manner using numerical methods. Recently, neural networks – deep-learning-based algorithms – have been developed to solve coupled PDEs. These networks compute the time and space derivatives of a PDE. The proposed challenge is to augment this new approach for aerodynamic problems with quantum capabilities.



## Wingbox Design Optimisation

Given the limitations of traditional computing, the aerospace industry faces a challenge in optimising multidisciplinary design. That's when design configurations such as airframe loads, mass modelling and structural analysis must be simultaneously calculated. This can cause long design lead times, convoluted processes and conservative assessments. Quantum computing offers an alternative path to explore a wider design space by evaluating different parameters simultaneously, thus preserving structural integrity while optimising weight. This balance is particularly important in aircraft wingbox design, where weight optimisation is key to low operating costs and reduced environmental impact.

**How do you propose quantum computing could address this complexity?**

## Aircraft Loading Optimisation

Airlines try to make the best use of an aircraft's payload capability to maximise revenue, optimise fuel burn and lower overall operating costs. Their scope for optimisation is limited by the aircraft's operational envelope, which is determined by each mission's maximum payload capacity, the aircraft's centre of gravity and its fuselage shear limits. The objective of this challenge is to calculate the optimal aircraft configuration under coupled operational constraints, thus demonstrating how quantum computing can be used for practical problem solving and how it can scale towards more complex issues.

**Put your theory to the test and be part of the breakthrough in quantum computing!**

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