8 - Sustainable Glider Tow Craft

Gliders were the first heavier-than-air aircraft capable of transporting people. Since then, gliding has significantly taken off in popularity as a sport. Typically, this entails a glider being launched into the air by use of a winch or via aerotow. Due to important considerations such as the drop-off location and altitude, an aerotow tends to be preferred over a winch. Additionally, despite the increasing awareness of climate change and unpowered nature of the sport, sustainability has not traditionally been a major influence on gliding and has not been thoroughly explored. A significant contribution of the emissions affecting climate change stems from aviation, and the industry is only expected to continue growing fiercely in the upcoming decades. The necessity of designing a sustainable glider tow craft is therefore indisputable.

Mission Objective

The objective of the mission is to design a craft capable of towing a glider sustainably, minimising the environmental impact of the gliding sport. The Motorised Autonomous Return Craft Used for Sailplane Towing (MARCUS-T) is designed to fulfil this objective by employing an electric propulsion system and hot-swappable batteries. It is also required to be remotely piloted by the glider pilot during take-off and climb to the drop-off location and altitude, after which the glider is released and the craft autonomously flies back to base. The MARCUS-T is designed to tow even the heaviest gliders regulations will allow, at a maximum take-off mass of the glider of 850 **kg**. Naturally, the cost of the craft is a driving design requirement to ensure an average gliding club may afford at least one MARCUS-T.

System Design

The MARCUS-T is largely similar to a conventional tow craft with its ability to connect to most gliders using a cable attached to either the nose hook or the hook at the centre of gravity of the glider. However, the maximum take-off mass is substantially lower than conventional tow craft at a value of 210 **kg** due to the autonomous nature of the craft. To comply with the mission objective, several design choices were made very early on in the design process. These choices must be reconsidered in case they later turn out infeasible. Firstly, the structure of the craft consists of a truss-type fuselage and a taildragger configuration due to the simpler, lighter, and cheaper design. Next, the electric propulsion system consists of a single engine along with one propeller with three blades. The batteries used for the engine are hot-swappable and made of lithium-ion polymer, weighing approximately 43 **kg**. Most batteries will be removable from the craft, with the exception of one, which will only be charged overnight in the hangar. During the daytime, the other batteries will be routinely swapped for charged ones inbetween aerotows. These batteries are charged on-site in a truck with on-board batteries to minimise the turnaround time. Furthermore, a thick airfoil was selected, with the aim of optimising climb performance. High-lift devices are also added in order to reduce the stall speed in landing configuration. Lastly, a conventional tail was sized for tow-force and cross-wind disturbances, and to ensure longitudinal and lateral stability.