

DSE 20: Aerobatic E-Flyer

Over the past decades, many current technologies are becoming more sustainable and the main trends focuses on reducing the use of fossil fuels. In the automotive industry electric propulsion is already the new standard, but in aviation it is rarely implemented at this moment. The current obstacle with the design of an electrically powered aircraft is the weight of batteries, which results in a low endurance and therefore is not suitable for the current needs of commercial aviation. The aviation industry contributes significantly to the emission of green house gasses, and therefore implementation of electric propulsion should be further investigated. Electric propulsion might be a solution for other types of flying, such as short duration aerobatic flight.

Mission Objective

The challenge of this project is to design an aerobatic aircraft that has an endurance of 40 min including take-off, landing and a reserve of 10 min. The aircraft shall have no fossil fuel emissions and shall be recyclable for most of the parts at end of life. The aircraft shall take up g-loads of 8 g and -6 g for single pilot operations, shall be able to sustain a 2.5 g turn for the first design and shall cruise at a speed of 150 kts. The aircraft must also be able to perform the following standard aerobatic manoeuvres: loop, tail slide, barrel roll, aileron roll, snap roll, spin, Cuban eight, Immelman and inverted flight. Furthermore, the aircraft must be designed in a way that future technology such as auto-recovery systems can easily be implemented. Moreover, the aircraft should be easy to maintain, to charge and to transport. Finally, the aircraft should satisfy all the standard aerobatic aircraft regulations of CS-23.

System Design

The design of this aerobatic aircraft contains several key features. The propulsion system is an electrically powered, in the fuselage integrated, ducted fan with a diameter of 63 cm consisting of a single rotor and stator, and has two air inlet ducts at the side of the fuselage. The electric motor for this ducted fan is chosen to be the P200T6 motor from Saluqi Motors, which outputs 260 kW and weighs 33 kg. The batteries to power this aircraft are the ELEO Size 35 Performance batteries with an energy density of 188 Wh/kg, and the total amount of ten battery modules results in a total battery weight of 276 kg. Furthermore, the aircraft makes use of control surfaces, a conventional tail, retractable tricycle configuration, fly-by-wire control system and energy recovery systems. The shape of the main wing follows the symmetrical shape of NACA 0015 at the root and NACA 0012 at the tip and has a span of 8.48 m. The resulting design has a total mass of 979 kg, and it can accompany up

to two passengers. There are still some details that need to be determined, and some analysis should still be performed such as the determination of the materials for the fuselage and subcomponents, the finalized noise estimation, the performance analysis, and a cost estimate. The preliminary CAD drawing is shown in the lower right corner and shows only the exterior structure of the design.

