Group 11 - HYDROGEN-POWERED LONG-RANGE EVTOL DESIGNED FOR CRASHWORTHINESS

There has been significant growth in research and development for alternate modes of transportation in search for faster, more efficient and more sustainable travel means. Pollution of the environment and traffic congestion have also made the need for alternatives more pressing. eVTOLs (electrical vertical take-off and landing) offer a solution to these problems, by reducing the emissions of pollutants and possessing the capability to bypass congested cities through the air. Our design, Aetheria, is a hydrogen-based eVTOL, which can enhance the performance of existing battery-powered eVTOLs.

Mission Objective

Aetheria can serve as a long-range air taxi (400 km) for four passengers, competing with international trains as the time spent in the first- and last-mile segments of the journey are significantly reduced. The city centres of Paris and London, the two largest cities in Europe, could be connected within 1.5 hours compared to a journey by train of roughly 3 hours. Sustainability-wise, every year in Germany, 1.4 billion people travel a range of approximately 400 km using cars which produce tons of CO2 which can be significantly reduced with Aetheria. Furthermore, Aetheria can also be used in North America, which has the largest market share to connect rural cities without the need for roads and rails which result in deforestation. Therefore, the mission need statement of Aetheria is to design a safe and sustainable, hydrogen-powered long-range eVTOL to transport four passengers from a dedicated location A to a desired location B.

System Design

Aetheria uses a tilt-rotor configuration to transition from vertical flight to horizontal flight as this resulted in a light and efficient design concept. The power system consists of batteries to supply the high power demand during hovering (vertical lift-off until the transition to horizontal flight), whereas compressed hydrogen is used during cruise due to its extremely high energy density (100 times higher energy density than batteries). Therefore, an extra range of 160 km can be accomplished with 3 kg of hydrogen (excluding the additional tank mass of 49 kg) rather than 300 kg of batteries. Thus, the hydrogen allows for a significantly lighter design with a higher range compared to battery-powered eVTOLs. Compressed hydrogen and oxygen are supplied through Polymer Electrolyte Membrane (PEM) fuel cells to produce power, with the only by-products being heat and water. This method makes the operation of Aetheria completely emission-free. As hydrogen is extremely explosive, Aetheria is specifically designed for crashworthiness. Batteries are placed in the wings away from the hydrogen which is placed in the fuselage to avoid a potential explosion, as well as to relieve bending moments and torsional loads. Furthermore, the hydrogen and passengers are placed within the crash structure which is a fuselage section that remains intact without deformation in case of an accident to avoid catastrophic explosions. To conclude, Aetheria offers a significant increase in range compared to similar designs such as Joby and Lilium because of the implementation of hydrogen while also being crashworthy. We believe, for this reason, Aetheria shall pave the way for a new revolution in the Urban Air Mobility industry.