

Investigation of the Wing Design and Endurance of an Ultralight Electrical Aircraft

An electrical airplane puts high requirements on the design of the aircraft. The main part of a plane that makes it fly are the wings, therefore the design of the wings are of utmost importance.

The interest for electrical vehicles has grown considerably over the past few years. This is no different in the aviation industry. Blackwing Sweden AB have joined the electrical revolution with plans to electrify their current ultralight 2-seater airplane. A current obstacle in electrification of airplanes is the weight that is added from the batteries. This project explores what amount of energy per kilogram of batteries is required to achieve the flight time target set by Blackwing Sweden AB. The energy in one kilogram batteries is currently lower than the energy in one kilogram of airplane fuel.

By varying the energy per kilogram of the batteries in the airplane, the required energy needed to achieve the two hour flight target set by the company was explored. The airplane was compared to similar electric airplanes to analyze how well it could compete and which plane potential customers would want to buy.

Using Computational Fluid Dynamics, a computer based program used to simulate the flow of for example air, the performance of the airplane has been modeled with several wings. The wings were of varying shape and length. The model was used in order to determine which wing has the best properties and highest bang for the buck. Four wing designs were considered. Two variations of Blackwing Sweden AB's current Blackwing wing, a longer wing and a shorter wing, as well as a new wing with a different wing profile. The wings were modeled with different angles of attack, which is the angle of which the air meets the wing profile, to explore the generated lift and drag of the plane. How far and how long the airplane could travel with the different wings were compared. The minimum and maximum velocities were analyzed.

The longer Blackwing wing was deemed the wing best suited to the companies requirements, having the second best performance but lower cost than the best performing wing.