Supporting a Wing with Hexagons to Make It Lighter

Kmetko, Alexander (School: University School)

This project examines if an object supported by a wing structure filled with hexagons will be more mass efficient than solid filled support structure. Aircraft are a large source of greenhouse gas emissions that lead to climate change. One way to reduce these emissions is to decrease the mass of airplanes allowing their engines to do less work. 3D printing is a modern tool used to prototype and develop numerous inventions. Unlike traditional machining 3D printers build up instead of cutting away freeing engineers from traditional limitations. A regular hexagon is one of the strongest and the most efficient shapes known. Due to its high ratio of area to perimeter it uses little material and yet still has immense strength, making it ideal to reduce mass. These two concepts were put together to test in this project if the support structure of a wing could be made more mass efficient. Sample wings were designed with a wing internal structure and then printed on a 3D printer with 1 set filled 25% with hexagons and the other filled fully. After their mass was logged, the wings were taken to a weight table which measured the force required to break each wing when deflected. The solid filled wings failed at an average of 17.12 N/g and the Hexagon filled at 19.13N/g, a 2.79N/g difference. A ttest concluded that the probability these data was random was <1%. If these data scales to the size and material of Airplanes, it could dramatically reduce mass.

Awards Won:

Raytheon Technologies Corporation: Each winning project will receive $1,000.