Taming the Oblique Wing: Improving Fuel Efficiency by Developing and Flight Testing an Oblique Wing Aircraft Utilizing a Novel Control Method

Shen, Kevin (School: Olympia High School)

By leveraging modern flight computer capabilities, I designed and flight tested an oblique wing aircraft (an efficient variable-sweep design where one wing sweeps forward and the other sweeps aft) capable of significantly reducing the aerodynamic coupling issue, an improvement over NASA’s manually flown oblique wings. After designing the model using computer-aided design and applying sweep theory to optimize the oblique sweep angle, I conducted a computational fluid dynamics simulation to analyze its performance. Analysis revealed that the simulated full-sized oblique wing aircraft could reduce drag by 9.2% compared to conventional symmetric designs, saving up to 25 billion dollars in global fuel costs and 96 million tonnes of annual CO2 emissions, validating the design. After constructing the test model, I overcame aerodynamic coupling by programming a custom-designed flight computer with a novel anti-coupling flight code. Using regression analysis with preliminary data from the flight data recorder, I extracted the coupling behavior of the model, which I used to tune the software. After three prototypes and 450 seconds of final flight data, statistical analysis revealed reduced coupling in roll-pitch and pitch-yaw up to 99% and 45%, respectively, though yaw-roll was left coupled for coordinated turning. The data also showed increased pilot control authority in all axes by at least 34%, indicating increased safety. My research demonstrates that the oblique wing’s coupling challenges can be significantly reduced, reviving this now-overlooked design as a promising candidate for the next generation of fuel-efficient aircraft and urging further exploration and adoption of the oblique wing.