Zephyr: A Military-Inspired, Hand-Built Fixed-Wing UAV on a $400 Budget

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Fixed-wing UAVs have greater efficiency, flight range, and speed compared to traditional multirotor drones, making them more suitable for applications like geological surveillance, weather studies, and delivery systems. However, they are often too expensive and inaccessible for most RC pilots, as commercial UAVs on the market cost anywhere from $1000 to $50000+ in full flight configuration and are not available to ship to all regions. Cheaper alternatives such as 3D-printable UAVs exist but require access to large-format 3D printers, creating additional barriers to accessibility. To make fixed-wing UAVs more practical and accessible for RC pilots who do not have such resources, this project developed an open-source UAV that takes inspiration from military UAVs like the Heron MKII MALE and AAI RQ-7 Shadow to create an inexpensive high-performance UAV that can be built under a budget of $400 using only simple tools and accessible materials. After multiple design iterations, the final constructed UAV was a fixed-wing inverted V-tail configuration with a 1,780 mm wingspan and a takeoff weight of ~1.84 kg, constructed entirely by hand, costing a total of $378.51. Autonomous features were integrated using iNAV firmware, enabling auto-launch, cruise, self-stabilization, and loitering capabilities. Following FAA Part 107 regulations, the UAV was flown and demonstrated successful flight characteristics pertaining to ease of control, stability, and autonomous flight across several autonomous missions. The results prove that a high-performance, autonomous fixed-wing UAV can be hand-built using accessible materials at a fraction of commercial costs, providing a viable and reproducible platform for RC pilots without access to expensive equipment or manufacturing resources.

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