MAE-495 AUAV Bootcamp Final Report
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Hayden Pernia
Instructor Charles Collins

Build Overview

The XUAV Talon is sold as a kit plane, meaning it only includes the airframe and no electronics. The ideal servos, motor, and ESC were specified by the manufacturer. For this build, the recommended servos were purchased, but the recommended motor size was not available, therefore a different larger size was used. An appropriate ESC was purchased to match the motor, and the battery capacity was sized to provide between 30 minutes and an hour of flight.

Assembly of the aircraft was relatively straightforward. First, carbon spars were glued into each separate half of the fuselage and the Lite Ply mid frame was assembled with wood glue. The two halves of the fuselage were adhered with the wood frame, firewall, and wheel mount in between using cyanoacrylate. The motor was then fastened to the firewall with extension leads running to the middle of the aircraft. Servos were then installed in the wings and stabilizers using hot glue. The control horns were attached to the surfaces and the linkages connected. The stabilizers were then glued to the fuselage using CA.

Aircraft Details

The XUAV Talon is a fixed wing aircraft designed for long endurance FPV flight. It is a pusher prop with a V-tail configuration and low aspect ratio wings (the ratio of wingspan to chord length). The wings have traditional ailerons and no independent flaps, although in this build flaps are mixed into the ailerons (flaperons). The wings do not have dihedral, but have a slight upward sweep at the tips. The lack of dihedral means the aircraft will hold a bank angle without continued aileron input. Opposite aileron is therefore required to level out the plane. The wing chord is tapered starting approximately mid span to reduce drag.

The V-tail configuration serves little practical purpose other than cosmetic appeal. There may be a slight reduction in drag compared to traditional horizontal and vertical stabilizers but it is negligible at RC scale. This configuration requires the use of combined elevator and rudder surfaces, also called ruddervators. When configured properly, control is very similar to a traditional aircraft tail.

The motor is mounted at the rear of the aircraft behind the tail. This location allows for an unobstructed view at the front of the plane for FPV cameras and looks good, but has the disadvantage of not

providing propwash over the elevator, reducing control at low airspeeds. Therefore, hand launches must be performed at an optimal angle to prevent a stall.

The Talon has a large and accessible payload bay since the wings mounted to the outside of the fuselage and do not join in the center. Its large wing area also means that it can carry heavier payloads than other aircraft of similar size. This build carries two 5000mAh 4S Lithium Polymer batteries in parallel to provide approximately 45 minutes of flight time. The 3542 1050kv brushless motor provides up to 820 Watts to a 12x6 propeller. This configuration provides in excess of a 1:1 power-to-weight ratio. The motor is powered by a 60 Amp electronic speed controller.

The center of gravity for the aircraft was not clearly published and was therefore determined through test flights. Initial estimation for the CG was the center of the main wing spar, 3 in from the leading edge, although over several flights this was moved back slightly to 90 mm or 3.56 in from the leading edge.

Electronics Details

RC control of the aircraft is provided over a 2.4GHz DSM2 link between a Spektrum DM9 transmitter module and a Lemon RX receiver. The DSM2 protocol provides a spread spectrum signal on two channels for redundancy and to minimize the chance of interference. The DM9 module is paired with a Turnigy 9XR-Pro transmitter.

The autopilot is a Pixhawk PX4 clone with a NEO-6M GPS and magnetometer. The RC receiver does not have a PPM output so an encoder is used to connect to the Pixhawk. Telemetry is provided to the ground station over a 915MHz connection. There is not an airspeed sensor on the aircraft presently but one may be added in the future to improve autopilot tracking in windy conditions.

The aircraft has an FPV camera mounted in the nose so the pilot can monitor conditions when flying at higher altitudes or distances (while remaining under 400ft AGL and within line of sight). Live video is broadcasted using a 200mW 5.8GHz transmitter and may be superimposed on the primary flight display of the ground station software using a capture card. To improve orientation in low-visibility conditions such as light fog or dawn/dusk, colored navigation lights are mounted to the underside of the wings, fuselage, and stabilizers. The FPV system and lighting are powered independently by a 1500mAh 3S Li-Po Battery.

Components and Materials

Airframe

X-UAV Talon EPO 1718mm Aircraft Kit V3	$89.99
Hobbywing Skywalker 2-6S 60A ESC With 5V/5A BEC	$21.99
Turnigy Aerodrive SK3 - 3548- 1050kv Brushless Outrunner Motor	$36.13
Master Airscrew 12x6 Propeller	N/A*
2x Turnigy 5000mAh 4S 20C Lipo Pack	$58.36
2x Turnigy S3101S Servo 2.5kg / 0.14sec / 17g	$10.98
2x HXT900 Micro Servo 1.6kg / 0.12sec / 9g	$5.98
HXT 4mm to XT-60 Battery Adapter (2pcs)	$3.40
Male XT60 Connectors (5pcs)	$2.17
42cm Servo Extension Lead (5pcs)	$2.70
RGBW LED Light Strips	N/A
3.5mm Bullet Connectors (5 pairs)	$5.10
Motor Lead Extensions ~1ft	N/A

RC Electronics

Turnigy 9XR-Pro 9Ch Transmitter	N/A
Spektrum DM9 DSM2 Module	N/A
Lemon RX DSMX 6-Channel Receiver w/ Diversity Antenna	$12.95

Autopilot

Pixhawk PX4 (Clone)	$121.50
NEO-6M GPS/Mag	Incl.
3DR Telemetry Radio 915MHz TX/RX (Clone)	$20.16

FPV Equipment

5.8GHz 200mW Transmitter w/ OSD & Polarized Antenna	N/A
Generic CCD FPV Camera	N/A
5.8GHz A/V Receiver w/ Dipole Antenna	N/A
EasyCap USB A/V Capture Card	N/A

Tooling and Materials

Hakko 70W Soldering Station
Thunder Power 800W Dual Battery Charger
Fluke 87-V Multimeter
Wire Stripper/Cutter
Various Hex and Phillips Drivers
Medium and Thin Cyanoacrylate
3M Dual Lock Fasteners
Double Sided Foam Tape
22 AWG Insulated Wire
Various Heat Shrink
.031” Leaded Solder
Wood Glue
Hot Glue

*Components marked N/A were already owned or borrowed

Specifications and Information

Operator Information

Pilot/Owner/Launcher/GS Operator	Hayden Pernia
FAA Registration Number	FA3X9ECWMY
HAM Callsign (FPV Operation)	KM4TCJ

Aircraft Information	XUAV Talon	
Material	EPO Foam, Carbon Spars, Lite Ply Frame	
Wingspan	68 in	1718 mm
Length	44.0 in	1118 mm
Airframe Dry Weight	36.96 oz	1050 g
Weight as Configured	104.0 oz	3400 g
Center of Gravity	3.56 in	90 mm
Wing Area	705 in^2	45.5 dm^2
Wing Loading	21.2 oz/ft^2	74.7 g/dm^2

Motor	3548 1050kV 820W
Propeller	12x6” 2-blade
Servos	2x17g Mixed Gear, 2x9g Plastic Gear
Batteries	2x5000 mAh 4s, 1x1500 mAh 3S

GPS Performance

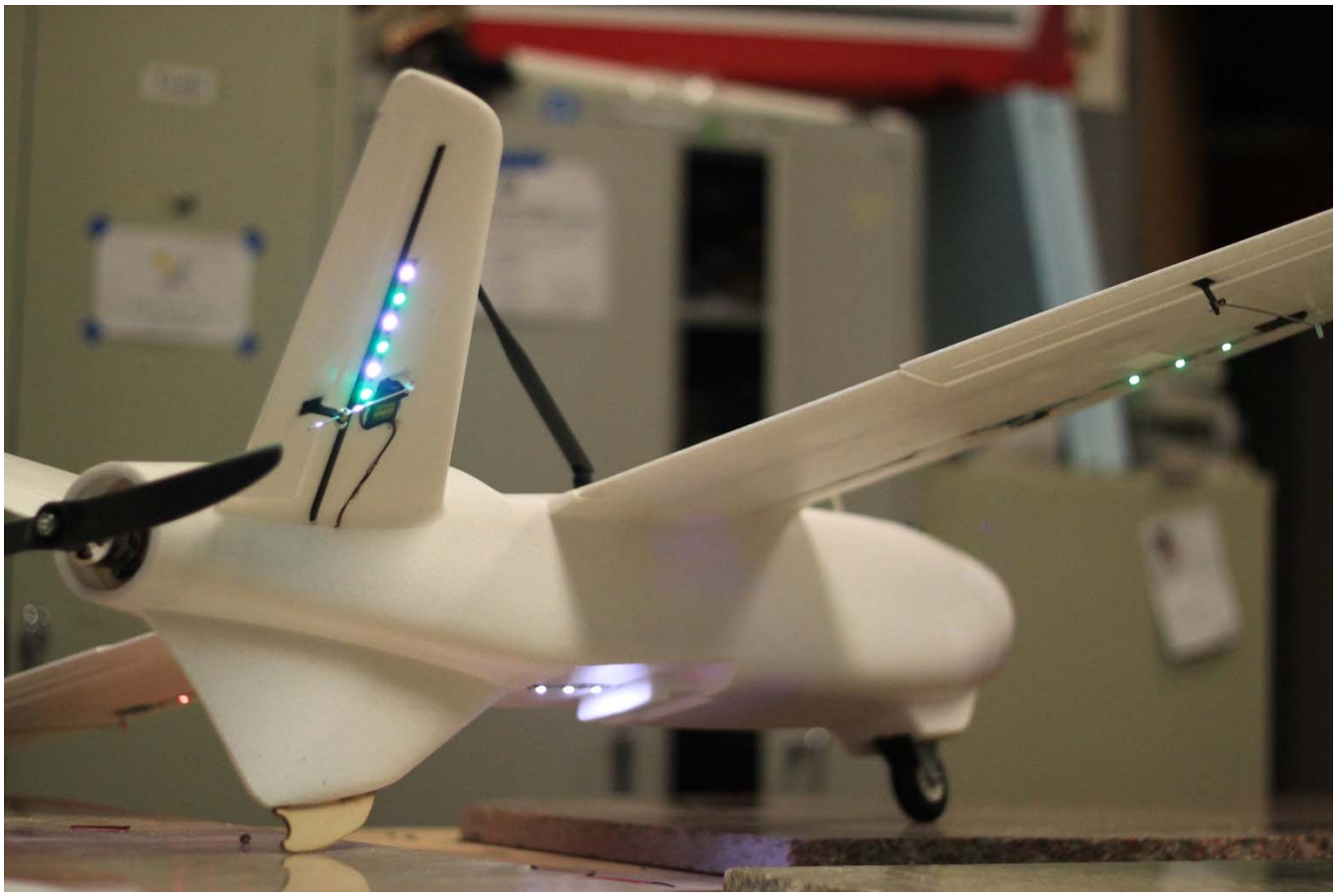
Accuracy	<3m, usually <1m
Refresh Rate	5 Hz

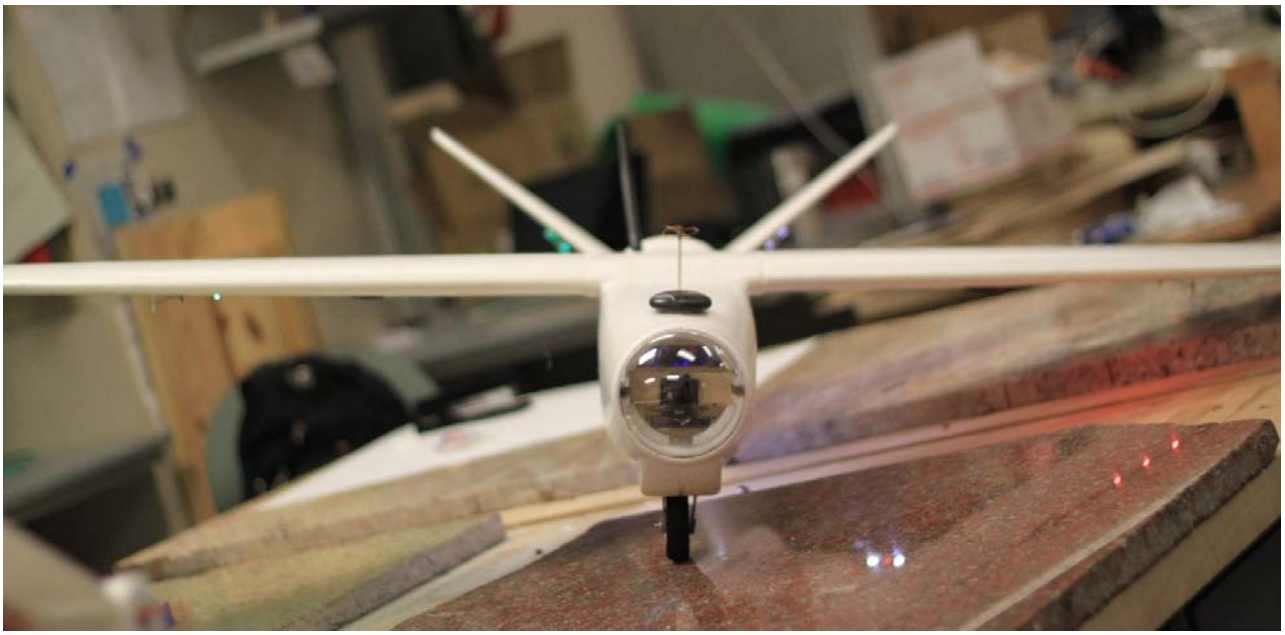
Data Logger	Mission Planner
Data Export Format	kml

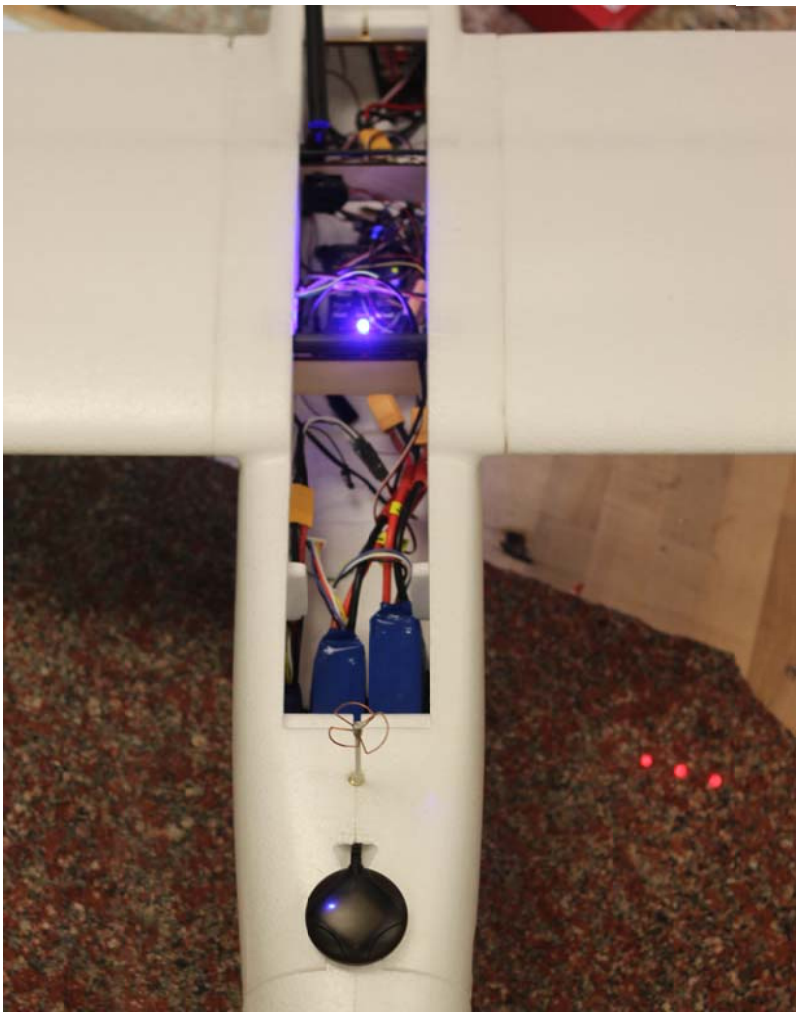
Flight Modes Tested

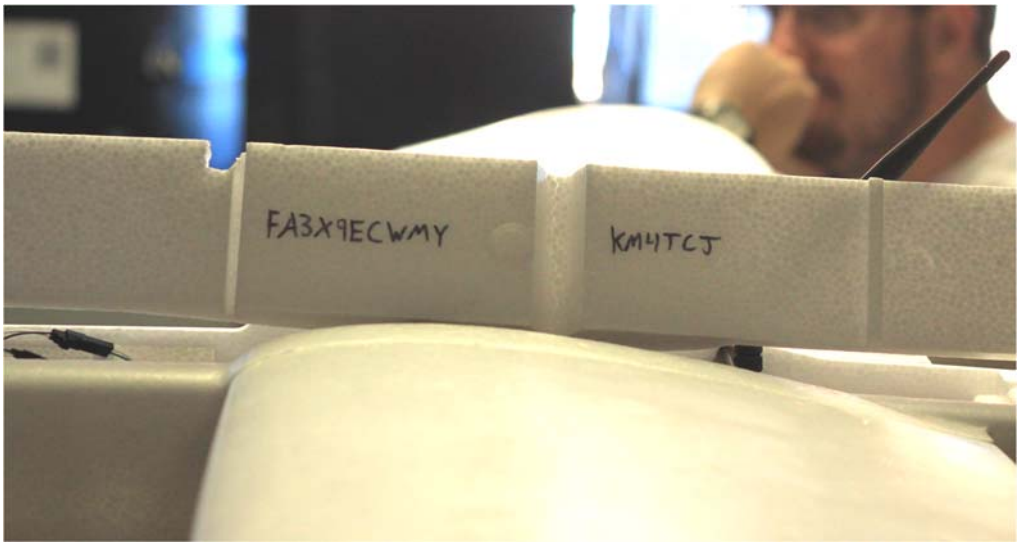
Manual	Performed
Stabilize	Performed
Fly-by-Wire	Performed
Circle	Untested
Loiter (GPS)	Performed

Aircraft Images





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