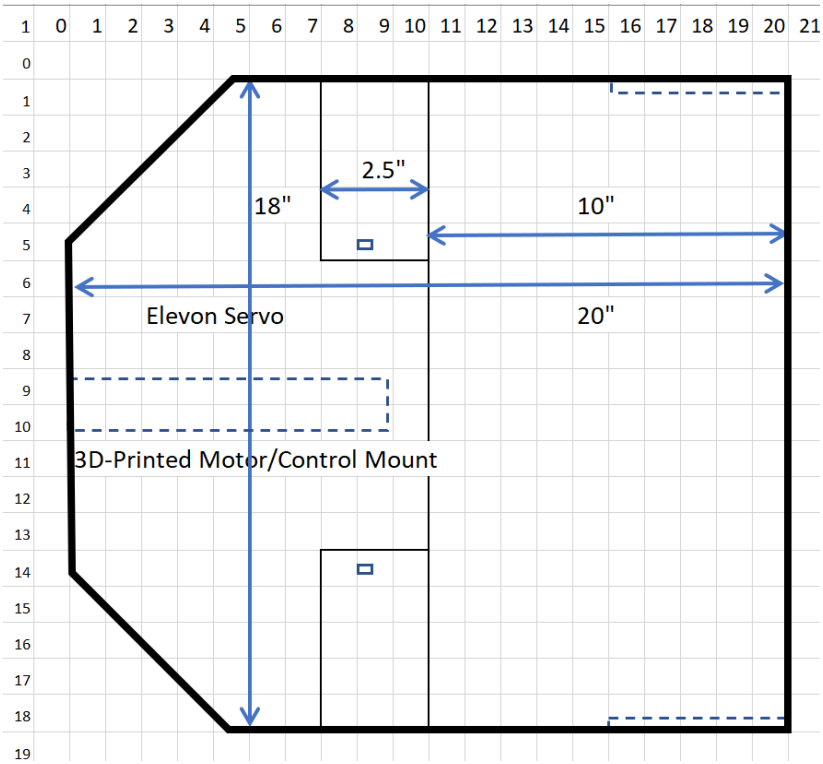
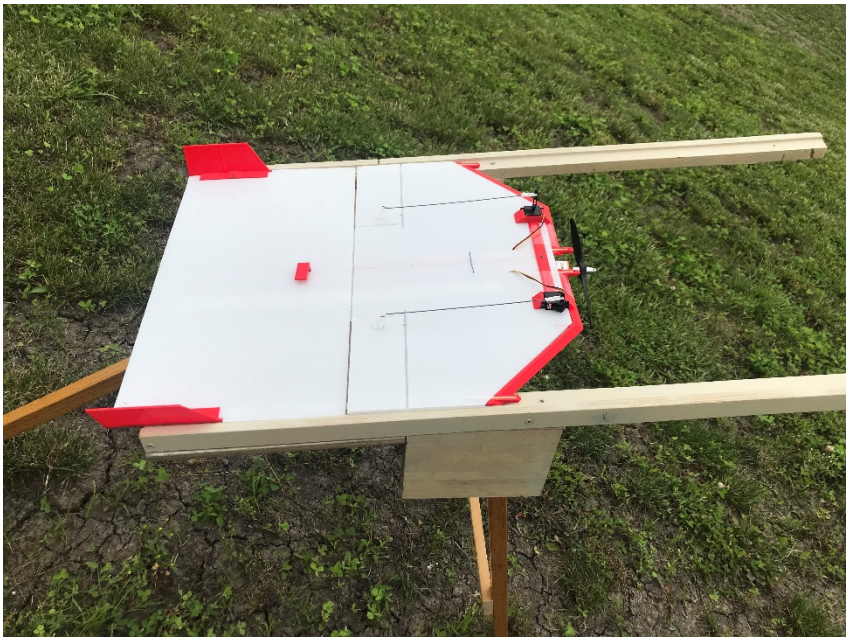
5/6/2022 Working Prototype -- Towed-Platform Aircraft*
Working Ramp

Construction of FPB Prototype: Materials of construction are 18” X 18” corrugated plastic with 3D-PLA-Printed motor mount and hardware bracket. Corrugations run front-to-back.





- The back-10 inches of the corrugated plastic is freely pivoting in ~5° span.

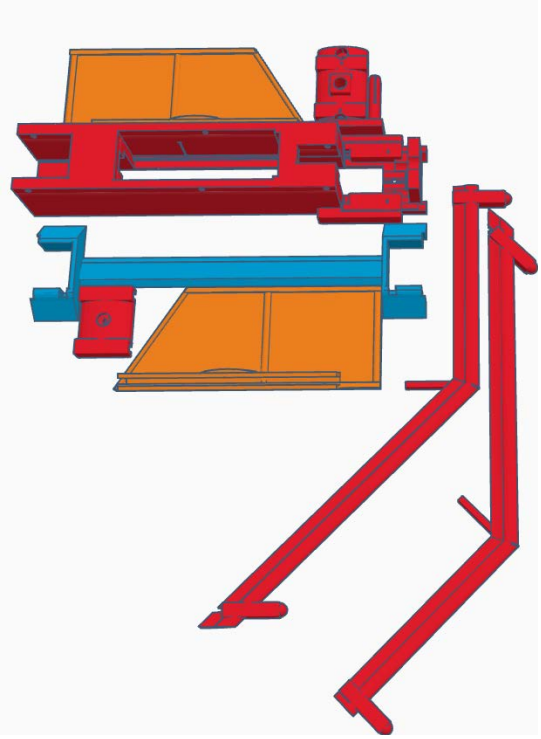
Bill of Materials and Preliminary Designs – Weight of this prototype is 400 g.
Transmitter - DX6e 6-Channel DSMX,
Receiver - AR620 6-Channel Sport,
Servos - HS-55 Ultra Micro Servo,
ESCs - Avian 30 Amp Brushless Smart,
Batteries (3S LiPO, >30C) – 520 mAh GNB
Charger - KX80 80W AC/DC Charger,
Motors – Brushless, A2212, D2830, & D3548 models at 1000, 1100, 1300, and 2200 KV.
Propellers – 2-blade (unless otherwise stated) fiber reinforced nylon at 7x4,
Connections – Several adaptors, typically EC3 power connections and 3.5 mm banana plugs.
Supply houses like Horizon Hobby and FlashHobby; parts can be ordered direct or through Amazon.

Tail and Control Mounts:
The mount/housing for electronics and the tail were 3D-printed using PLA filament. The base case tail was 6 inches long and high. Designs were made in Tinkercad; the images are provided below and STL files are attached:

Preparation of Corrugated Plastic:
With-corrugation cuts are made with a razor blade; cross-corrugation cuts (part way through for joint) are made with a table saw set to cut a depth of 2 mm into a 4 mm thick piece of corrugated cardboard. Cuts may be clean through to separated or partly through to create a hinge. When going across the corrugations, cutting of a groom with a table saw works well to create a hinge.

Bamboo kabob skewers may be sanded to slightly reduce diameter then pushed into the corrugations. The bamboo adds strength and may 4mm to 6mm (e.g. 1.5 D) wood screws can be to secure objects to the corrugated plastic (a top hole of slightly smaller diameter than the wood screws may be used to make it easier to drive the screws into the bamboo (or between bamboo skewers). Double-sided tape may be used in addition to or alternative to wood screws.
The same bamboo skewers may be taped on the front edge to round the front edge or may be used as dowels to attach 3D-Printed part in front of forward-oriented corrugations.

3D-Prints:
There is an optimal approach to design of these aircraft that balances 3D printing, use of board stock, and use of reinforcing bamboo sticks (kabob skewers). The 3D printing allows for robust extensions built upon flat surfaces that can be screwed onto the board stock (at reinforced bamboo locations) and/or attached with double-sided tape. Below are the 3D prints used to attach the electronics and tail. STL files are attached.



Controls and Programming:
The controls on the aircraft include: 1) speed control of the single front propeller and 2-3) a servo to control each of the two flaps. The transmitter is set up to in the "elevon" configuration, which identifies that the two flaps serve in the capacity of an elevator and aileron.

Ramp for Takeoff:
The corrugated plastic will slide along a smooth painted surfaces, and so, a ramp is sufficient for takeoff. The prototype ramp is set at an angel of 5 degrees with a length of 36 inches. The ramp consists of two 0.75 inch boards with half-inch board attached to outer sides that extend about 3/8" above the ramp surface. The spacing between insides of outer sides (0.25 inch clearance) is 18.25 inches for an aircraft that is 18 inches in width. The takeoff method is highly reliable when the throttle and flaps are properly trimmed and adjusted for takeoff.

Three folding legs are attached to the bottom of the platform through loss-fitting screws. The front two have crossbeam to keep them equal distant and are designed to set on the ground surface. The back has a sharp point and is designed to stick into the ground where the pitch angle of the ramp is determined by the angle of the back leg and the extent to which it sticks into the ground.

Control of Flight:
Theory identifies that a flat rectangular aircraft is very difficult to control, having a tendency to flip and dive. This is the case for this FPB (flying pizza box) prototype. Previous RC pilots have identified that the center of gravity should be about 5 inched from the front of the aircraft with a 1 inch difference changing the controllability from "novice" to "expert".

Evolution and Path Forward:
HS-Drone technology is about making transforming the FPB for an unstable aircraft to a highly stable aircraft while reducing and/or eliminated the tail.