Condor

2019

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As a direct response to the 2019 AUVSI SUAS challenge, Condor was built to complete a long distance payload drop with high accuracy.
Speed, high payload capacity, and endurance allowed Condor to successfully complete the given mission with excellent precision.

Top speed – 120 km/h
MTOW – 12kg
Wing Span – 1500mm
Max elec Power – 7600W

Challanges included building a very stiff but light frame that was not succeptable to vibration or bending. Large and thin carbon fiber tubes paired with a simple center plate design ensured all specs were met.

The power system required significant testing to ensure over current and over tempurature limits were not exceeded. Careful battery, motor, and propeller optimization was required to ensure distance, speed, and payload requirements were met.

Condor design

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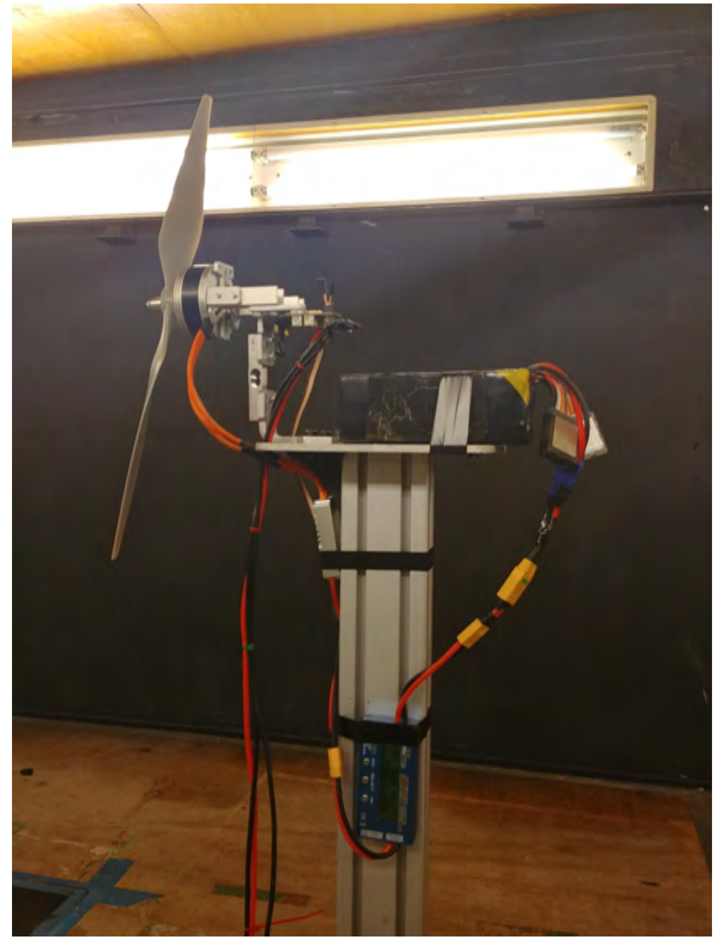
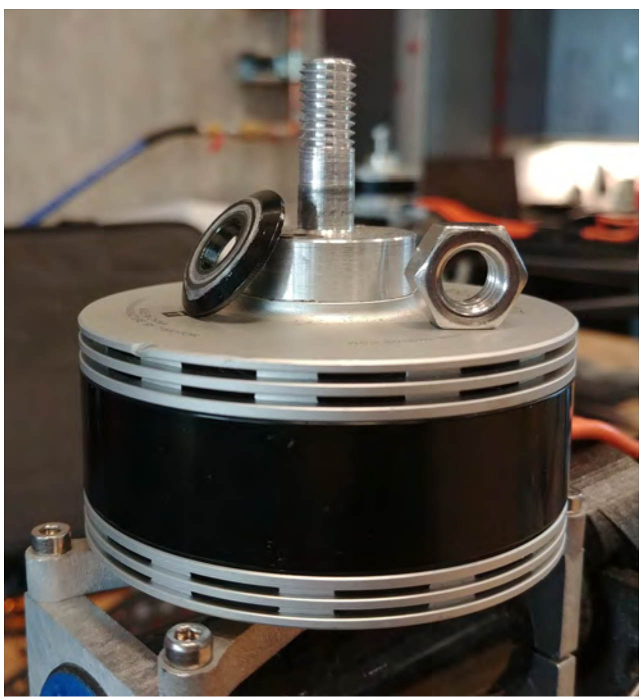
Power system Optimization:

In order to meet the distance, speed, and payload requirements for Condor I conducted several Prop, motor, and Speed controller (ESC) tests. I started by using a dynomometer and logging ESC to verify manufacturer specs and thrust/RPM correlation. This allowed us to do further tests with out the dynomometer. Then a number of different ESCs were tested on the dyno for efficiciency comparison (primarly FOC vs standard motor driving)
Finally different motors were tested to identify the best optimization of cruise power, thermal limits, and efficiency.





Custom Prop Mounts

Upon reciving our motors of choice, it was discovered that no company made prop adapters that would meet our spcific needs.

With that, I quickly designing and hand machined a set of prop adapters that would perfectly match our motors and props, including 2x left hand threaded adapters. This allowed our development prorocess and testing to continue quickly and quarateed sturdy mounting for our props.

Thermal Model of Brushless Motor 2018

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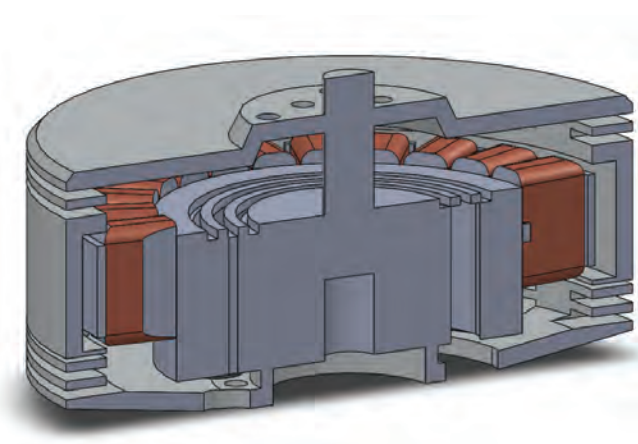
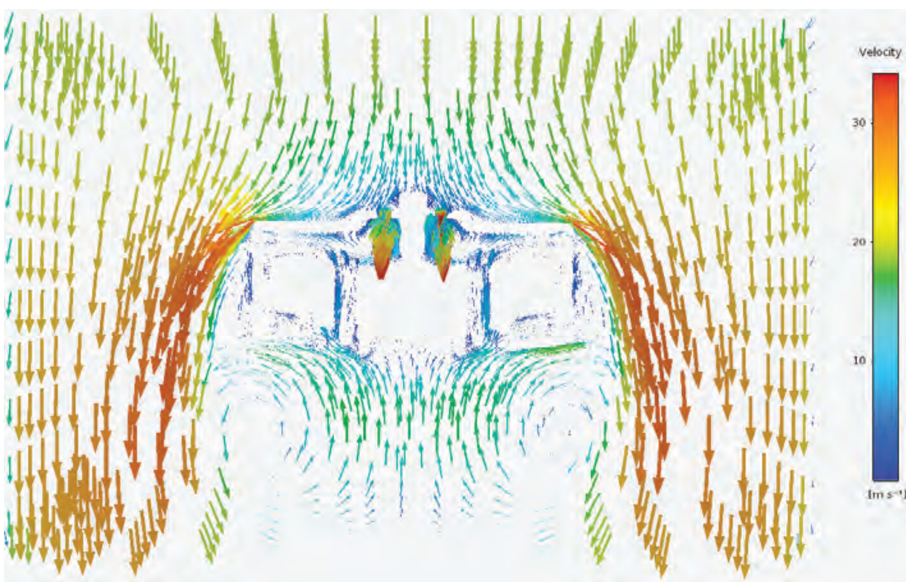
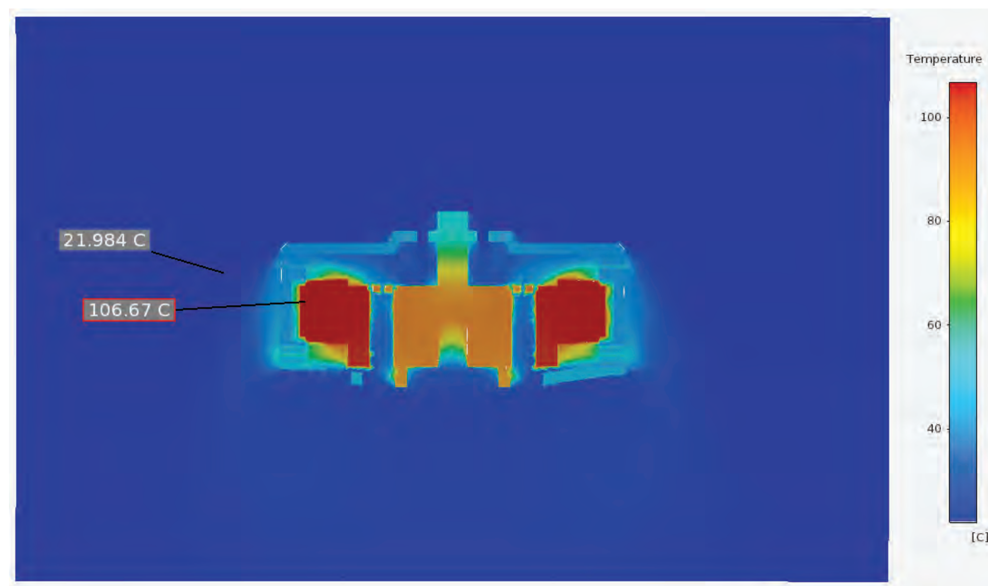


As an extra credit project I decided to model the heat transfer through the brushless motors used on my design team's drone. It was of particular interest as we were running the motors at the edge of their rated thermal limits

-Modeled accurate motor internals
-Simulated flow and heat transfer in ANSYS to find max temps.
-Validated simulations with bench tests that showed comparable results.



Vsualization of airflow through and around motor. Of note is the upward airflow through the inside of the motor over the coils



Thermal heat map showing the very hot coils and the heat transfer through the motor.

The SNOWZY

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The snowzy was a solution to a problem a lot of people didn't realize they had. Lithium batteries don't work in the cold so we found a way to maintain operating temperature of the device. We built a heated case to go around any Android phone allowing sustained use of the phone in sub-zero conditions. With the device we proved an extension in battery life of up to 100%

- Served as team lead, managing every part of the project and making sure deadlines were met.
- Single handedly created an accompanying Android app to tell the case the internal phone temperature and display relevant info to the user
- Created detailed CAD renders for presentation
- Ran in depth calculations for heat transfer through phone.

FEATURES & COMPONENTS

Structural Case
- Provides extra insulation to front screen
- Structure for holding device together

External Device Battery
- Powers the microcontroller and heating elements

Insulation
- Ceramic wool
- Locks in heat and serves as fire deterrent

Recycled Casing
- Secures components to structural case
- Crafted from plastic bags

Microcontroller
- Bluno Beetle
- Serves as bluetooth connection between phone application and heating wires
- Integrated with user interface LEDs

Heating Wires
- 36 gauge Nichrome wire

Thermal Pads
- Sandwiches the Nichrome wire
- Disperses thermal energy evenly over phone backing

The Gimbal

2018

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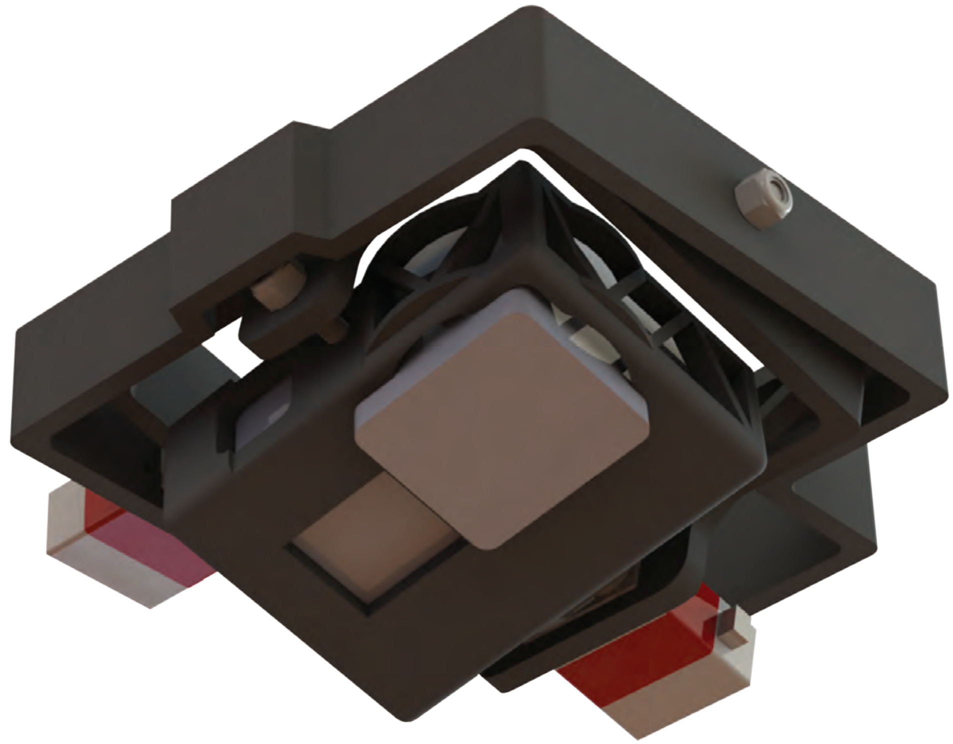
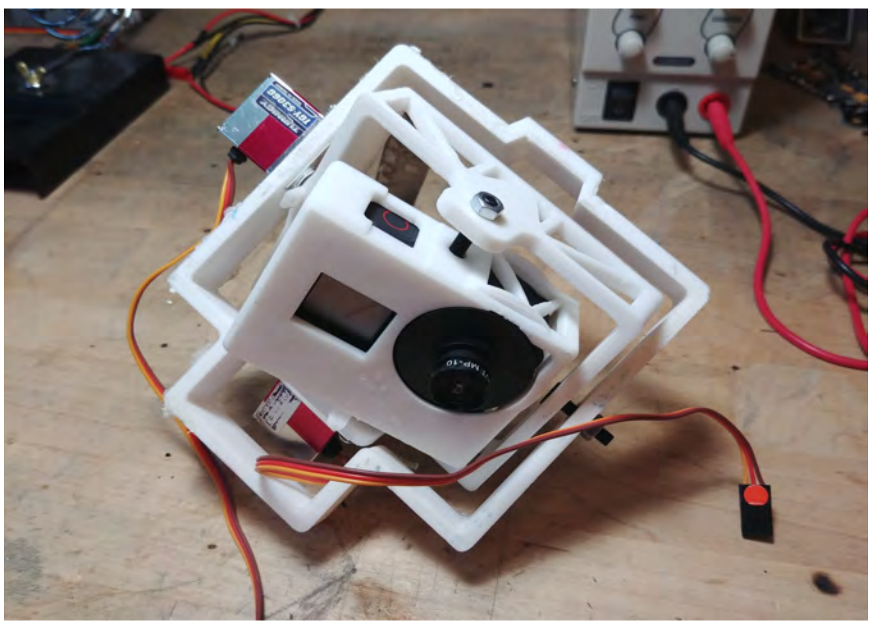
This was a sub project of UAS that I personaly took on. We needed a very light low profile camera gimal to fit into the bottom of our fixed wing aircraft and carry our modefied GoPro Hero 6 (not pictured).

- Designed from the ground up
- Designed for 3D printing and to be as light as possible
- Succesfuly made and printed to be under 100g





Final Gimabal with Modified GoPro Hero 6 installed after removal from competition aircraft

Evo Car Share Roof rack Protection

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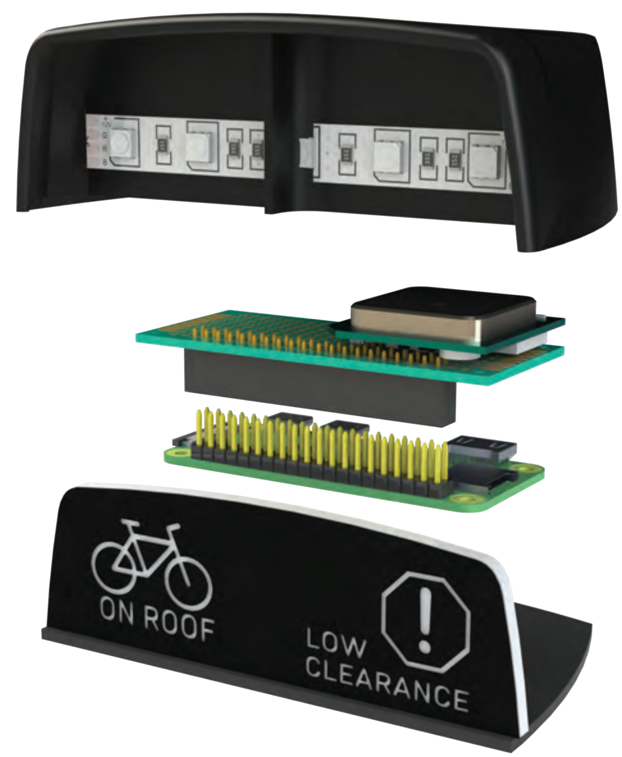
The Problem:

For a year long design course a group of us were approached by a local car share company in Vancouver Canada that emphasises their identity through the roof mounted bike racks they include on all their cars. This also presents a problem of customers accidentally driving into underground parkades with a bike on the roof. Our group was tasked with finding a solution to minimize the economic strain of this problem.

The Solution:

After exploring a wide range of solutions, we settled on a location based warning system that would give an alert to the driver when they were about to drive into a low clearance parkade with a bike on the roof. I spearheaded the design and implementation of a GPS system that ran on a raspberry pi to constantly read the current GPS location and compass heading to compare to a database know parkades' entrances. The solution was tested extensively both theoretically and then implemented into multiple Evo fleet cars for client testing.



The Result:

After completetion of the class a contract was signed and three full systems were delivered and installed in EVO cars for final verification by Evo techs.

The Raven

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Project Raven was born out of a need for a stable, high-endurance multi-rotor platform. It was originally designed for an Australian Medical express competition to serve as an aerial relay station, halfway between the active aircraft and the ground station. Now Raven serves as a versatile aircraft ideal for low altitude mapping of large areas as well as carrying and delivering heavy payloads. The modular payload attachments and option for multiple batteries further expand its mission envelope.

The Tricopter

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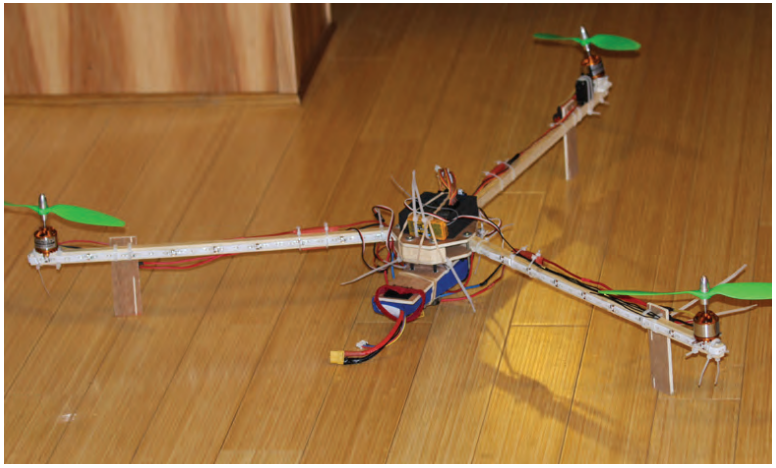
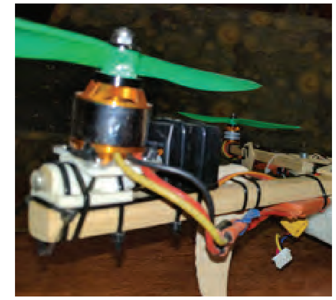
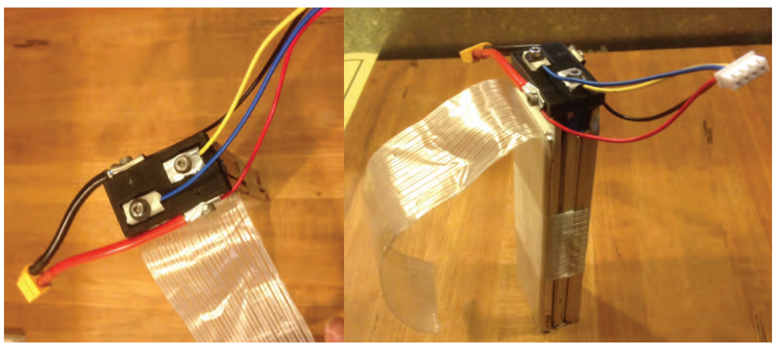




The Origin: It started out at as birthday gift of a pile of parts. The frame was hand cut from left over marine plywood and bamboo flooring. The frame design was a modified version of an existing design. Materials, to wire routing, and size were changed to meet demands.

The Modifications: The original design stayed in one piece for about 4 months before I realized I wanted a more compact and versatile design. I quickly found a PDF of something I wanted and set out on converting the PDF to a usable cad file, and then adapting it to my needs. I adapted the joints for the thicker material I was using. I added more space inside and external mounting points for a GPS. It was cut with a CNC router and assembled by hand. In the rebuild I also shorted the arms to make a more agile copter that could do some basic acrobatics.



The battery: When the McGill Formula Electric team had some spare Lithium battery cells I was quick to jump on them. I quickly designed a 3D printed mount to hold the tabs with bolts as soldering them proved futile. It was wrapped tightly to prevent puffing and covered for protection. It became the largest pack I had.