Applewhite Aero Baton

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The Applewhite Aero Baton

- The Applewhite Aero Baton is an autonomous delivery drone that is capable of being deployed from moving aircraft.
- The Baton uses a coaxial motor along with a gimbal to move vertically and horizontally through the air.
- By using GPS and LiDAR to track position, the Baton can intelligently navigates to waypoints.
- The Baton is capable of carrying small loads such as a blood transfusion, first aid kit, or a water bottle.

LiDAR Landing/Terrain Following

Using a bottom mounted Garmin LiDAR-Lite v3HP, the Baton is capable of sensing distance to the ground below 40 meters at centimeter accuracy [1]. This allows the Baton to disarm at the correct altitude when attempting to land and to accurately detect altitude when flying close to the ground to prevent any crashes.

Aircraft Deployment

The Applewhite Aero Baton is capable of being deployed from a moving aircraft at high altitudes via "Throw" mode. "Throw" mode will:
1. Detect free fall
2. Stabilize the Baton
3. Switch into "Auto" mode and start the predefined mission

Telescopic Payload Design

- A telescopic payload tube allows for efficient storage for when the Baton is not in use.
- A simple squeeze-and-pull action extends the Baton's payload length by 5.67 inches.
- A door is attached to provide easy access to the payload section
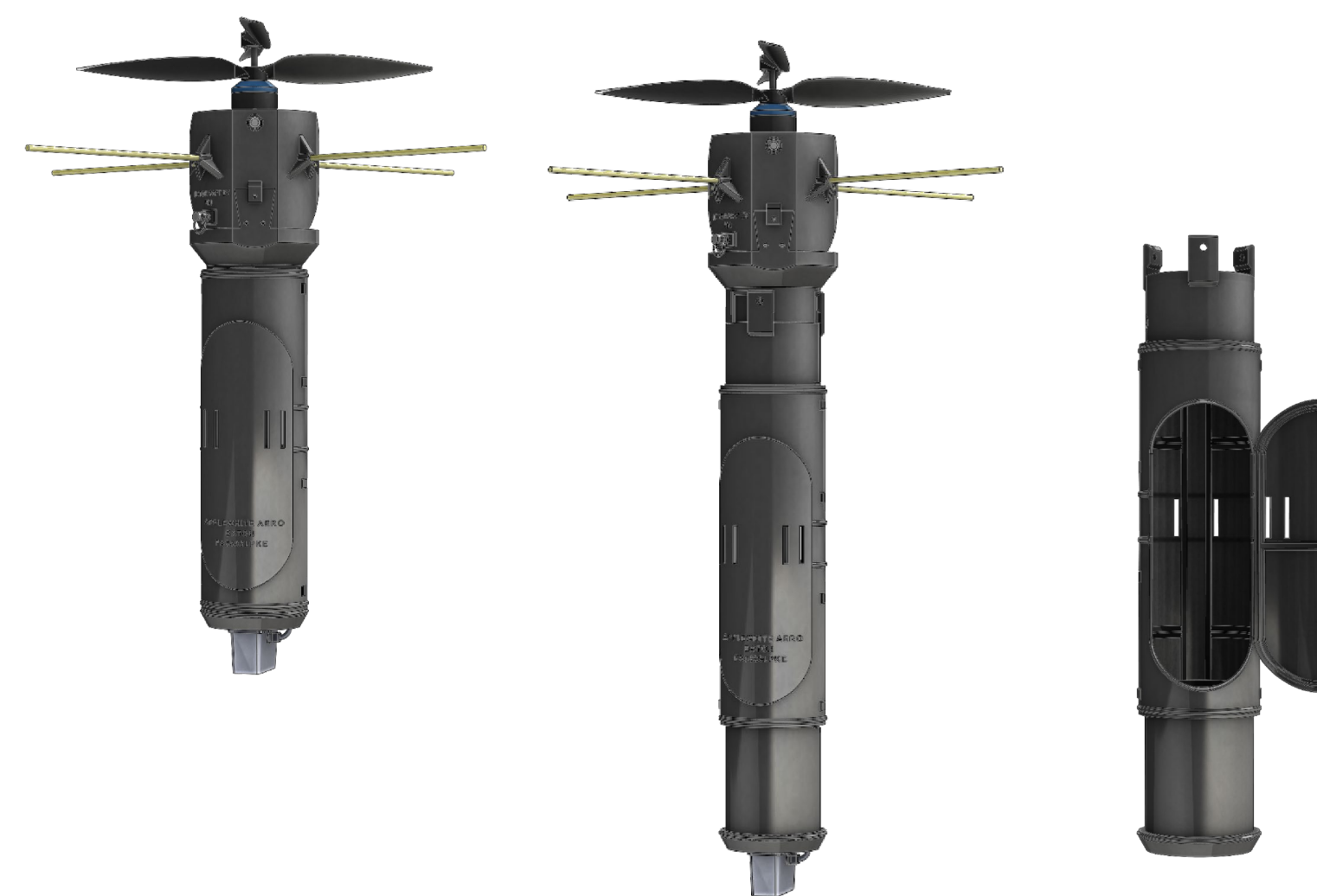
PID Control

Carefully tuned controls allows the Baton to automatically stabilize itself in the air while maintaining position. This is done by using Ardupilot's proportional-integral-derivative control loop with calculated gain values [2].
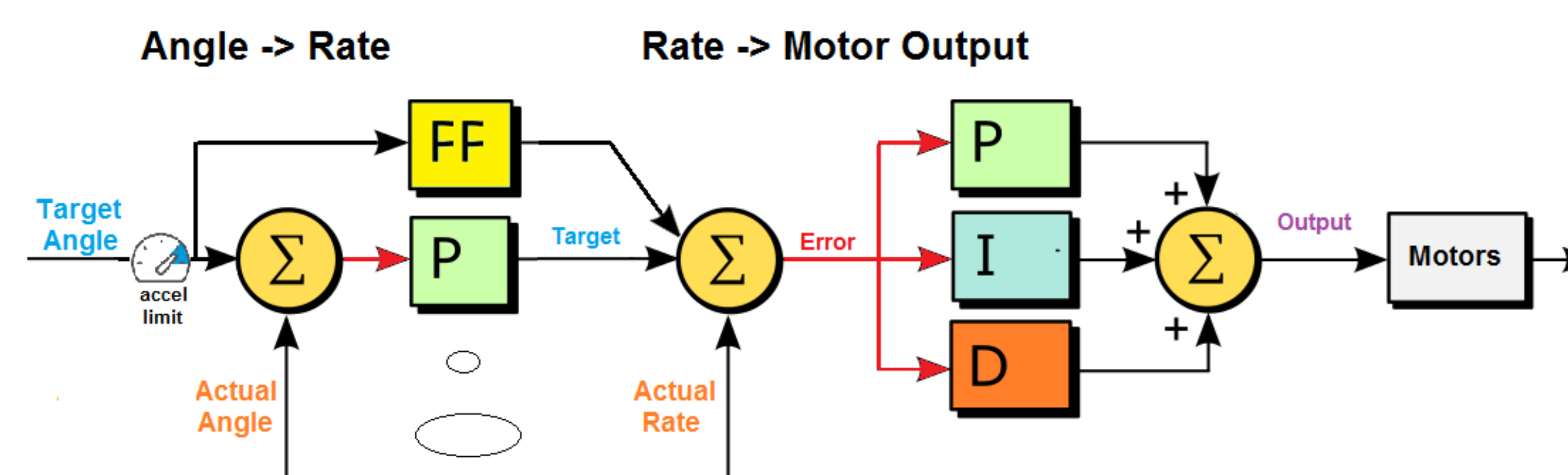

Simple Command Line Mission Planning

A command line script was developed in order to make deploying the Baton simple for any military personnel to use. The user will have to simply plug in the baton, type in the coordinates, hit enter, and send the baton away.

```
Number of coordinates to enter: 1
Enter latitude of Coordinate 1: 1
Enter longitude of Coordinate 1: 1
CRITICAL:autopilot:PreArm: Hardware safety switch
CRITICAL:autopilot:PreArm: Compass not calibrated
CRITICAL:autopilot:PreArm: Compass not calibrated
CRITICAL:autopilot:PreArm: Rangefinder 1 was not detected
Baton found on port COM4
Home location set!
Mission uploaded successfully!
```

Electronics Core

The electronics core was redesigned in order to increase manufacturability and repairability without compromising performance. The previous design took up to an hour to disassemble using manual tools which made repairs very long and tedious. This new design also allows the user easy access to all the vital electronic components in under 5 minutes with manual tools.
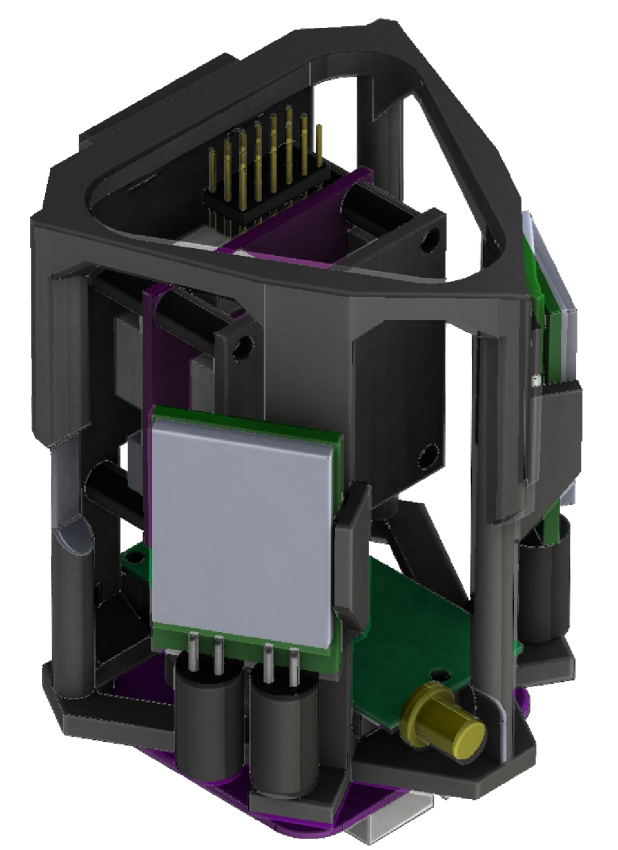
Custom Designed Battery

A prototype battery was custom designed in order to fit the Baton's cylindrical shape better. The previous batteries being used were rectangular shaped and were cumbersome to try to fit into a circular battery bay. In addition, the previous batteries used lithium polymer pouch cells which are easily punctured. This new prototype battery uses lithium ion cells which have metal encasings and features 1.5 times the capacity of the previous batteries.

Future Work, References, and Acknowledgments

- Refined battery manufacturing techniques (spot welding)
- Tuning the gains the on PID
- Test flight in various situations with various loads
- Swarming/array

[1] "Copter Attitude Control¶," *Copter Attitude Control - Dev documentation*. [Online]. Available: https://ardupilot.org/dev/docs/apmcopter-programming-attitude-control-2.html. [Accessed: 25-May-2020].

[2] Garmin and Garmin Ltd., "Garmin LIDAR-Lite v3HP: Distant Measurement Sensor," *Garmin*. [Online]. Available: https://buy.garmin.com/en-US/US/p/578152#specs. [Accessed: 25-May-2020].

ELECTRICAL & COMPUTER ENGINEERING

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