**Individual Lab Report 3**

**By Clare Cui**

Team B: Arcus

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28 October 2016

## Individual Progress

This week, I worked primarily with CAD for the UAV. Because it was not explicitly stated in my last ILR, Logan and I are modeling the entire UAV for a few reasons. One is that we plan to have a minimum of two sensor modalities onboard – as of right now, this is the Velodyne Puck Lite and an mvBlueFox RGB camera – which have differing fields of view. We are making custom parts to mount these sensors, and we need a way to visualize the FOVs so that the mounts orient the sensors correctly. Another reason that we need to do this is to manage the cabling of the electrical system on the UAV. We would like to mount all components on the UAV as compactly as possible, so this involves taking into account the minimum cable radii to determine component spacing. Also, in more than one case, we will need to shorten the cabling, so the CAD would be helpful in determining the length to be used.

For the sensor mounting, I started out by measuring a few pertinent parts on the UAV to which the mount attaches. This included carbon fiber rods, mounting brackets, and rubber bushings that attached underneath the base plate. I created an assembly of these parts, which can be seen in Figure 1. Although an added base plate would be useful for the sake of completeness, the clearances of the assembly are fully defined by the dimensions of the rods and accompanied parts. I also measured the spacing between the rods and placed them accordingly in a subassembly.

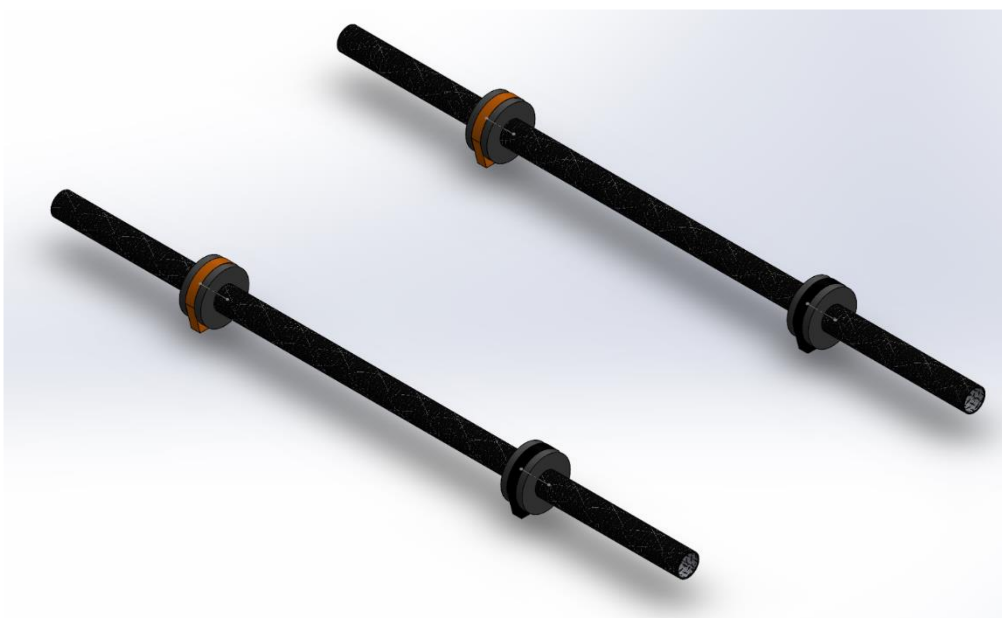

***Figure 1:*** *Subassembly for sensor mount reference.*

The best field of view for the sensors would be underneath the base plate of the UAV. Because the batteries are some of the heaviest components of the UAV, we decided that they would also need to be situated underneath the main chassis to maintain a lower center of gravity. The RGB camera and LiDAR need to have intersecting fields of view, but, since we would like to both intrinsically and extrinsically determine their intersection, we are going to design the RGB camera mount such that its angle is adjustable. Thus, we have an "undercarriage" sensor mount assembly that will carry batteries, RGB camera, and LiDAR sensor.

The undercarriage mount attaches to the chassis *via* an envelope that encloses the rods at either end. A close-up of this design can be seen in Figure 2. The envelope will have webbing between the rods to prevent twist or torsion of the carriage. It will come together as two pieces that will bolt together at the center of the assembly, as depicted in Figure 3. Since there is still room for travel along the length of the rods, a hard stop will be designed into the mount which will be stopped against the base plate itself (also seen in Figure 3). The mount will have a removable bottom plate that to which the Velodyne will attach. This subassembly can be seen in Figure 4. After bolting all three sections of the mount together, foam padding will be placed on the walls and plate so that the batteries are isolated from vibrations while flying and there is tolerance for battery expansion. The RGB camera mount will be situated on the envelope attachment and can also be seen in Figure 2. There will be a base designed for the camera that will be mounted on a dowel pin that is placed between the two rod envelopes. To adjust angle, there are a couple options. The dowel pin can either be kept in place with a set screw that screws into one of the envelope sections, or the camera base will be designed as a ring clamp that can loosen, allowing angle adjust accordingly.

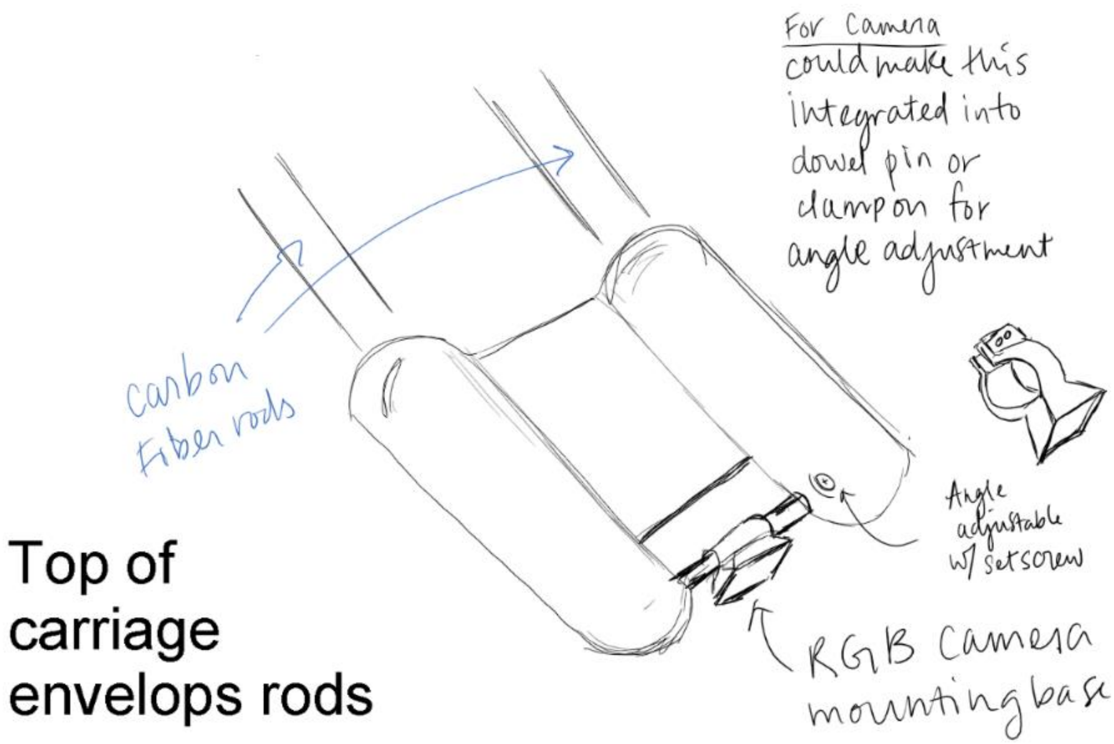


***Figure 2:*** *Undercarriage envelops carbon fiber rods to attach to the chassis.*

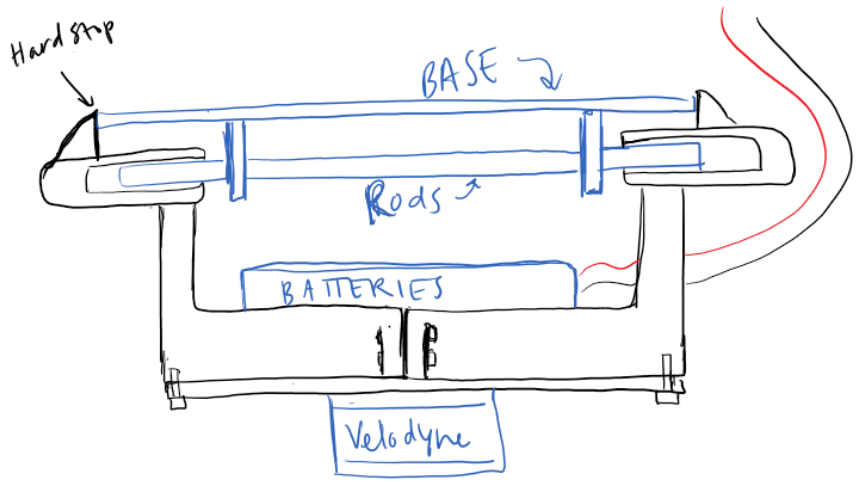


*Figure 3: Front view of the undercarriage sensor mount assembly.*

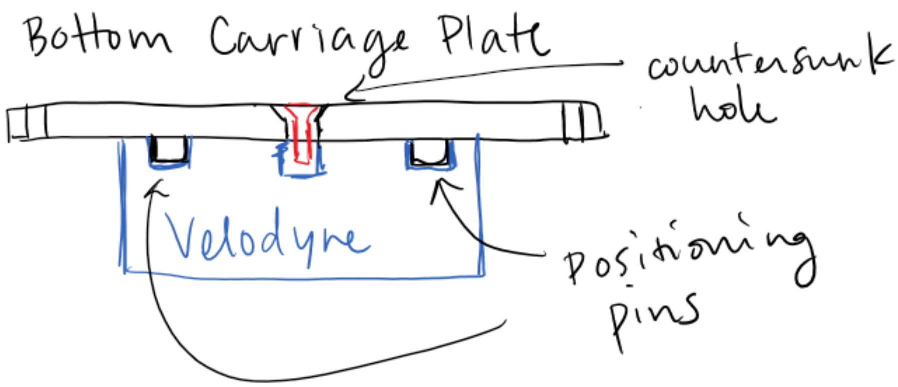


*Figure 4: Undercarriage bottom plate that will mount the Velodyne and the rest of the undercarriage assembly.*

**Challenges**

The primary challenge that I experienced this week was meeting the goal for designing the sensor mount design. Although I did not have it by the most recent Progress Review, I plan to have the mount designed in SolidWorks and fabricated by 3D printing hopefully by the end of this weekend.

**Teamwork**

**Logan Wan:** Logan was responsible primarily for the power distribution board part sourcing this past week, was a support for mechanical tasks, and he oversaw general project management duties.

**Angad Sidhu:** Angad did extensive work with BLAM over the past week. He did research into localization and found an issue with loop closures using GDB, a C++ debugger. He also wrote an odometry script to compare the BLAM pose estimate to the GPS ground truth.

**Maitreya Naik:** Maitreya did the power distribution board schematic for this past week and sourced parts online for purchasing for the PDB.

## Future Plans

In the next week, I will be completing the sensor mount design for the battery, LiDAR, and RGB camera, with its fabrication done by October 31. In the future, further protection for the Velodyne may be designed at the cost of the field of view of the sensor due to it being a very expensive piece of equipment. Additionally, it will be necessary to reduce as much material on the mount as possible so that it does not obstruct the field of view for the different sensors. I will also be working on doing all the CAD modeling for the UAV and mounting the sensor hardware. Finally, I will also be working with Maitreya to get the camera and IMU calibrated. One issue that he is currently running into with this is running the software Kalibr due to a version issue. We will either try to find a copy of Kalibr that works on another computer or look for other software packages to use.