Engineering Addendum

To Whom it May Concern,

The biggest challenges we faced during this project were in the mechanical design aspects and budgetary constraints. The biggest problem we ran into that we were unable to solve were the encoders. It was important to have absolute encoders because even if the manufacturing had been perfect, there still would have been some sources of error that the encoders would have allowed us to account for. Unfortunately we were unable to solve this problem without increasing our budget by around 50%. The mechanical design was also overall challenging without a mechanical engineer on the team though doable because of one of our team members had extensive mechanical design experience.

Another key aspect that would have made the project easier from the beginning was if Linux had been chosen as the operating system. Windows was chosen because the motors and controllers had drivers already written in Windows, but later on it was discovered that they also existed in Linux.

As far as the conceptual piece of the project, it is important to understand the basics behind TLEs, satellite paths, and coordinate systems before starting. It is also important to note what software packages are available for completing the TLE translation and coordinate transforms. For a python implementation, the library Pyephem exists for TLE and star paths and coordinate translations into observer centric coordinates. In Matlab it is possible to use the SGP4 package for path the information and the built-in functions for coordinate transforms.

It is also important to note that TLEs have an inherent error because of the potential drift in low earth orbit. The drift which can be up to a kilometer or two a day means that TLEs need to be updated every couple days to stay current and close to accurate. The only way to remove this error is through image processing and starmaps/platescales. Through the comparison of the predicted TLE track to the real position measured against the true position of the stars, it is possible to find a more precise and absolute position of the satellite. This step is a further step that would increase the accuracy and usability of the mount in communication. We have taken the first steps to include this approach in our mount, but it raises other problems because of the duration of exposure and total number of frames combined needed to use this method.

Good luck,
Team Leo