**Commissioning the Claspers**

To fully commission the claspers, they must satisfy the following key functions:

1. Claspers can engage and disengage the cube consistently (no motion involved)
2. Claspers can engage/disengage the cube consistently (after motion – 90/180 degree turns)
3. Claspers turn a consistent number of degrees every time

**Test Trials to be Executed in Sequence**

**Engagement [X]**

1. Using a magnetized cube, disengage then re-engage the cube with each clasper
2. Check that the position of the clasper on the cube has not changed

Observations:

* Engagement is consistent. Clasper position does not change with disengagement and re-engagement

**Consistent Stepping [X-conditional]**

1. Turn on the steppers
2. Insert magnetic cube
3. Execute 50 step sequence 5 times back and forth to verify consistency
4. Repeat the above trials **with a magnetic cube**

Observations:

* Different number of steps needed for stepper A and stepper B for 90 degree turns. Stepper A achieves a half-turn with 50 steps while stepper B requires from 50-60. Can conclude that stepper B is missing steps.
* Tuning VREF to 1.2V results in no noise, but based on the polulu calibration guide and the motor specs, it should only be set to about 0.4V. Datasheet for the stepper might be wrong.
* Stepper A is working without a hitch. 50 steps results in a half turn, it’s repeatable, etc.
* After improving structural integrity of stepper B’s housing sections, number of missed steps is down from 15 to around 2-3 full steps.
* Shaft-to-Adapter section of Stepper B seems looser than Stepper A’s. May be the cause of the few missed steps. Attempted to epoxy the shaft to the adapter to improve rigidity, but it didn’t help. Could try to improve the rigidity of the connection even more
* Upon testing, consistency of 90 degree turns appears to be acceptable.

**Symmetry [X]**

1. Using a magnetic cube, note the position of the clasper on the cube
2. Disengage a clasper
3. Turn 180 degrees
4. Verify that clasper position has changed minimally
5. Verify that the cube sits flat
6. Above two checkpoints verify symmetry along both axes

Observations:

* Symmetry was observed to be consistent. Change in clasper position was not noticeable after 180 degree turns in both claspers.
* Claw supporting X-axis may need 7.2V instead of 6V. Cube is drooping.

**Cube/Face Turning [X]**

1. Insert magnetic cube
2. Engage both claspers
3. Turn the cube/face using one clasper
4. Turn it back to re-verify consistency
5. Turn the cube/face using the other clasper
6. Turn it back to re-verify consistency
7. Execute steps 3-6 five times for a total of 10 face turns and 10 cube turns
8. Make note of any issues

Observations:

* Both claspers are consistent to within 2 full steps. Whether this is sufficient is *to-be determined*. Assuming one clasper never makes too many consecutive turns, the alternative clasper may be able to correct for the error during it’s turn.
* Clasper A’s stepping sequence generates significant vibrations. These vibrations reverberate through the cube, causing undesired turning during CTURNs
* Adding an extra screw (increasing rigidity of the clasper) and half-stepping minimizes the vibrations. Beyond half-stepping, vibrations become too big of an issue – every few steps, a “jitter” is observed, this effect is amplified when half-stepping, quarter-stepping, etc.