MERCER ENGINEERING
Different by design

Centrifugal and Centripetal Force Demonstration Device

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MERCER BEARS

Artificial Gravity

Deep space travel faces many obstacles, one of which is being unable to recreate gravity in a space station. In theory a space station could rotate on an axis in an attempt to use centrifugal force to recreate gravity. As long as the space station spun fast enough it would be theoretically possible for a force to be felt . This centrifugal force should in theory be felt to be pushing away from the center of the axis of rotation. This is much like taking a sharp turn in a car and feeling a pull in the opposite direction of the turn. In my project I aimed to study this centrifugal force to see how it affects a wireless dynamics sensor that can measure acceleration in all three dimensions

Centrifugal vs. Centripetal

The only problem with this artificial gravity theory is the fact that centrifugal force is not truly considered a force. Centripetal force on the other hand is a true force. Centripetal force is the force that keeps an object from flying out of a circular path. Both centripetal and centrifugal force can be calculated with the same equation of F_c=mass(velocity^2/radius). Centrifugal is regarded as the absence of centripetal force and centrifugal force can only be felt if there is contact between the vehicle making the turn

Test Planning

In order to test the artificial gravity we will be using a wheel that will rotate with a high velocity. Attached to the wheel will be a wireless dynamic sensor that will measure the acceleration it experiences. Centripetal acceleration tells us the sensor should experience an acceleration towards the center of the wheel. The dynamic sensor can also measure forces in one dimension parallel with the acceleration in the X direction. This will be the same direction in which we expect to see the acceleration. As seen in the Google sketch below, there will be other poles connected to the wheel to balance the weight of the sensor. By analyzing the acceleration and forces from the dynamics sensor, we will be able to figure out the direction of acceleration and either centripetal or centrifugal forces.

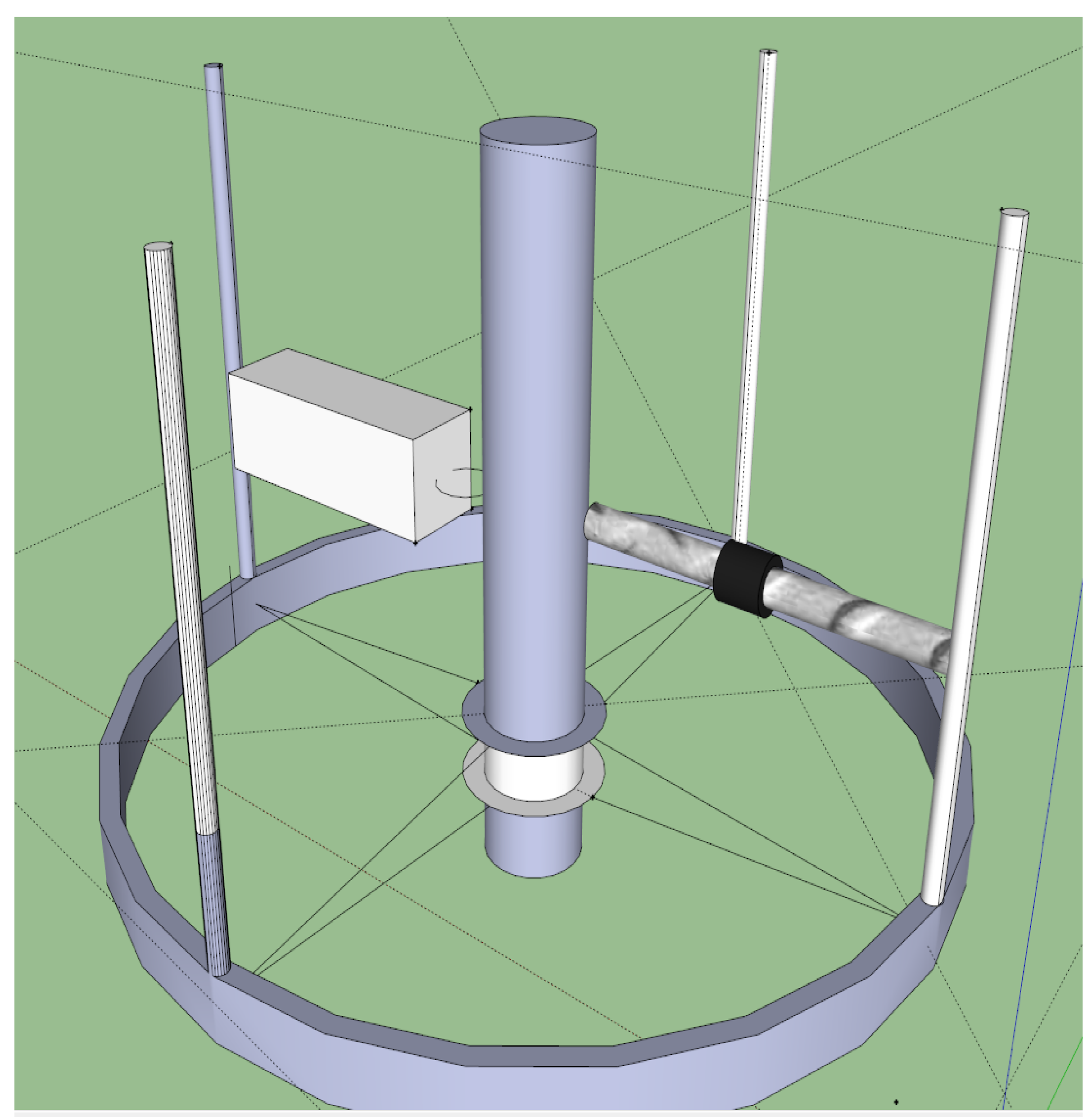


Figure 1. SketchUp drawing of the gravity simulator.

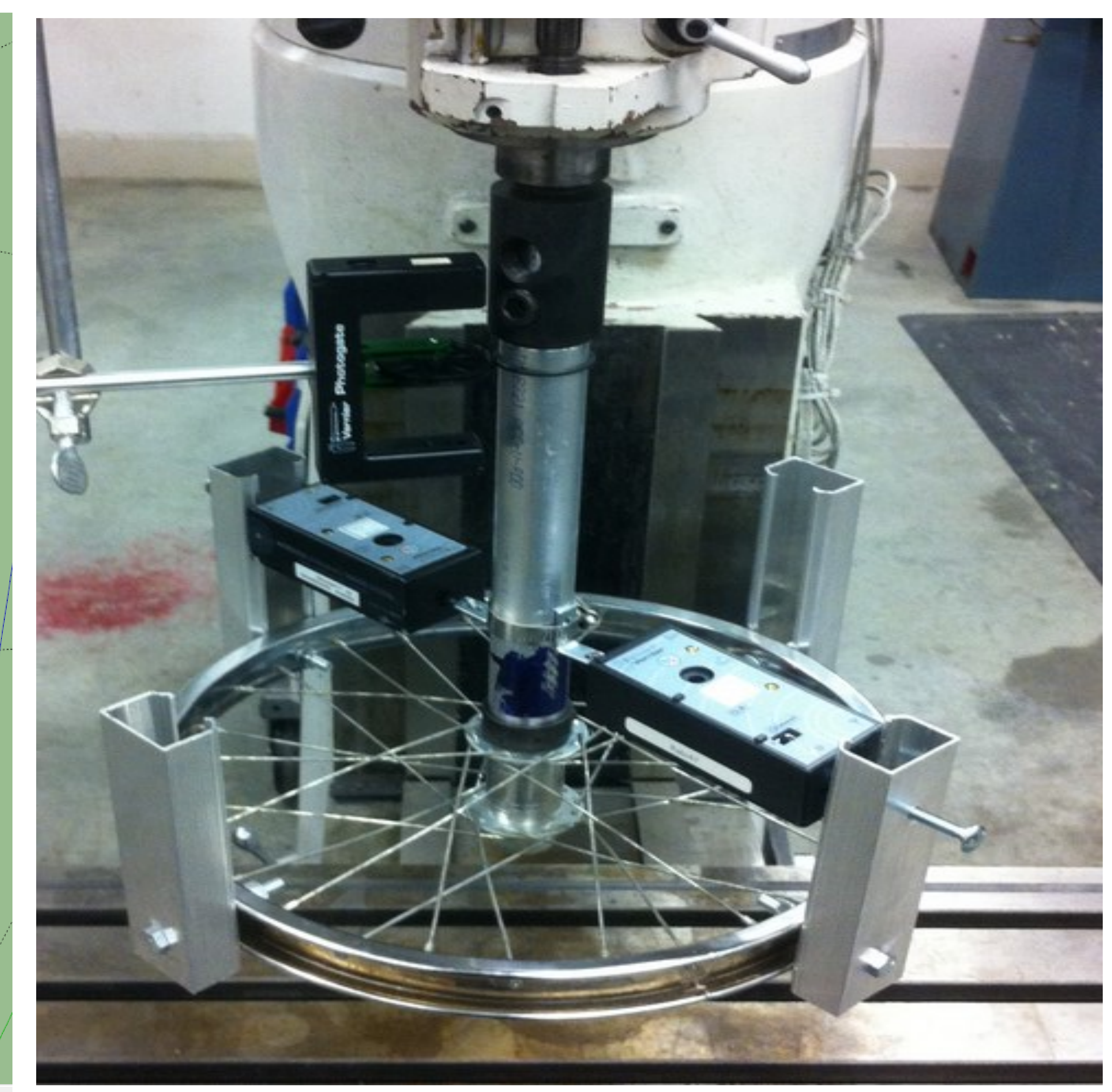
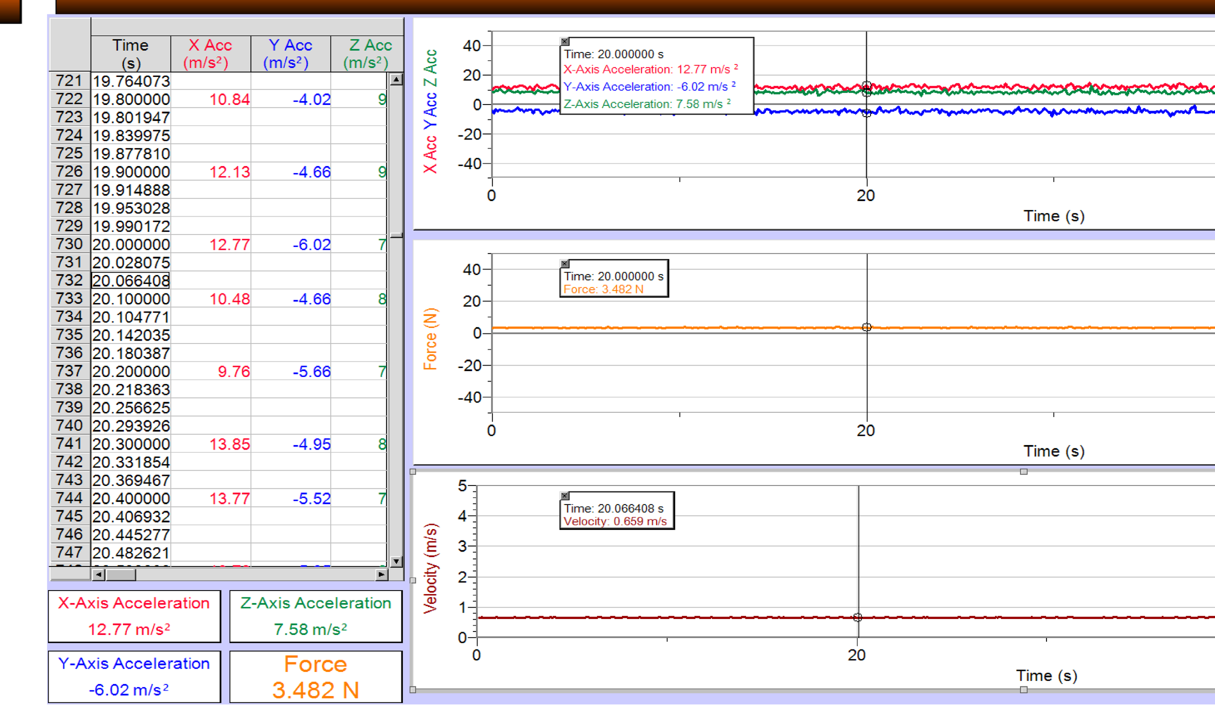


Figure 2. Final design in the end mill.

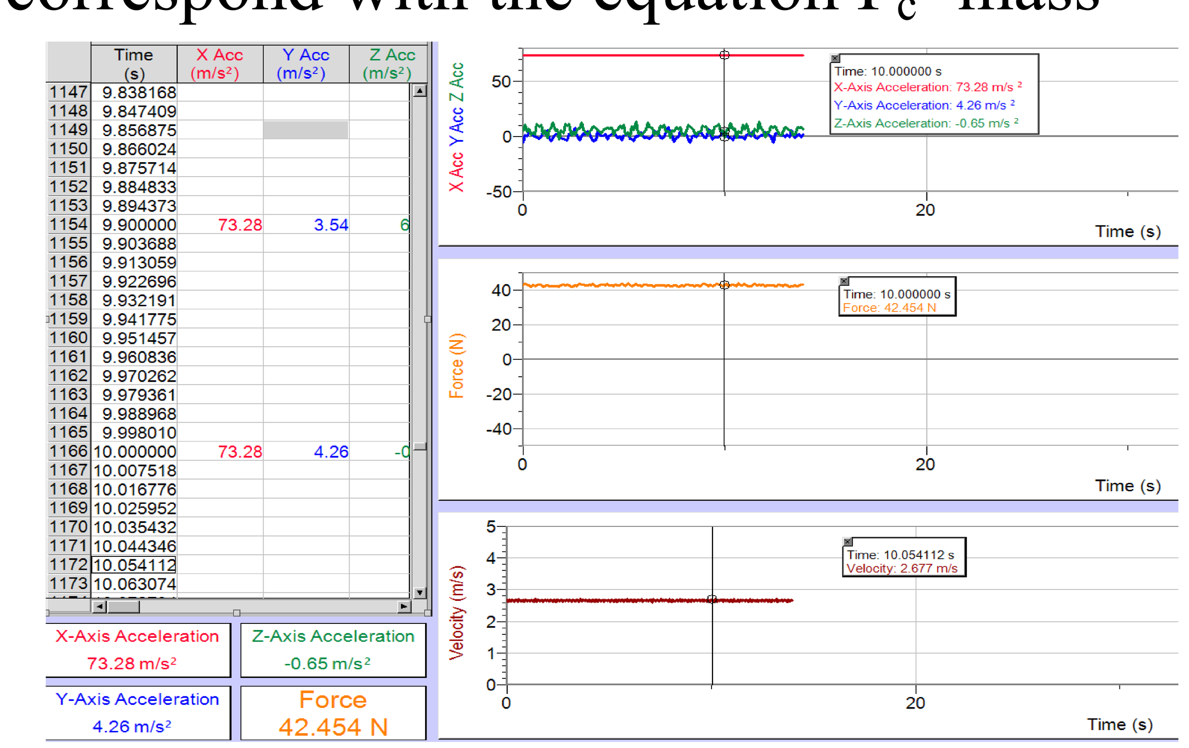
Testing

During testing we had two wireless dynamic sensors connected to the wheel with a center of mass 12.7 centimeters from the center of the wheel as seen in the picture on the right. One sensor was turned on while the other was only present to balance the weight. As expected the sensor told us it had an acceleration pointing towards the center of rotation. This is due to the centripetal acceleration. Simultaneously the sensor felt a force that was stretching the dynamic sensor. This tells us the sensor was sliding away from the center of the circle. This was due to the centrifugal force acting on the sensor.

Results



In testing we saw that X direction acceleration pointed towards the center of the circle while there was a tug on the dynamic sensor. This means the sensor was moving away from the circle. This is seen in the results from the dynamic sensor above and below. Above it can be seen with a lower speed there is a lower acceleration and lower force acting on the sensor. Below shows the information retrieved when the sensor was spun faster. The force and the acceleration are greater in the test below. These values correspond with the equation F_c=mass



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