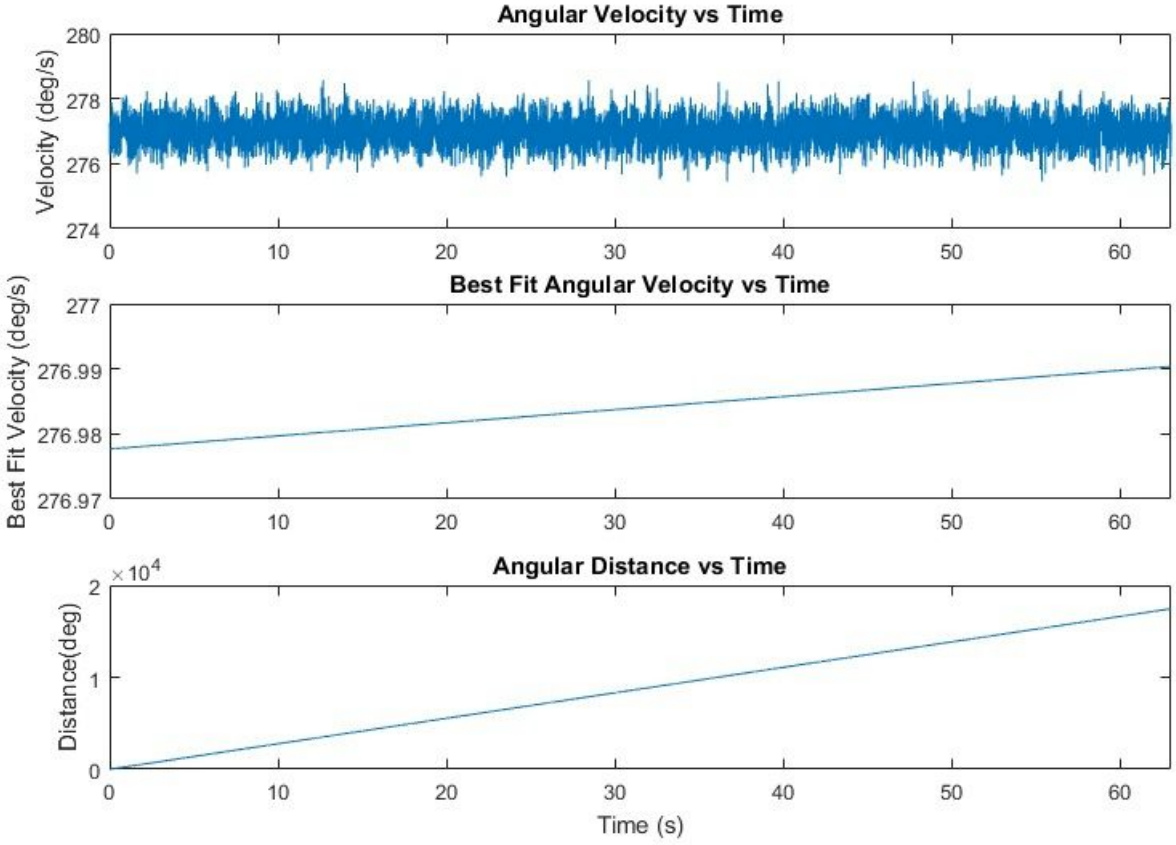
Wearable Sensor Testing Report 4/8/2016

All of the following results are from older data with the wearables configured to capture at 200 Hz. When the sensors were changed to 500 Hz, the actual capture rate was inconsistent and the data suffered as a result and was thus unusable. This is what I was trying to convey in an admittedly confusing manner before. I've run many tests but I will highlight a few that I believe to be important. All of the following tests were using the same sensor. Results vary slightly with the sensor, but I wished the following data to be consistent.

Note: All following velocities and distances are found in the Z-axis of the gyroscope.

LP Player Test

- The following test involves an inertial sensor placed on a rotating LP player.
- Player rotating at 45 rpm (270 degrees per second).
- Test run for 63.02 seconds

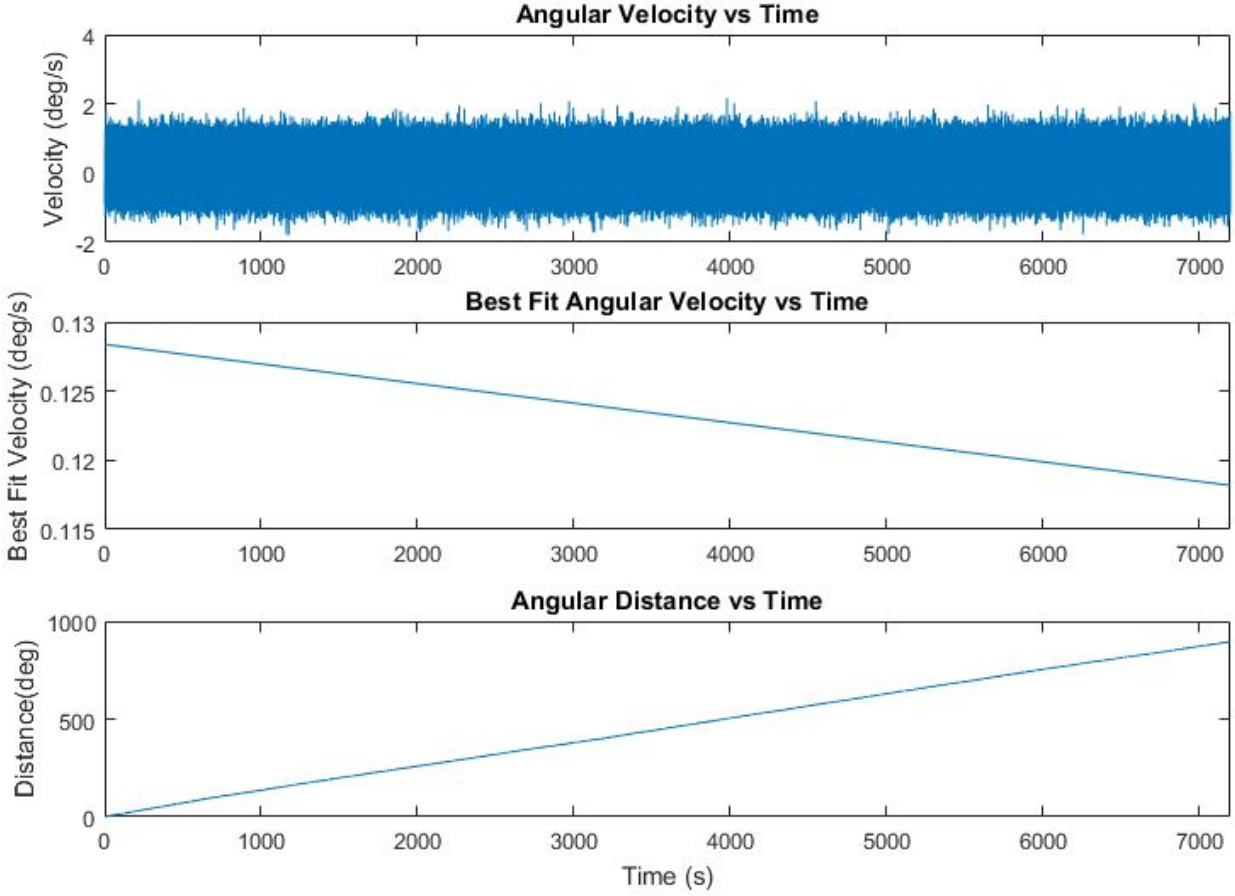


- Mean Velocity: 276.98 deg/s Expected: 270 deg/s
- Final Distance: 17455 deg Expected: 17014.4 deg

It is difficult to know how much of the discrepancy between actual and expected is due to inaccuracy in the “45 rpm” setting of the LP player and due to the drift.

Stationary Test (Power Unplugged vs Plugged)

- Test consists of sensor sitting stationary on undisturbed surface.
- Test run for 7199.2 sec (~2 hours).
- Sensor fully charged and then unplugged.



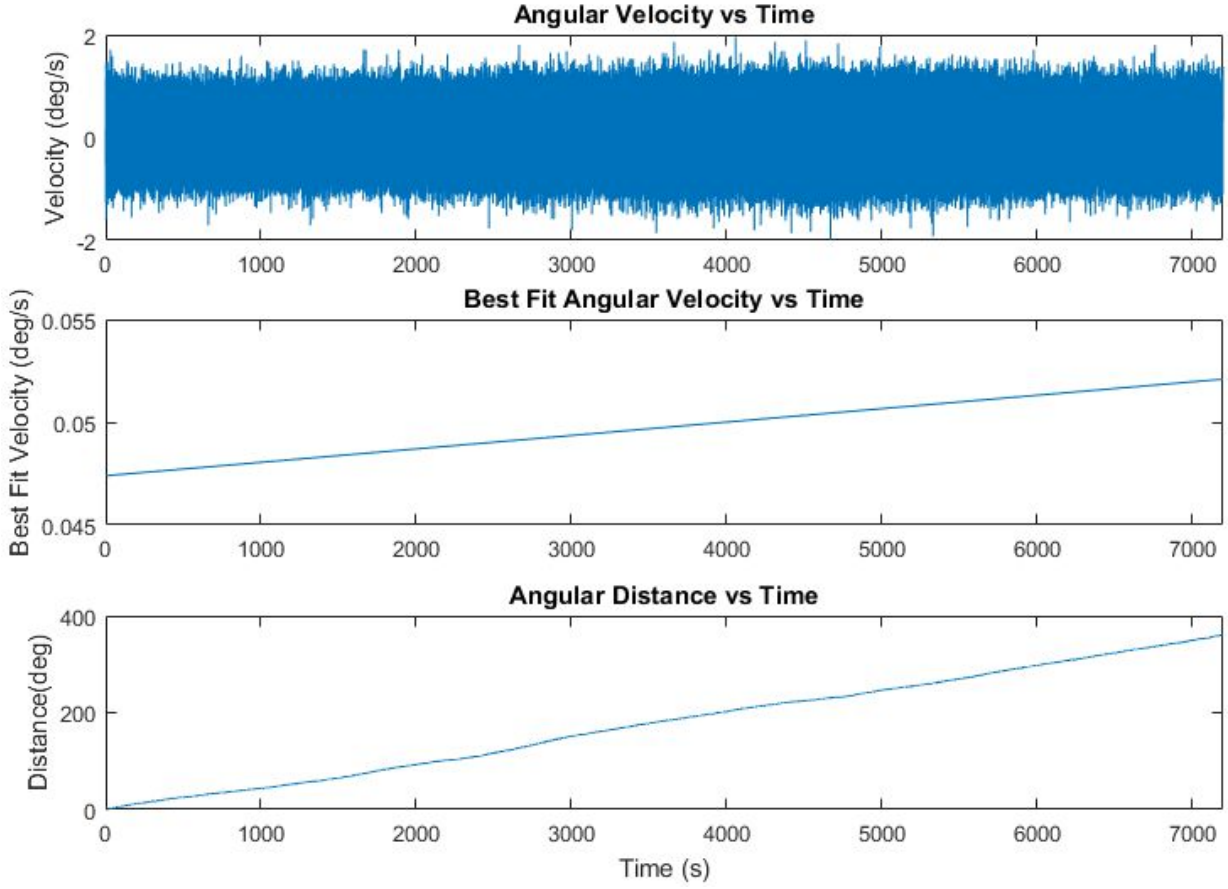
- Mean Velocity: 0.123 deg/s Expected: 0
- Final Distance: 895.14 deg Expected: 0
- Corrected Distance: 858.44 deg
- Drift: 0.0102 deg

“Drift” refers to the difference in starting velocity from the best linear fit line and the ending best fit ending velocity.

Velocity is corrected by subtracting the discrepancy in initial best fit velocity from current best fit velocity from it. Or more simply put, flattening out the best fit line and adjust velocity by the same amount.

This correction fixes the data by only 4.2%. I believe the main problem to be the inherent offset that the gyroscopes are reading. Even when noise is filtered with a digital low pass filter, there is a clear average offset of ~0.13 degrees per second. This number is different for each sensor. Drift is certainly a function of the voltage of the battery, as shown in the test below with the power cord plugged in for the duration.

- Test is run with sensor sitting stationary on undisturbed surface.
- Sensor fully charged, and plugged into power cord for the duration of test.
- Test run for 7197.9 sec (~2 hours)



- Mean Velocity: 0.0497 deg/s Expected: 0
- Distance: 360.75 deg Expected: 0
- Corrected Distance: 343.84 deg
- Drift: 0.0047 deg

These results are nearly 2.5 times better than where a sensor is not plugged in. I believe that it would be worth looking into a battery that would more consistently deliver voltage for a longer period of time. This must be taken into account when 3D printing an enclosure for the sensor.

Thank you for your time Dr. Jafari. Please let me know if you have any further questions about my results thus far.