Prototype testing of the Motion Detection Unit occurred on both straight track segments and curved segments and used all available hardware types. Analysis of results from representative tests will be presented. Each data set is filtered for noise and then the accelerations on the Y-axis and rotations about the Z-axis where examined. The Y-axis is used due to it being placed in parallel to the track in the test setup. The series of tests conducted on the straight track was conducted over distances of 50 to 70 in. Figure 1 shows the processed data from a sample test where the train moved 52 inches along a straight section of track using the IMUduino as the measuring device. For this sample, the calculated position was 2.4 inches from the actual end point of the of the train movement. This is caracteristic of all tests of similar length, where the largest difference was approxamately 3 inches with the average being about 2 inches on straight track.

Figure IMUDuino distance measurements along Straight Track: Distance Travelled Along Y-Axis (m) vs. Distance Travelled (m) X-Axis

For the tests that occurred using a curved segment of track, the test was conducted so that the train began on a short straightaway, entered a righthand turn of 90º, and concluded on a second straightaway. A sample of collected data is shown in Figure 2, which displays a calculated distance traveled that is 2 inches away from measured distance traveled. The calculated rotation of the system was 85º for the entire test with the system making an actual 90º turn. These numbers were consistent with the measurements taken during other test runs across both hardware sets, however it was noted that track segments that cause bumps or other disturbances introduced noticeable gyroscope drift in the data.

Figure IMUDuino distance measurements along Curve Track: Distance Travelled Along Y-Axis (m) vs. Distance Travelled (m) X-Axis