**Position via Regression Summary**

To find the position of an accelerometer inside of a device, one can use linear regression. In this case, this method was done by placing a device with an accelerometer inside, namely the PocketLab Voyageur device, at the top left corner of a rectangular frame. This frame was then placed onto a turntable with a known rotational velocity of 72 RPM. Data is taken after the turntable is turned on and is at its maximum speed for approximately 10 seconds. The device is then moved over 1cm to the right (on its positive x-axis), and the process of data collection is repeated, until the device reaches the top right corner of the frame. The device was then placed at the top left once again, and instead of shifting 1cm in the horizontal direction, it is moved in the vertical direction. Once again, data collection was repeated as usual until the device reached the bottom left corner of the frame, which marked the end of the data collection.

Next, the acceleration data was considered, and through the use of rotational kinematics, the distance between the bottom right corner of the device and the actual location of the accelerometer in the device was found. This is because, in the calculations, we chose to take the bottom right corner of the device as the radius of the rotation tracked by the accelerometer. This, of course, is not correct, since it is the accelerometer that tracks the movement and not the chosen point. When the distance in x and in y was calculated, we can subtract these distances from the chosen point on the device to obtain the actual location of the accelerometer inside the device.

The table below compares the obtained acceleration data from 18 runs of moving along the x-axis, and 24 runs along the y-axis. There were more runs along the vertical axis simply because the rectangular frame was longer in the vertical direction. The table also shows the x and y values of “r,” which is the position of the accelerometer sensor with respect to the bottom right corner of the device. Below that data, the average rx and ry were calculated. They were then compared to the true position of the sensor given by the device’s schematics, and a percent error was calculated for both the x and y axes.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Acceleration Data** | | **Position of sensor** | |
| **Run #** | **ax (m/s2)** | **ay (m/s2)** | **rx (cm)** | **ry (cm)** |
| **1** | -5.32 | 7.15 | 2.83 | -2.28 |
| **2** | -4.31 | 6.36 | 3.34 | -2.47 |
| **3** | -3.94 | 6.14 | 2.89 | -1.80 |
| **4** | -2.99 | 5.48 | 3.31 | -1.79 |
| **5** | -2.68 | 5.48 | 2.78 | -0.79 |
| **6** | -1.81 | 4.16 | 3.08 | -1.76 |
| **7** | -0.93 | 3.38 | 3.41 | -1.94 |
| **8** | -0.48 | 2.89 | 3.09 | -1.67 |
| **9** | -0.05 | 2.08 | 2.73 | -1.89 |
| **10** | 0.65 | 1.32 | 2.78 | -2.02 |
| **11** | 1.40 | 0.66 | 2.89 | -2.01 |
| **12** | 2.07 | -0.04 | 2.90 | -1.93 |
| **13** | 2.51 | -0.95 | 2.56 | -2.43 |
| **14** | 3.65 | -1.66 | 3.27 | -2.48 |
| **15** | 3.98 | -2.55 | 2.76 | -2.82 |
| **16** | 4.80 | -3.10 | 3.00 | -2.64 |
| **17** | 5.40 | -3.76 | 2.90 | -2.63 |
| **18** | 6.29 | -3.91 | 3.23 | -1.86 |
| **19** |  | -5.20 |  | -2.79 |
| **20** |  | -5.79 |  | -2.68 |
| **21** |  | -6.69 |  | -3.02 |
| **22** |  | -7.42 |  | -3.12 |
| **23** |  | -8.14 |  | -3.20 |
| **24** |  | -8.67 |  | -2.99 |
|  | | **Average:** | 2.99 | -2.07 |
| **Schematic:** | 2.5 | -2.1 |
| **Percent Error (%):** | **19.43** | **-1.59** |

*Figure 1: Acceleration and radial data of an accelerometer on a turntable*

*Figure 2: Acceleration in x Compared to its Position on a Turntable*

*Figure 3: Acceleration in y Compared to its Position on a Turntable*

In conclusion, the above data presented a viable way of calculating an approximate location of an accelerometer sensor. In the x axis, our results were off by 0.49 cm, or 19.48% of the actual position, while our results in the y axis fell 0.03 cm, or 1.59%, short of the actual position. The sources of error in these values come from the fact that the rectangular frame on the turntable visibly wobbles. This is because the frame’s center of mass is not perfectly aligned with the center of rotation, therefore some parts of the frame will be affected by gravity more than the others. By minimizing the wobble of the frame on the turntable through experimental improvements, the results would allow for an accurate and consistent method of finding the position of an accelerometer sensor in a device.