iBeacon Based Ranging

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Ranging:

To come up with the ranging equation, we implemented an algorithm that scanned for a specific control beacon at known distances. The way it functioned was, with each button press, the RSSI, Tx Power and the distance to the beacon (which is pre-determined) are stored in lists.

We took two approaches to this. First, we performed the ranging experiment inside the link lab with the beacon being incrementally distanced from the receiver by 0.5m. However, this did not yield good results, as seen in Fig. 1.

Background pattern

Description automatically generated

Figure : Ranging equation data collection test performed indoors

Our assumption is that this is due to the multipath effect of signals interference, which gives us RSSI values which may be incorrect. To remedy this, we performed the same experiment outside the link lab, and we obtained much better results, as shown in figure 2:

Background pattern

Description automatically generated

Figure : Ranging equation data collection test performed outdoors

We decided to stop the testing at 8.5m because the default setting for the minimum\_rssi in the BLERadio.start\_scan() function is set to -80 and we thought that would be a good place to stop.

These datapoints were then fed to a graphing tool to try and approximate the distance-rssi-tx\_power equation. The graphing tool is shown in figure 3. We tried two different functions based on some theories we found [here](http://www.davidgyoungtech.com/2020/05/15/how-far-can-you-go). The first function we tried was

The values 0.0233 and -0.41 were computed based on tuning the function to best fit the data points we programmed in. However, we found that the curve, while following the general pattern, was still not close to the data points, only working for two of them.

So, we came up with a new equation:

The values 0.01 and -0.21 were likewise computed by tuning the new function to fit the data points. This time, we found a better match, and the curve was a better approximation for the data we had at hand.

And so, this was the function we decided on for the ranging.

Chart

Description automatically generated

Figure : Graphing tool used to approximate the distance-rssi-tx\_power relation

You can refer to our tuning parameters on the plotting tool [here](https://www.desmos.com/calculator/g6ypxes8gt).