CS425A-Assignment1

Shrey Mehta (200580)

Abstract

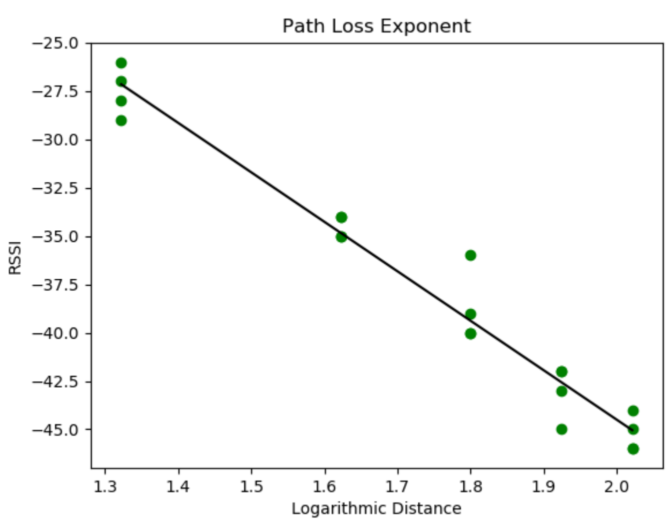
Report for the first assignment of CS425A 2022-23-II offering.

Step 1: Calculating the Path Loss Exponent

I have used the WiFi analyser app to calculate the RSSI using a personal hotspot of one mobile phone placed at various distances from the device in which the app is being used. The readings corresponding to various distances of one mobile phone with the hotspot and the other with the application are obtained. The readings have been taken for 4 different orientations of the device at 5 different values of distances keeping the device with the wifi analyser app fixed. The following readings were obtained using the application:

Distance (cm)	Orientation 1 (dBm)	Orientation 2 (dBm)	Orientation 3 (dBm)	Orientation 4 (dBm)
21	-28	-29	-27	-26
42	-34	-34	-35	-35
63	-39	-36	-40	-40
84	-45	-42	-42	-43
105	-46	-46	-45	-44

The python file used for making all the calculations has been attached along with the zip file.
The log-log plot of the RSSI Values is plotted against logarithmic values of distances. The following plot is obtained :



Preprint. Under review.

The best fit line has been found using the Linear Regression Model of sklearn and the slope of that line has been found by using the numpy.polyfit() function.
The slope of the best fit lit when divided by 10 has been found to be 2.56 , which is the calculated Path Loss Exponent.

$$\boxed{n = 2.56}$$

The obtained value seems appropriate with the experiment being carried out inside the lab with a smartphone hotspot. The variance is then calculated using the predicted datapoints and the datapoints obtained using the application. On calculation, the Variance was found to be :

$$\boxed{Var = 1.44\ dBm^2}$$

So, from step 1, we get n = 2.56 and Variance = 1.44 dBm^2.

Step 2: Range Estimation

For the value of d_0 = 1m, the $P_r(d_0)[dBm]$ is found to be -45.5 dBm/cm on average. The value of n and the observations for a particular orientation have been taken from step 1.
So, we can see that from the formula, the value of d can be calculated as :

$$d = 100 * 10^{((P_r(d_0) - P_r(d))/10n)}$$

So, we take 5 different values of $P_r(d)$ and estimate d using the above formula, and compare it with the actual distance.

P_r(d) (dBm)	Observed Value of d (cm)	Theoretical value of d (cm)	Absolute Error (cm)
-28	21	20.71	0.29
-34	42	35.53	6.47
-39	63	55.73	7.27
-45	84	95.60	11.60
-46	105	104.60	0.40

From this data, we calculate the average mean error (Err) which comes out to be

$$\boxed{Err = 5.21\ cm}$$

So, from this step, the mean absolute error in the measurement of distance is found to be 5.21 cm.