LAB2 report

111550016 于子博

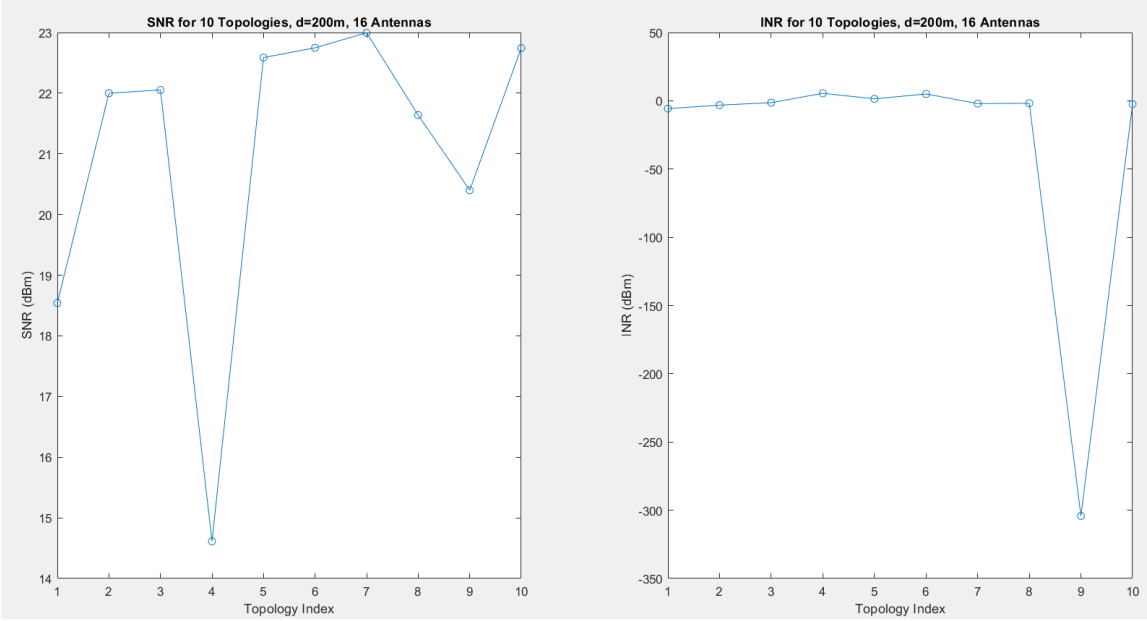
Task 1

Results for d=[50:50:500]m, antenna number 8 and 16

```
Average SNR (dBm) for different distances and antenna numbers:
   28.9001   34.5008
   22.8467   28.4011
   19.3059   24.3073
   16.7126   21.5658
   14.6891   20.2246
   13.2854   18.8853
   11.9132   17.1889
   10.8577   16.1337
    9.7489   14.8616
    8.5439   13.3368

Average INR (dBm) for different distances and antenna numbers:
   15.6120    9.7146
    7.5819    0.7172
    1.3529    3.4495
    7.4516   -1.7924
   -2.4930   -4.7124
    3.9824   -2.9681
  -19.3006   -1.4402
  -13.6149   -1.3406
  -14.2589   -4.5050
  -10.7002   -6.9836
```

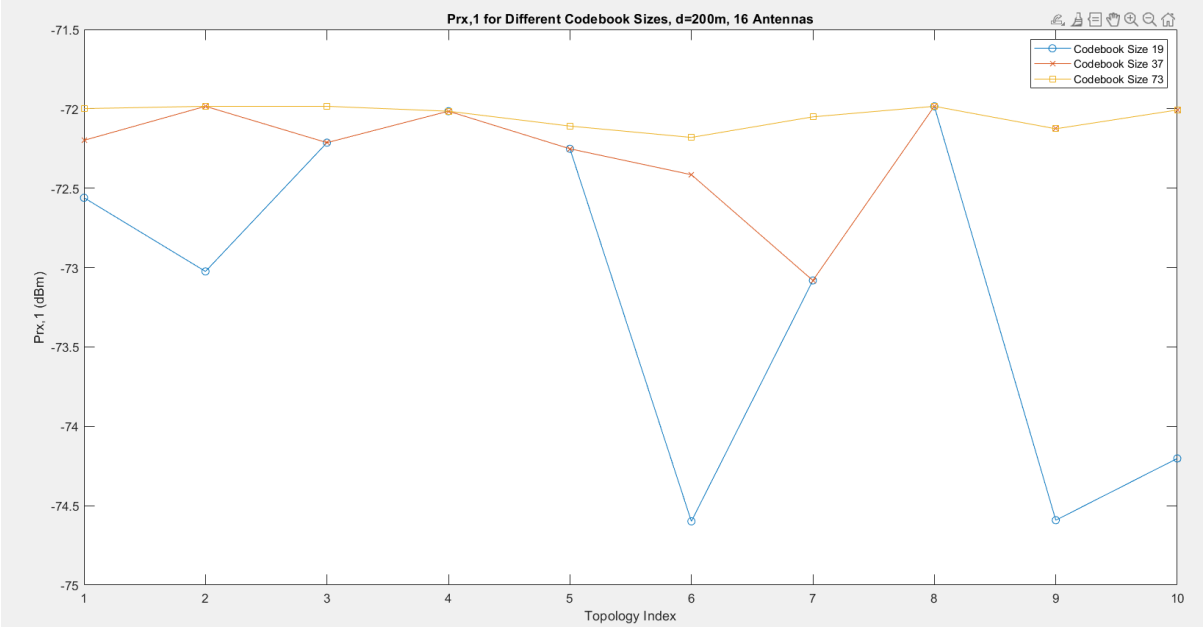
Plot the SNR_{dBm} and INR_{dBm} of 10 topologies when d=200m, antenna number = 16



Observation about the side lobe interference:

We can observe that the INR of rx2 is usually less than 0, indicating that the side lobe power is less than the noise. I believe the possible reason is that the positions of rx1 and rx2 are random, and they are usually not too close to each other, thus the influence of the side lobe is relatively small.

Plot the $P_{rx,1}$ (in dBm) of 10 topologies for various codebook sizes (19, 37, 73, i.e., [0:10:180], [0:5:180], [0:2.5:180]) when d=200m, antenna number = 16

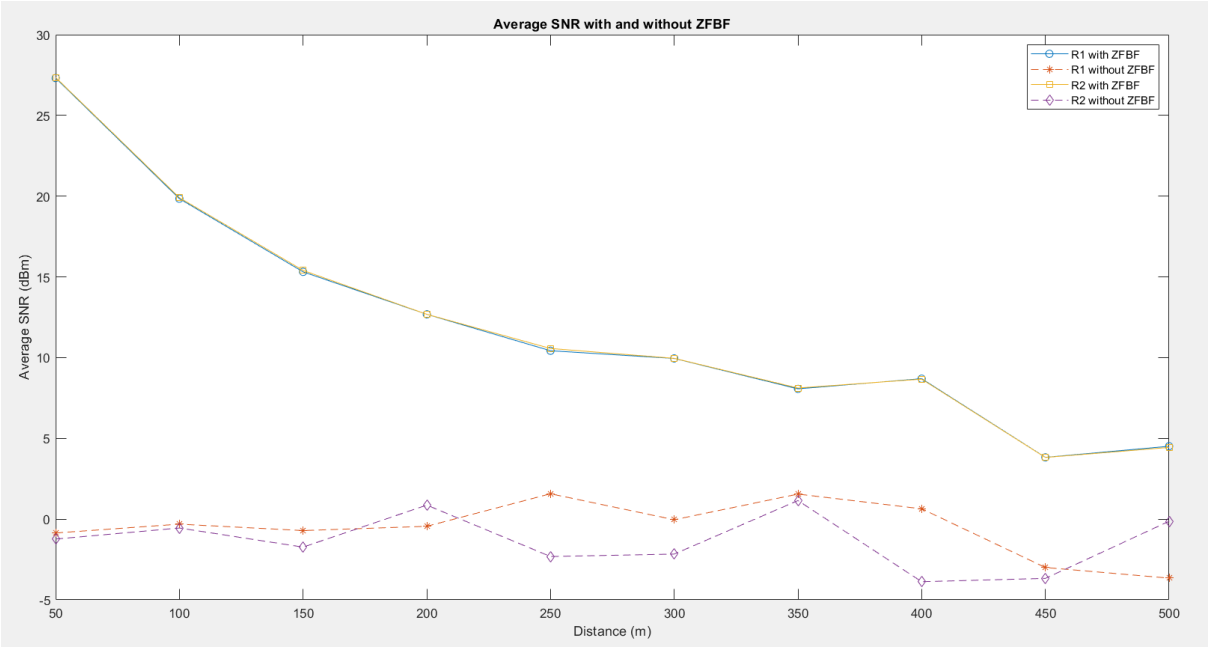


Observation about the impact of codebook sizes:

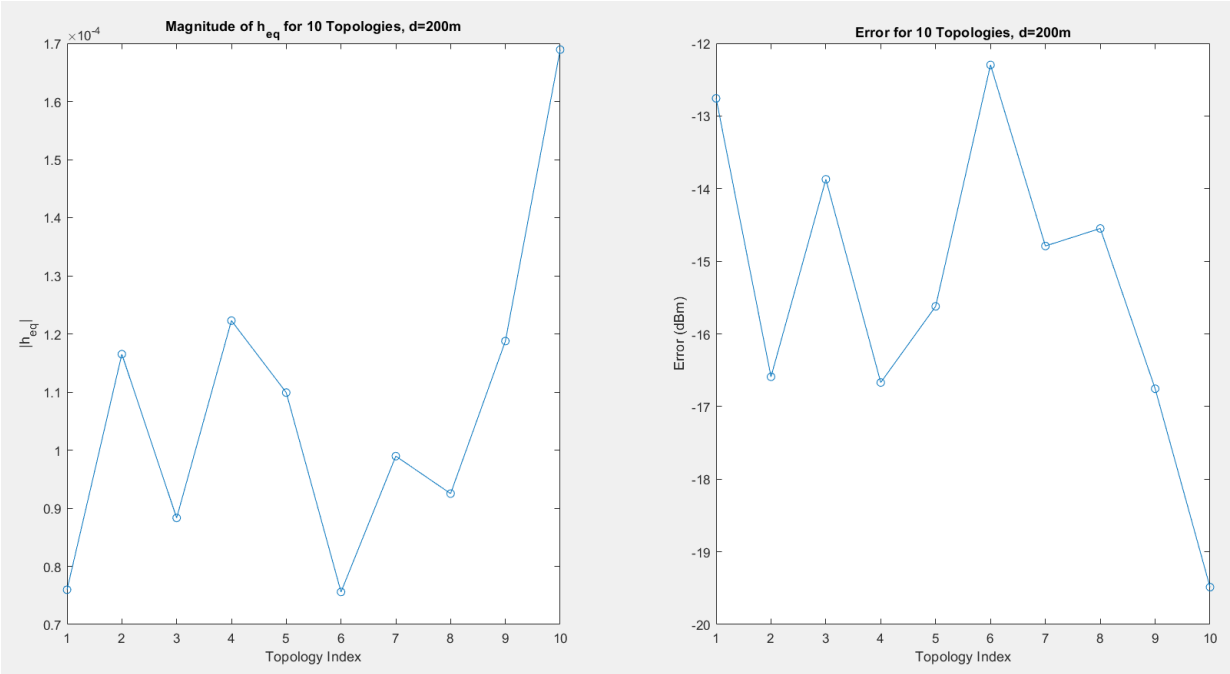
We can clearly see that as the codebook size increases, the received power also increases. This is intuitive because a larger size provides more possible angles, allowing for a greater maximum gain.

Task 2

Results for d=[50:50:500]m



Plot the $\mathbf{h}_{eq}$, error(in dBm) of R_1 with ZFBF when d=200m



why error, h_{eq} varies across different rounds of experiments:

Because the positions of rx1 and rx2 are different in each experiment, the decoding method will also differ depending on their relative positions, which in turn leads to variations in error and h_{eq}.

Observation about the correlation between h_{eq} and error:

h_{eq} and error are negatively correlated because noise is divided by h_{eq} during decoding. Therefore, the two are generally negatively correlated.

What have you learned from this lab?

The implementation of Analog and Digital Beamforming, some MATLAB techniques

What difficulty have you met in this lab?

Details when writing the program, and the related mathematical formulas.