EE677: MIMO Wireless Communications **EE Dept. IITK**

MATLAB Assignment-1

Capacity of SIMO/MISO *Aug. 2023*

Note: SNR[dB]=$10\log_{10}$(SNR).

1. *Capacity plot for AWGN SISO channel:* Recall the capacity is $C = \log(1 + \text{SNR})$, where $\text{SNR} = \frac{P}{N_0}$. We will vary the SNR from 0 dB to 40 dB in steps of 5 dB. For each value of SNR in dB, compute its linear value and then compute C. Plot these C values with respect to SNR[dB].

2. *Capacity plot for fixed SIMO channel with channel information at both tx and rx:* Recall the capacity for this case is $C = \log(1 + \|\mathbf{h}\|^2\text{SNR})$, where $\text{SNR} = \frac{P}{N_0}$. Generate $n_r \times 1$ channel $\mathbf{h}$ whose entries are iid complex-Gaussian with zero mean and unity variance. We assume $n_r = 4$ receive antennas. Now we will vary the SNR from 0 dB to 40 dB in steps of 5 dB. For each value of SNR[dB], compute its linear value, and then compute the expression $\log(1 + \|\mathbf{h}\|^2\text{SNR})$. Plot the capacity obtained for different SNR values with respect to SNR[dB]. Plot in the same graph the capacity of AWGN SIMO with $n_r = 4$ receive antennas for the same SNR values.

3. *Capacity plot for fast-fading SIMO channel:* Recall the capacity for this case is $C = \mathbb{E}\log(1 + \|\mathbf{h}\|^2\text{SNR})$, where $\text{SNR} = \frac{P}{N_0}$. We will vary the SNR from 0 dB to 40 dB in steps of 5 dB. For each value of SNR[dB], compute its linear value. Repeat the steps below for each SNR value.

   (a) Generate $n_r \times 1$ channel $\mathbf{h}$ whose entries are iid complex-Gaussian with zero mean and unity variance. We assume $n_r = 4$ receive antennas.

   (b) Compute the expression $\log(1 + \|\mathbf{h}\|^2\text{SNR})$.

   (c) Compute $C = \mathbb{E}\log(1 + \|\mathbf{h}\|^2\text{SNR})$ by repeating steps (a) and (b) 1000 times, and by averaging the values obtained in step (b).

   Plot C obtained Step-C for different SNR values with respect to SNR[dB].

Please read this carefully.

- Each one of you have to individually do all assignments. You can discuss with your friends but you will have to completely write your own code.
- Copying also means sharing your code with some else for them to copy. We will not differentiate between the two acts, and both such cases will be awarded zero. Our decision will be final.

Please follow these Coding instructions:

- Properly comment your code.
- The code should execute and generate the desired output.

- Your submission should be self-contained (should include all the files required for running it).
- Avoid hard-coding the values of the variables for specific configurations. The code should be generic.

Please follow these submission instructions.

- Deadline is 3rd of Sep., 11:59 pm.
- All codes should be in one .zip/.rar folder. Please do not submit separate files.
- Upload your properly commented in drive link which will be provided later. Name your code as rollno.zip.
- Please submit one final zip file.
- Please do not mail your file to me.