Homework 1 (EE7600 MIMO Systems for Wireless Communications)

1. Consider the following MIMO channel

$$X_k = \sqrt{\rho} S_k H_k + W_k, \qquad k = 1, 2, 3, \ldots,$$

where H_k is an i.i.d. random-channel-matrix sequence. Assume the realization of H_k is known for the receiver but unknown for transmitter (coherent case).

(a) Write the formula for the ergodic capacity of this channel.

(b) Simulate and plot the capacity value for SNR ρ of 0dB–30dB with increment 2dB and the number of antennas $M = N$ from 1 to 5.

(c) Draw conclusion from simulation results in (b).

2. Consider the following MIMO channel with a random constant-channel-matrix

$$X_k = \sqrt{\rho} S_k H + W_k, \qquad k = 1, 2, 3, \ldots .$$

Assume the realization of H is known for the receiver but unknown for transmitter (coherent case).

(a) Describe the outage capacity of this channel with certain outage probability.

(b) Simulate and plot the outage capacity value with outage probability 10% for SNR ρ of 0dB–30dB with increment 2dB and the number of antennas $M = N$ from 1 to 5.

(c) Draw conclusion from simulation results in (b).

Note: Assume M, N are the numbers of transmit and receive antennas, respectively. T is the length of block of channel uses. Random variable is $\mathcal{CN}(0, 1)$.