PDC Report 2023
(due 23 Dec. 2023)

Please submit your report in hard copy, duplex printed and no longer than 10 pages.

A problem1-Consider the following **single-input single-output (SISO)** wireless communication system.

1. **AWGN channel is considered**, BPSK or QPSK is used. Please illustrate the transmission process and do simulations in Matlab:

1.1 please give the theoretical result for bit error rate (BER).

1.2 please show the simulation result of BER vs SNR. Compare the theoretical result with the simulation result.

A problem2--Consider the following **single-input single-output (SISO)** wireless communication system. **Channel state information (CSI) is available at Rx but not at Tx.**

2. Rayleigh flat fading channel is considered, BPSK or QPSK is used. Please illustrate the transmission process and do simulations in Matlab:

2.1 please give the theoretical result for bit error rate (BER） --optional.

2.2 please show the simulation result of BER vs SNR. Compare the simulation result with the theoretical result of AWGN channel.

Tx

Rx

B problem1--Consider the following **single-input single-output (SISO)** wireless communication system. **Neither Tx nor Rx has the Channel state information.**

3. Rayleigh flat fading channel is considered. The channel information keeps constant for the duration of two symbol transmissions. Please illustrate the transmission process and do simulations in Matlab:

3.1 The channel information is not known at Rx, how to do the transmission? Please give the simulation result and compare the BER with the case when CSI is available at Rx under the same simulation parameters.
what can you find out from this exercise?

B problem2--Consider the following **single-input multiple-output (SIMO)** wireless communication system. **CSI is available at Rx but not at Tx.**
4. Rayleigh flat fading channel is considered. Each receiver antenna experiences statistically independent fading, and independent AWGN.
BPSK or QPSK is used. Can we get any benefit from the multiple receive antennas? Please illustrate the transmission process and do simulations in Matlab:

4.1 please show the simulation result of BER vs SNR. Compare the BER with the single-receive-antenna case under the same simulation parameters. what can you find out from this exercise?

B problem3--Consider the following **multiple-input single-output (MISO)** wireless communication system. **CSI is available at Rx but not at Tx.**
5. Rayleigh flat fading channel is considered. The channel from each transmit antenna to the receive antenna is statistically independent fading.
BPSK or QPSK is used. Can we get any benefit from the multiple transmit antennas? Please illustrate the transmission process and do simulations in Matlab:

5.1 please show the simulation result of BER vs SNR. Compare the BER with the single-transmit-antenna case under the same simulation parameters.
what can you find out from this exercise?

B problem4--Consider the following **multiple-input single-output (MISO)** wireless communication system. **CSI is available at Tx and Rx.**

6. Rayleigh flat fading channel is considered. The channel from each transmit antenna to the receive antenna is statistically independent fading.
BPSK or QPSK is used. Can we get any benefit from the multiple transmit antennas and the CSIT? Please illustrate the transmission process and do simulations in Matlab:

6.1 please show the simulation result of BER vs SNR. Compare the BER with the BER in 5.1 under the same simulation parameters.
what can you find out from this exercise?

C problem1--Consider the following wireless relay system.

6. The direct transmission is blocked. The transmission from the source S to the destination D is helped by a relay R. **Rayleigh flat fading channel is considered**. **CSI is available at each receiving node.**

7.1 Please give a relay transmission scheme and show the simulation result of BER vs SNR .

7.2 If the relay is untrustworthy, how can the source information be delivered to D by R while R can not decode the source information ?
   Please give a secure relay scheme and show the simulation result of BER vs SNR (the BER at D vs. the BER at R).
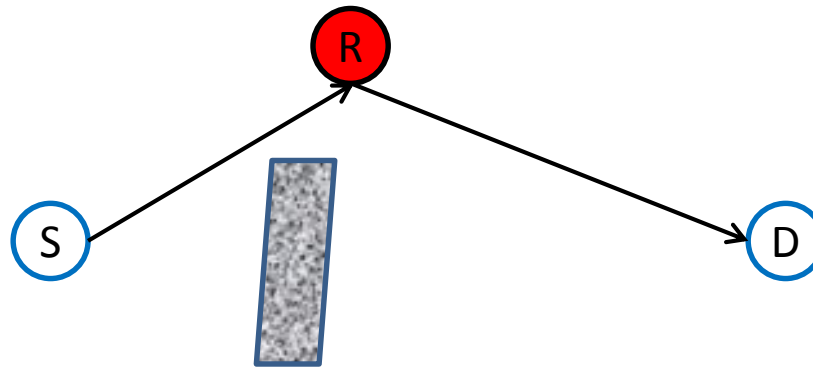
Instructions:
1. Options
1.1 **For students not majored in wireless communications**, you can choose one out of A Problems 1 and 2, and choose one out of B Problems 1, 2 and 3. You should finish 2 problems.
1.2 **For students majored in wireless communications**, you can choose :
   two out of B Problem 1, 2, 3 and 4. You should finish 2 problems.
   Or you can just finish C Problem1.
Common requirements:
2.   You can do the simulations in baseband, in terms of signal space. (No need to do the frequency up conversion or down conversion)
3.   You should give every simulation parameters you have used.
4.   The simulation results should be analyzed.
5.   Matlab code should be attached.
6.   The similarity of the reports can not exceed 50%.