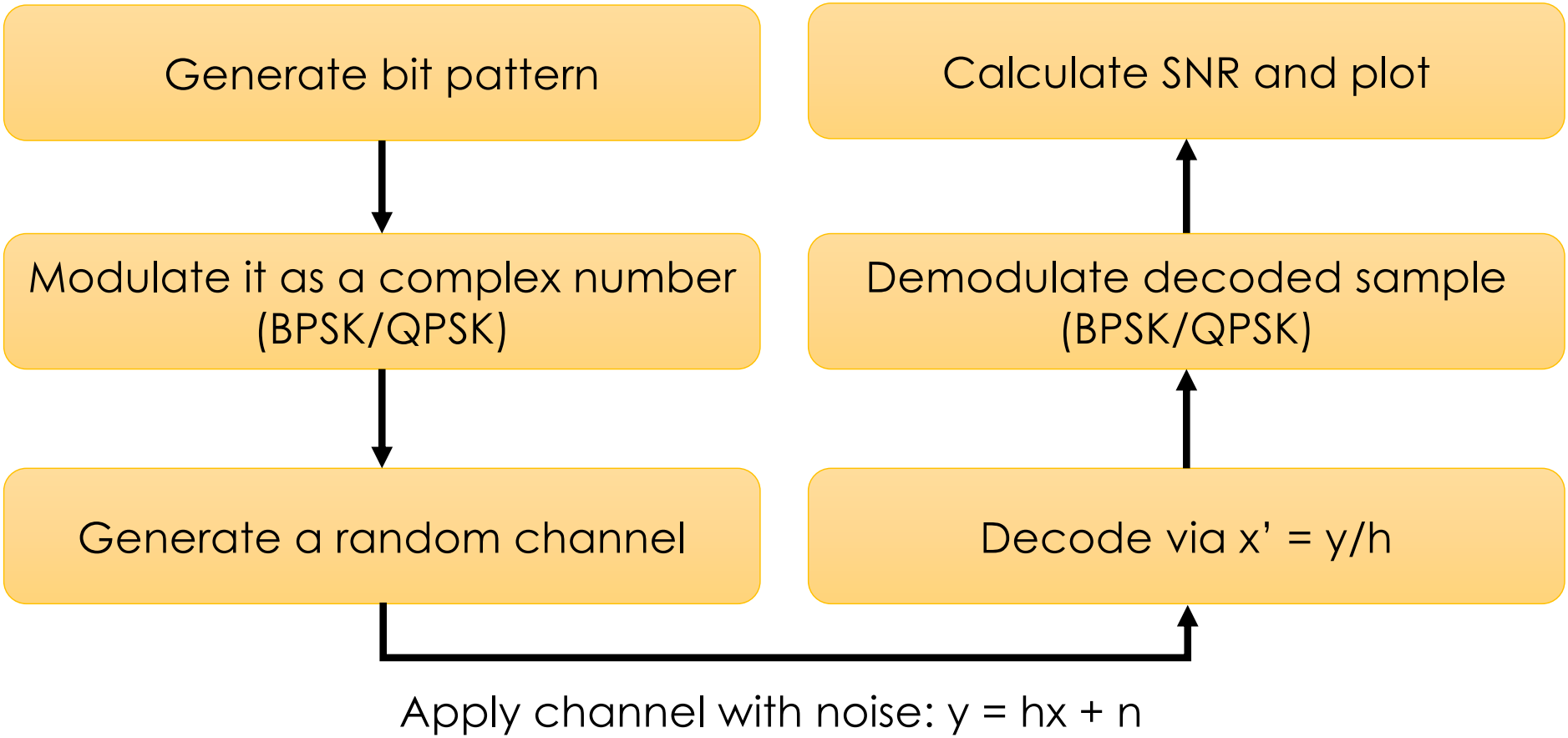
Network Systems Capstone @CS.NYCU

Lab7: MIMO ZF Equalization

Example of Wireless Transmission



Example Code

1. Generate a sequence of data bits
2. Modulate the bits into BPSK samples
3. Generate random channel h
   - (TODO) $|h|^2$ should be equal to the receiving power
   - (TODO) P_{rx} should be derived based on the Friis path loss model
4. Simulate the reception over the channel with AWGN
   - $y = hx + n$
   - Expected noise power $E[|n|^2]$ is set to -85 dBm
5. SNR and BER calculation

Snapshot of Example Code

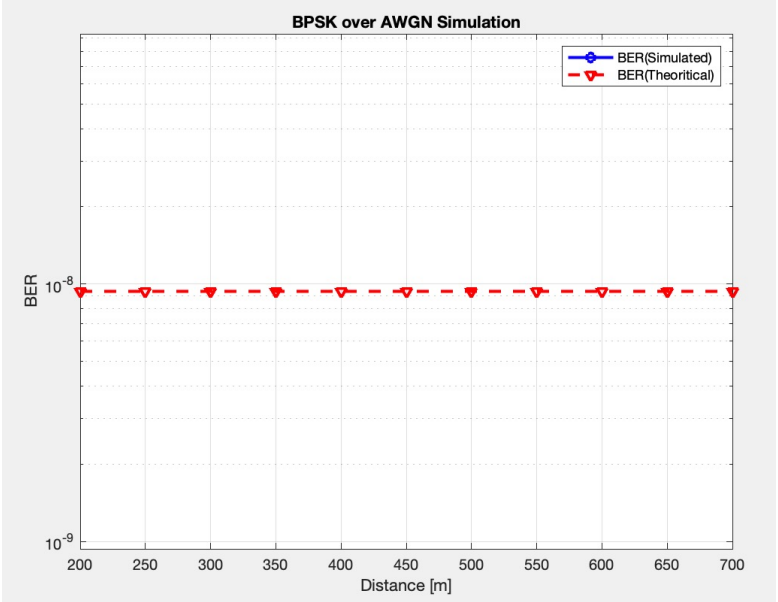
- pre _ lab7_SISO()

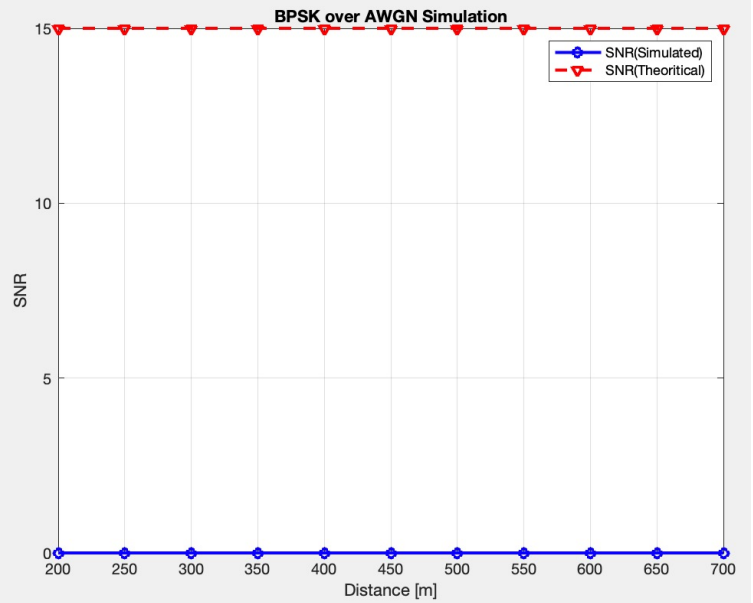
```
%% Equalization
% Detection Scheme:(Soft Detection)
% +1 if o/p >=0
% -1 if o/p<0
% Error if input and output are of different signs
for d=1:length(dist)
    % TODO: s = y/Pr
    % TODO: x_est = 1 if real(s) >= 0; otherwise, x_est = -1

    SNR(d)=Pr(d)/Pn;
    SNRdB(d)=10*log10(SNR(d));
    BER_simulated(d)=0;
    SNRdB_simulated(d)=0;
    % TODO: compare x_est with x (true value) and calculate BER_simulated(d)
    % TODO: noise = s - x, and, then, calculate SNR_simulated(d)

end
```

Output of Example Code

```
dist=200:50:700;          % distance in meters
PtdBm=4;                  % transmit power in dBm
PndBm=-85;                % noise power in dBm
Pt=10^(PtdBm/10)/1000;    % transmit power in watt
Pn=10^(PndBm/10)/1000;    % noise power in watt
Bit_Length=1e2;           % number of bits transmitted
```

```
SNRdB =

   11.9643   10.0261    8.4425    7.1035    5.9437    4.9207    4.0055    3.1776    2.4219    1.7266    1.0829
```





TODO: Pre-Lab7-SISO

Input and Output

- Input
  - Link distances: 200m ~ 700m
  - Tx Power: 4dBm
  - Noise Power: -85dBm
- Output
  - SNR, BER
  - Plot the figures
    - Constellation points for every different distance
    - BER bar graph (x-axis: distances, y-axis: BER)
    - SNR bar graph (x-axis: distances, y-axis: SNR)

TODO

Given a link distance and1,000 random samples

1. Calculate the path loss and drive the receiving power
2. Given the received sample y, decode the received sample x'
3. Determine whether x' is decoded correctly and calculate BER
4. Calculate the error (noise) by n' = x'-x and derive the average noise power and, thereby, the average SNR
5. Plot figures

Code Submission

- Deadline: May. 10 (Mon.) 23:59
- Submit to new E3
    - Source code: pre_lab7_SISO.m