Homework Set 4 Jeffrey Jiang

EE 132A ID: 904255069

Problem 5:

For this project we just wanted to plot the effect of the SNR on the error probability, as an introduction to tradeoffs. The Matlab code is shown below and so is the plot. We see that on the log-log plot that we have plotted, the points are roughly linear.

N = 100000;

SNR\_dB = [3 4 5 6 7 8 9 10];

SNR = 10.^(SNR\_dB / 10);

E\_av = 10;

sig = sqrt(E\_av ./ SNR);

H = randi(8, 1, N);

X = zeros(N, 2);

constel = [-1 3; 3 3; -3 1; 1 1; -1 1; 3 -1; -3 -3; 1 -3];

for i=1:N

X(i,:) = constel(H(i),:);

end

basis0 = [ones(1,10) zeros(1,10)];

basis1 = [zeros(1,10) ones(1,10)];

factor = norm(basis0);

basis0 = basis0 / factor;

basis1 = basis1 / factor;

S = zeros(N, 20);

for i=1:N

S(i,:) = X(i,1) \* basis0 + X(i,2) \* basis1;

end

p\_e = zeros(1,8);

for k=1:8

noise = sig(k) \* randn(N,20) / factor;

R = S + noise;

Y = zeros(N,2);

for i=1:N

C\_0 = conv(R(i,:), basis1);

C\_1 = conv(R(i,:), basis0);

Y(i,1) = C\_0(20);

Y(i,2) = C\_1(20);

end

H\_hat = zeros(1,10000);

for i=1:N

min = 1;

dist = (Y(i,1)-constel(1,1))^2 + (Y(i,2)-constel(1,2))^2;

for j=1:8

if dist > (Y(i,1)-constel(j,1))^2 + (Y(i,2)-constel(j,2))^2

min = j;

dist = (Y(i,1)-constel(j,1))^2 + (Y(i,2)-constel(j,2))^2;

end

end

H\_hat(i) = min;

end

error = H ~= H\_hat;

p\_e(k) = mean(error);

end

plot(SNR\_dB, log(p\_e));

title('Error Probability as a Function of SNR');

xlabel('SNR (dB)');

ylabel('log(p\_e)');

