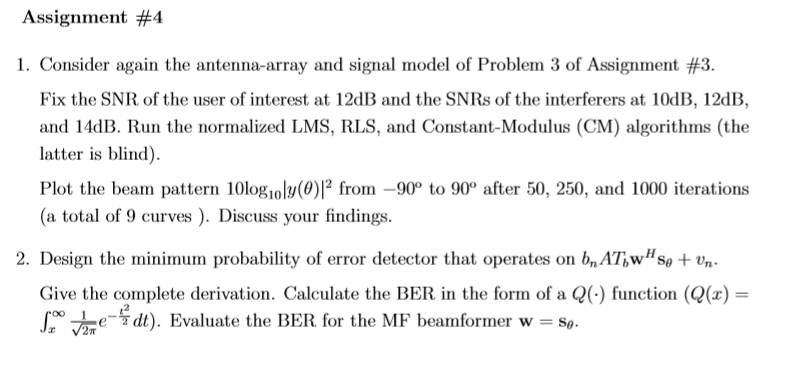
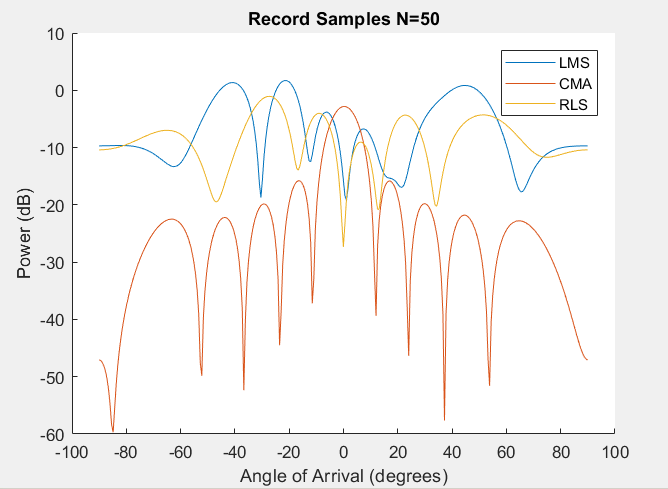
Assignment #4

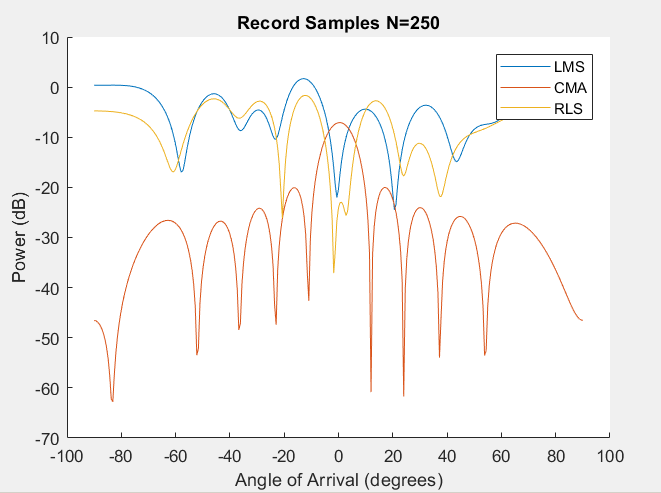
Hector Lopez EEL6935

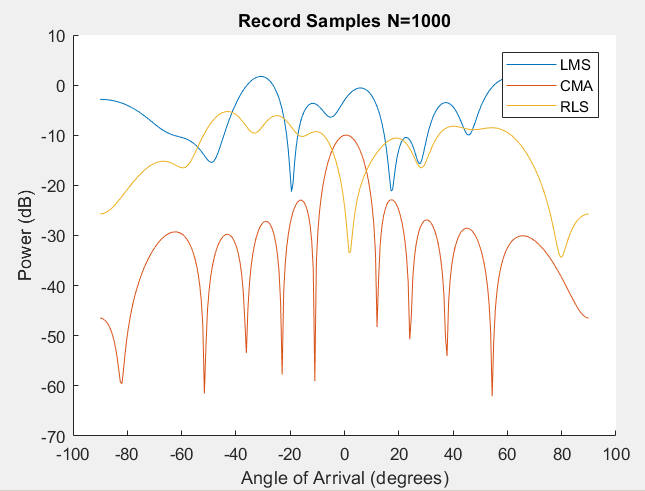


# Part 1

Normalized LMS and RLS seam to provide similar responses until we use a large sample size. At that point the LMS and RLS seems to diverge in response. The CM algorithm seems to respond similarly in all record sizes.







%%% Data Generation

clear all;

M=10; % Number of elements in antenna array

N=[50,250,1000]; % Data record sets sizes

K=3; % number of interfers signals

I=eye(M); % identity matrix

sigma=1; % variance

c=1; % constant

u=0.0000001; % small gain factor for LMS

beta=0.95;% forgetting factor, with 20 sample memory

eps0=1;% RLS initial value constnat for R^-1(1)

E0=10^(12/10);%12dB

%interfers signals

E1=10^(10/10);%10dB

E2=10^(12/10);%12dB

E3=10^(14/10);%14dB

theta=-pi/2:0.01:pi/2;%range of theta for user signal analysis

%th0=20; %angle of arrival for user signal

%th1=-80;

%th2=80;

%th3=60;

th\_i=[-31,62,19,-68]/180\*pi;

fc=2\*10^6;%carrier frequency

lambda\_c=fc/(3\*10^8);%carrier wavelength

d=lambda\_c/2;%nyquist distance

%create array response vectors for each incoming interfer

S0=zeros(M,1);S1=zeros(M,1);S2=zeros(M,1);S3=zeros(M,1);

for m=1:M

S0(m)=exp((-1i\*2\*pi\*(m-1)\*d)\*sin(th\_i(1)));

S1(m)=exp((-1i\*pi\*(m-1)\*d)\*sin(th\_i(2)));

S2(m)=exp((-1i\*pi\*(m-1)\*d)\*sin(th\_i(3)));

S3(m)=exp((-1i\*pi\*(m-1)\*d)\*sin(th\_i(4)));

end

wcma = zeros(M,N(3));

wcma(:,1)=S1/M;

wlms=zeros(M,N(3));

wrls=zeros(M,N(3));

R=(1/eps0)\*I;

%%% Simulation

for i=2:N(3)

% get three new random bits for each signal

b=complex(sign(randn(K,1)));

b0=complex(sign(randn(1)));

%BPSK Signal

n = sqrt(sigma)\*complex(randn(M,1), randn(M,1))/sqrt(2);

r=b0\*sqrt(E0)+b(1)\*sqrt(E1)\*S1+b(2)\*sqrt(E2)\*S2+b(3)\*sqrt(E3)\*S3+n;

R=(1/beta)\*(R-((R\*r\*ctranspose(r)\*R)/(beta+ctranspose(r)\*R\*r)));

wlms(:,i)=wlms(:,i-1)-(c/(norm(r)^2))\*r\*(ctranspose(r)\*wlms(:,i-1)-conj(b0));

wcma(:,i)=wcma(:,i-1)-u\*r\*ctranspose(r)\*wcma(:,i-1)\*(abs(wcma(:,i-1)'\*r)^2-E0);

wrls(:,i)=wrls(:,i-1)-R\*r\*(r'\*wrls(:,i-1)-conj(b0));

end

%% Data Analysis

for k = 1:3

for th=1:length(theta)

x=zeros(M,1);

for m=1:M

x(m)=exp((-1i\*pi\*(m-1))\*sin(theta(th)));

end

ylms(th)=wlms(:,N(k))'\*x;

ycma(th)=wcma(:,N(k))'\*x;

yrls(th)=wrls(:,N(k))'\*x;

end

ylms\_db = 10\*log10((abs(ylms).^2));

ycma\_db = 10\*log10((abs(ycma).^2));

yrls\_db = 10\*log10((abs(yrls).^2));

theta\_deg = 180\*theta/pi;

figure

hold on

plot(theta\_deg,ylms\_db)

plot(theta\_deg,ycma\_db)

plot(theta\_deg,yrls\_db)

title(sprintf('Record Samples N=%d',N(k)));

legend('LMS','CMA','RLS');

xlabel('Angle of Arrival (degrees)');

ylabel('Power (dB)');

end

# Part 2

