```
close all
% Lab 3: Radio Engineering, Eurecom, Henning Schei
```

Problem 1

```
T_S = 1/(7.68e6);
omega_max = 300;
nb_samples = 10e-3 * 7.68e6;



rayChanObj = rayleighchan(T_S, omega_max, 0, 0) ;
rayChanObj.StoreHistory = 1;
x = ones(nb_samples,1);
y = filter(rayChanObj,x);
g = rayChanObj.PathGains;

[acf_sos,lag_sos] = xcorr(sumofsinusoids((1/(7.68e6)), 20, 300,nb_samples));
[acf_flt,lag_flt] = xcorr(y);

subplot(1,3,1)
plot(lag_sos,acf_sos/max(acf_sos));
title 'Sum of sinusoids'
subplot(1,3,2)
plot(lag_flt,acf_flt/max(acf_flt));
title 'Filter based method'
chlen = -0.01:T_S:0.01;
subplot(1,3,3)
plot(linspace(-76799,76799,length(besselj(0, 2*pi*300*chlen))),besselj(0, 2*pi*300
title 'Theorethical'

figure;

plot(lag_sos,acf_sos/max(acf_sos), 'r');
hold on
grid on
plot(lag_flt,acf_flt/max(acf_flt),'g');
hold on
plot(linspace(-76799,76799,length(besselj(0, 2*pi*300*chlen))),besselj(0, 2*pi*300
title 'Problem one'
legend('Sum-of-Sinusoids', 'Filter based', 'Bessel function'  );
```

```
Warning: Imaginary parts of complex X and/or Y arguments ignored
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```
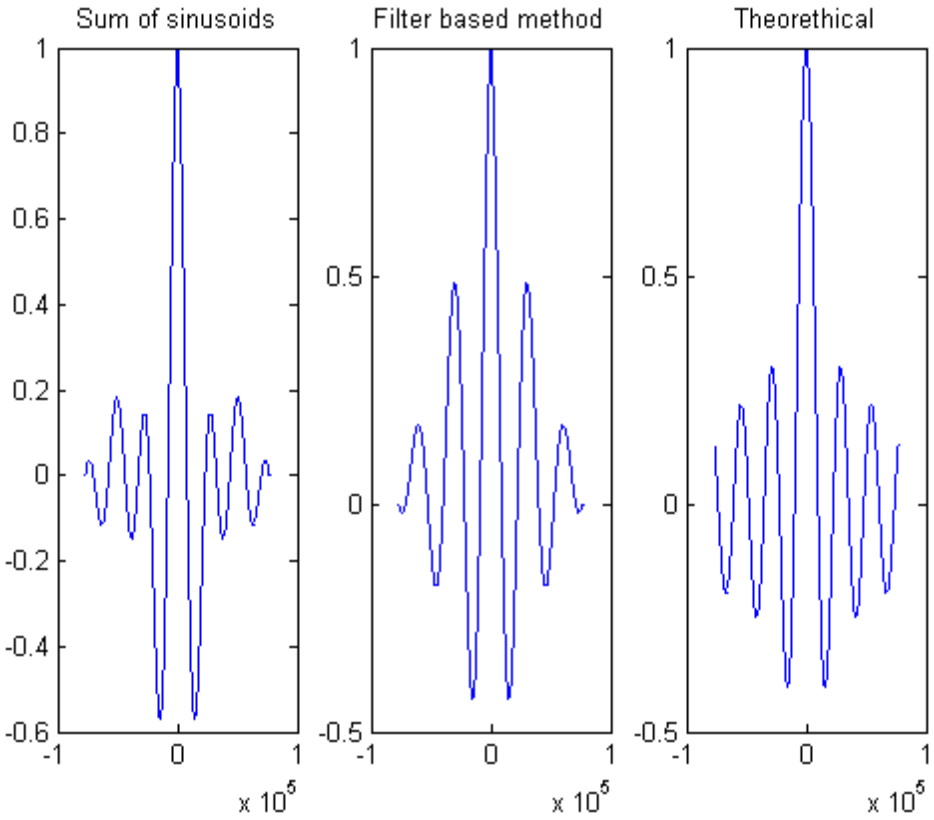
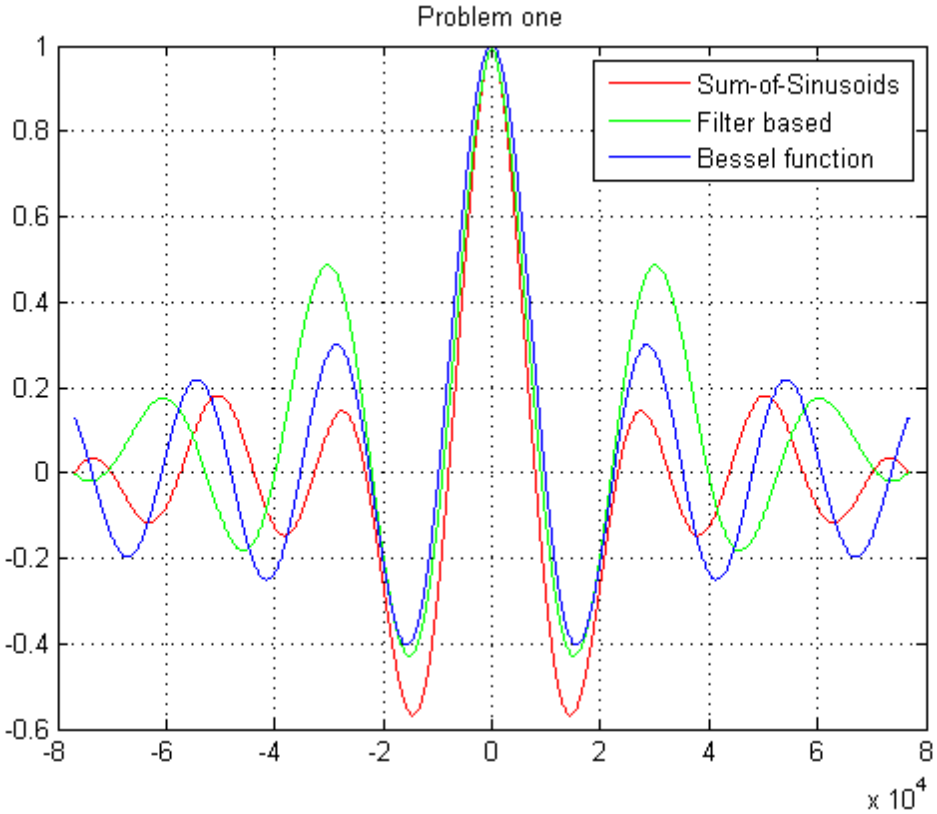
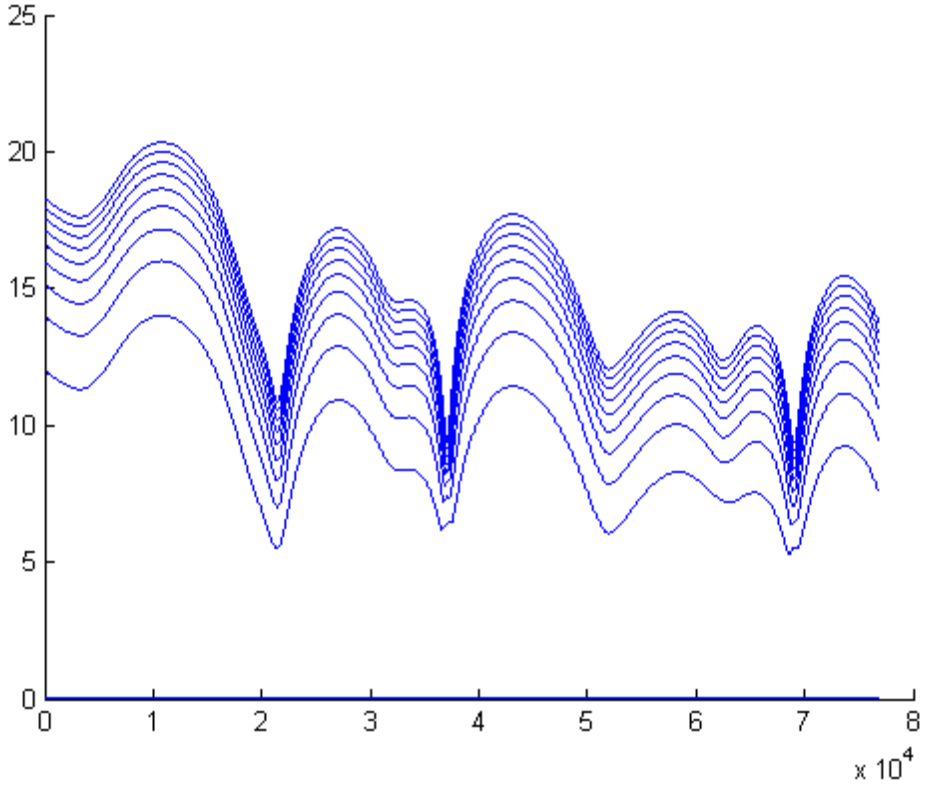


Sum of sinusoids
Filter based method
Theorethical
x 10^5
x 10^5
x 10^5

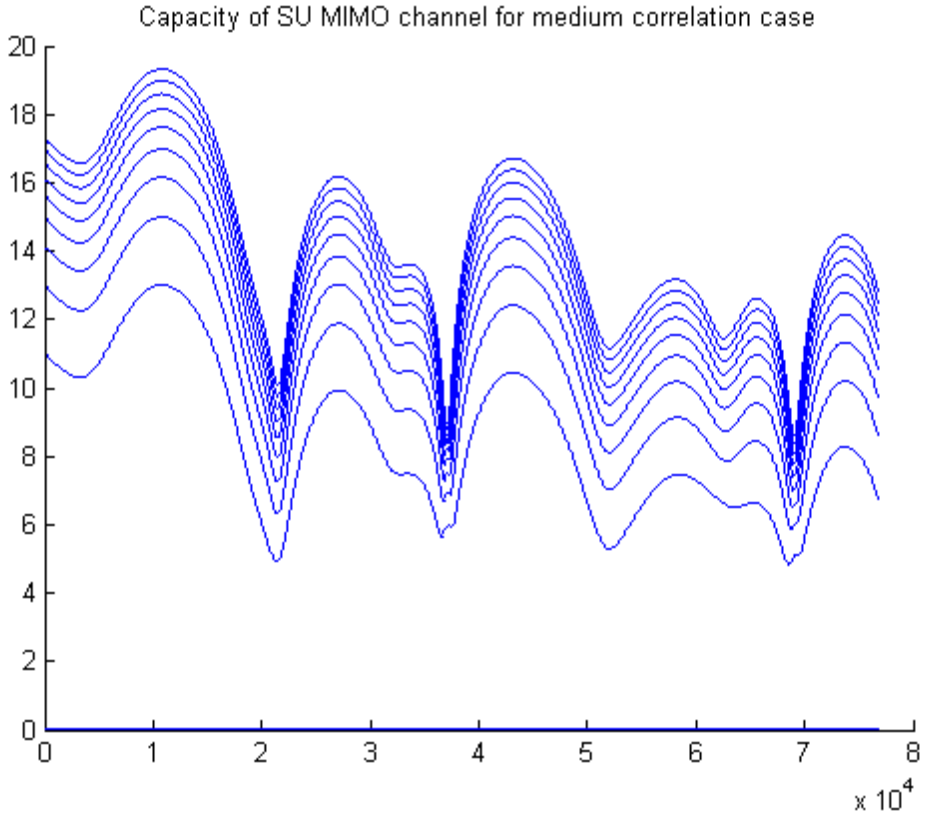

Problem one
Sum-of-Sinusoids
Filter based
Bessel function
x 10^4

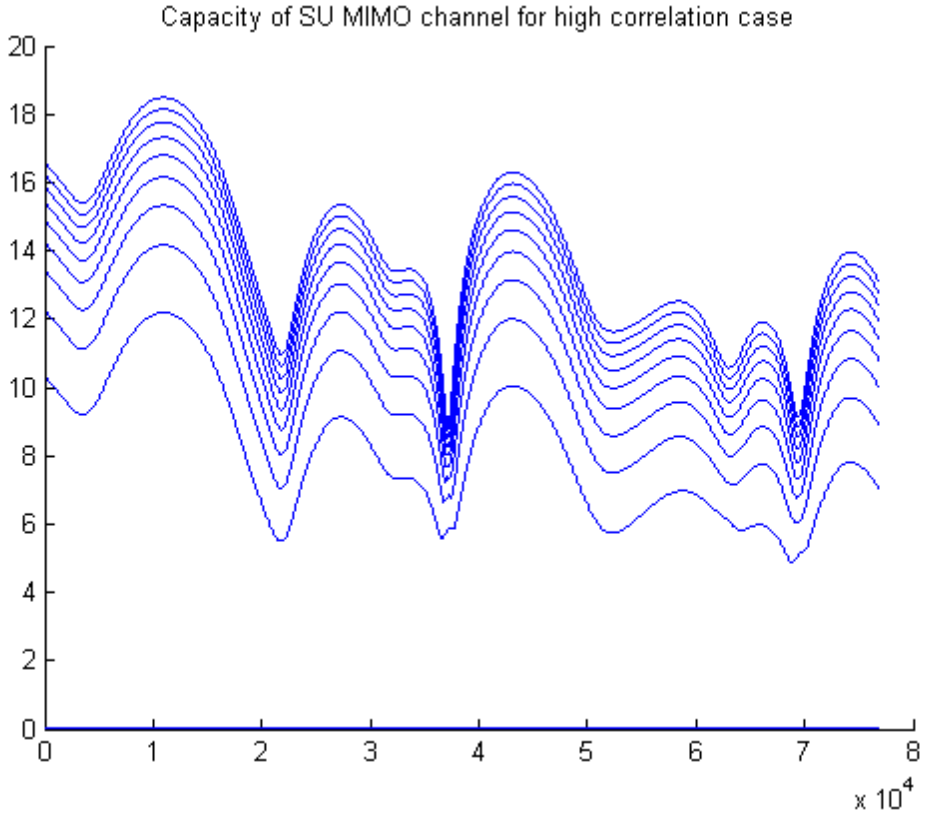
Problem 2

```
% Generate foure independent fading channels

a = [0 0.3 0.9]; b = [0 0.9 0.9];
G = zeros(2,2,nb_samples);
tmp = sumofsinusoids((1/(7.68e6)), 20, 300,nb_samples);

for k=1:2
    for j=1:2
        for i= 1:length(sumofsinusoids((1/(7.68e6)), 20, 300,nb_samples))
            G(k,j,i) = tmp(i);
        end
        tmp = sumofsinusoids((1/(7.68e6)), 20, 300,nb_samples);
    end
end

Rtx1 = [1 a(1); conj(a(1)) 1] ; Rrx1 = [1 b(1); conj(b(1)) 1];
Rtx2 = [1 a(2); conj(a(2)) 1] ; Rrx2 = [1 b(2); conj(b(2)) 1];
Rtx3 = [1 a(3); conj(a(3)) 1] ; Rrx3 = [1 b(3); conj(b(3)) 1];

H1 = zeros(2,2,nb_samples);
H2 = zeros(2,2,nb_samples);
H3 = zeros(2,2,nb_samples);

for n =1:length(G)
    H1(:,:,n) = sqrtm(Rrx1) .* G(:,:,n) .*transpose(sqrtm(Rtx1));
    H2(:,:,n) = sqrtm(Rrx2) .* G(:,:,n) .*transpose(sqrtm(Rtx2));
    H3(:,:,n) = sqrtm(Rrx3) .* G(:,:,n) .*transpose(sqrtm(Rtx3));
end


SNR = power(10,-20/10):10:power(10,30/10);

figure;

for i=1:10:length(SNR)
    [CAP] = capacity_SU_CL_ML( H1, SNR(i),0);
    hold on
    plot(CAP);
end
figure;
title 'Capacity of SU MIMO channel for medium correlation case';
for i=1:10:length(SNR)
    [CAP] = capacity_SU_CL_ML( H2, SNR(i),0);
    hold on
    plot(CAP);
end
figure;
title 'Capacity of SU MIMO channel for high correlation case';
for i=1:10:length(SNR)
    [CAP] = capacity_SU_CL_ML( H3, SNR(i),0);
    hold on
```

```
    plot(CAP);
end
```




Capacity of SU MIMO channel for medium correlation case
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
8
x 10^4


Capacity of SU MIMO channel for high correlation case
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
8
x 10^4

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