Lab8_201806061211_凌智城

Test1

1.code

```
%% Test name
clc;
clear all;

A = 0.5*[1 1 1 1;
      1 exp(-1i*pi/2) exp(-1i*pi) exp(-3*1i*pi/2);
      1 exp(-1i*pi) exp(-1i*2*pi) exp(-3*1i*pi);
      1 exp(-1i*3*pi/2) exp(-1i*3*pi) exp(-9*1i*pi/2);];

%% Calculate the real part, image part, amplitude, and angle of
each element on the third row. (10 points)

B = A(3,:);
for i=1:4
   ans_1(i,1) = real(B(i));
   ans_1(i,2) = imag(B(i));
   ans_1(i,3) = abs(B(i));
   ans_1(i,4) = angle(B(i));
end
ans_1

%% Calculate the sum of all the entries on the second column.
(10 points)

ans_2 = sum(A(:,2))

%% Verify the orthogonality of A, i.e.,AAH=AHA=I, where I is
identity matrix.  (10 points)

C = A';
I_1 = A*C;
I_2 = C*A;
```

2.fig

```
ans_1 =

    0.5000         0    0.5000         0
   -0.5000   -0.0000    0.5000   -3.1416
    0.5000    0.0000    0.5000    0.0000
   -0.5000   -0.0000    0.5000   -3.1416
```

fig.1 real part, image part, amplitude, angle

```
ans_2 =

  -9.1849e-17 - 1.1102e-16i
```

fig.2 sum

3.discussion

A` is conjugate transpose matrix； A.` is transpose matrix.

Test2

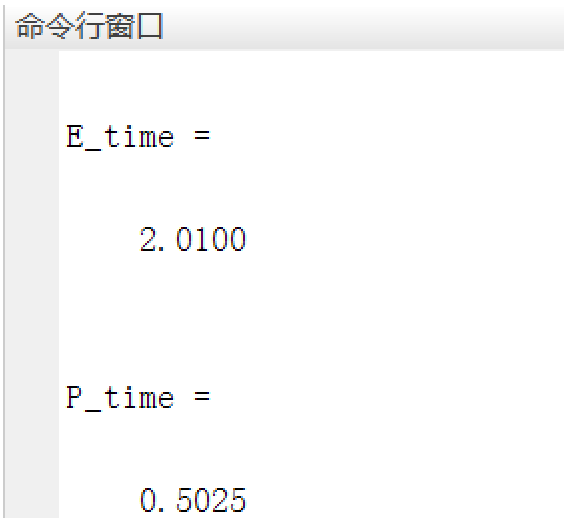
1.code

```
%% Test name
clc;
clear all;

% Initialization.
t0 = 4;                    % Signal duration
fs = 100;                  % Sampling rate
Ts = 1/fs;                  % Sampling interval
fc = 10;                    % Carrier rate
t = 0:Ts:t0;                % Time vector
N = length(t)-1;             % Length of t
dt = t(2)-t(1);
Ac = 1;

%% Plot the signal in the time domain and its magnitude
spectrum, explain the resulted spectrum. (20 points)
```

```
m = cos(2*pi*t)+sin(pi*t);
s = Ac*m.*cos(2*pi*fc*t);
[f,Sf] = T2F(t,s);

figure('NumberTitle', 'off', 'Name', 'Signal of final exam2_1');
subplot(121)
plot(t,s);
grid on;
xlabel('Time(s)');ylabel('Amplitude');
title('Time domain waveform of s');
legend('T-domain');

subplot(122)
plot(f,abs(Sf));
grid on;
xlabel('Frequency(Hz)');ylabel('Amplitude');
axis([-30 30 0 1.2 ]);
title('Frequency spectrum of Sf');
legend('F-domain');

suptitle('Signal of final exam2\_1');

%% Calculate the energy and power of the signal from 0s to 4s,
in time domain. (10 points)

E_time = sum(abs(s).^2)*dt
P_time = sum(abs(s).^2)/N

%% The signal is passing through a noiseless bandlimited
¡®channel¡¯, whose response is H(f)=1, |f|¡Ü2Hz and H(f)=0,
otherwise. Plot the resulted signal in the time domain. Compare
with the original signal and explain your results (10 points)

for k = 1 : length(f)
    if abs(f(k))>2
        Hf(k)=0;
    else
        Hf(k)=1;
    end
end
Xf = Sf.*Hf;
Xf = Xf.*exp(1i*2*pi*f*t(1));
[t,Xt] = F2T(f,Xf);      % FT
```

```
figure('NumberTitle', 'off', 'Name', 'Signal of final exam2_3');
subplot(121)
plot(t,s);
grid on;
% axis([ 0 N -4 4]);
xlabel('t(s)');ylabel('Amplitude');
title('Original signal in the time domain');
legend('Time-domain');

subplot(122)
plot(t,Xt);
grid on;
% axis([ 0 N -4 4]);
xlabel('t(s)');ylabel('Amplitude');
title('Passing through a noiseless bandlimited channel');
legend('Signal>2Hz has been filtered');

suptitle('Signal of final exam2\_3');
```

2.fig



```
命令行窗口

E_time =

    2.0100


P_time =

    0.5025
```

fig.3 energy and power.

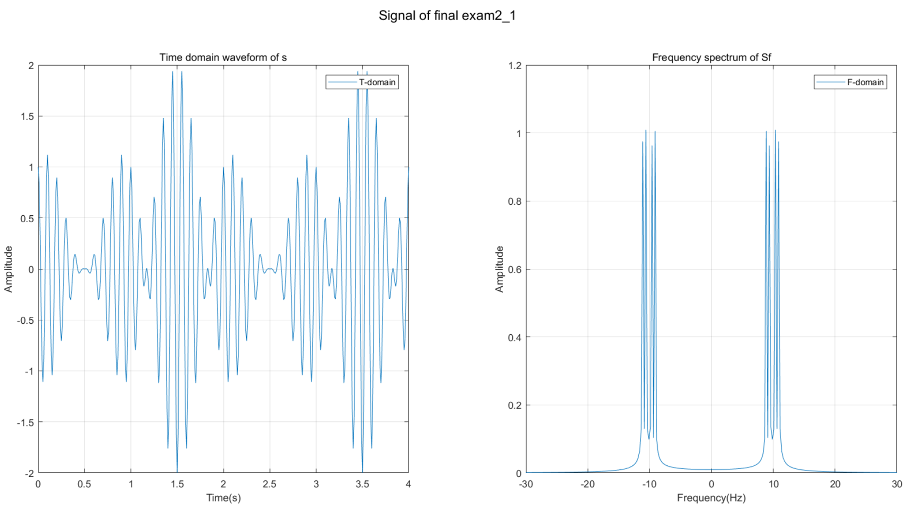


fig.4

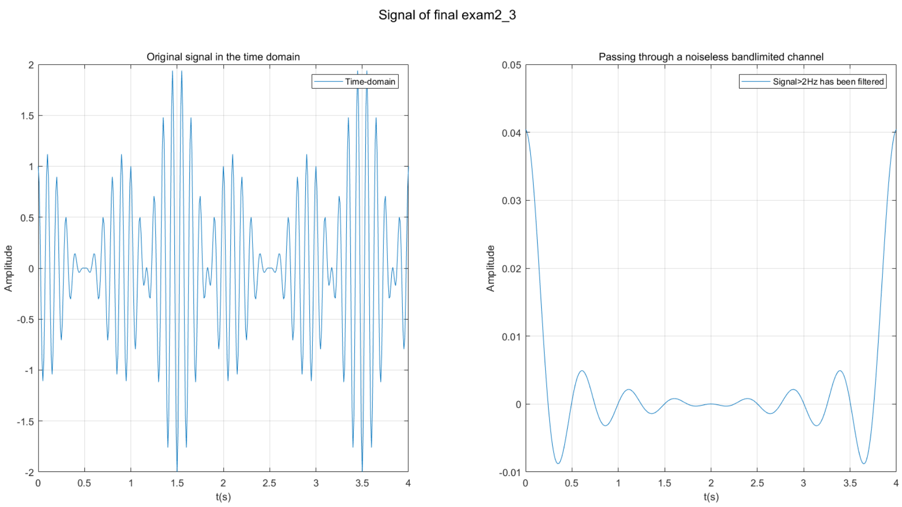


fig.5

3.discussion

In fig.4 spectrum is in fc=10Hz, that is carrier frequency.

In fig.5, the signal f of passband is 2Hz<carrier f(10Hz), Most of the signal is filtered out, if it is increased to more than 10Hz, the original signal can be restored.(如果增加信道的截止频率，如>10Hz，即可以恢复出原样).

Test3

1.code

```
%% Test name
clc;
clear all;

% The corresponding 8QAM signal.
T = 1;                    % Symbol interval.
Tb = T/3;                 % Bit interval.
m = [1,2,3,4,5,6,7,8];  % Equally spaced.
M = 8;                    % QAM:M=8
gT=sqrt(2/T);             % Transmission pulse.
A_mc = [-3,-1,1,3,-3,-1,1,3];
A_ms = [1,1,1,1,-1,-1,-1,-1];


%% Calculate the average energy per symbol and per bit of 8QAM,
respectively. (10 points)

Es = sum(A_mc.^2+A_ms.^2)/8
Eb = Es/3

%% Simulate the symbol error rate of 8QAM under SNR-per-bit=0dB.
(10 points)

SNRindB=0;
[smld_err_p,smld_err_pb] = smldpe_QAM_8(SNRindB,Es)    %
simulated error rate

%% Plot the received constellation diagram after the 8QAM
signals pass through the AWGN channel under SNR-per-bit=0dB and
10dB, respectively, explain your results. (10 points)
fc = 5;                   % Carrier frequency.
fs = 1000;                % Sampling frequency.
for i=1:1:M
    m_c=A_mc(i)*gT;
    m_s=A_ms(i)*gT;
    % Sampling.
    [~,x_c] = Sampling(T,fs,m_c);
    [t,x_s] = Sampling(T,fs,m_s);
    % Carrier wave.
    carrier_c = cos(2*pi*fc*t);
```

```
    carrier_s = sin(2*pi*fc*t);
    % QAM modulation.
    u_m=x_c.*carrier_c+x_s.*carrier_s;
end

SNRindB_awgn_1 = 0;
snr_1 = 10^(SNRindB_awgn_1/10);       % SNR per bit (given)
nc_1=sqrt(Es/(6*snr_1))*randn(7000,1);
ns_1=sqrt(Es/(6*snr_1))*randn(7000,1);
for i=1:1:7000
    Sm1_x(i) = A_mc(fix(i/1000)+1)+nc_1(i);
    Sm1_y(i) = A_mc(fix(i/1000)+1)+ns_1(i);
end
% for i=1:1:7000
%    if(x(i)==0)
%        plot(Sm1_x(i),Sm1_y(i),'r*')
%        hold on;
%    elseif(x(i)==1)
%        plot(Sm1_x(i),Sm1_y(i),'g+')
%        hold on;
%    elseif(x(i)==2)
%        plot(Sm1_x(i),Sm1_y(i),'b.')
%        hold on;
%    else
%        plot(Sm1_x(i),Sm1_y(i),'c.')
%        hold on;
%    end
%    axis square
% end

% SNRindB_awgn_2 = 10;
% snr_2 = 10^(SNRindB_awgn_2/10);        % SNR per bit (given)
% nc_2=sqrt(Es/(6*snr_2))*randn(5000,1);
% ns_2=sqrt(Es/(6*snr_2))*randn(5000,1);
```

2.fig

命令行窗口

```
Es =

     6


Eb =

     2


smld_err_p =

    0.3590


smld_err_pb =

    0.1584
```

fig.6

3.discussion

The final constellation diagram is not finished.（最后的星座图没画完）