**Lab 4：The Continuous-Time Fourier Transform**

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| **Introduction**  The continuous-time Fourier transform (CTFT).    extends the continuous-time Fourier series (CTFS) to allow frequency-domain analysis of  aperiodic as well as periodic continuous-time signals. This is an important and powerful  technique since many signals that appear to have complicated structure when viewed in the  time domain are simple when viewed in the frequency domain. In addition, the behavior of  many LTI systems is easier to understand in the frequency domain than in the time domain.  To use frequency-domain techniques effectively, it is important to develop intuition for how  properties of signals in the time and frequency domains are related.  The exercises in this chapter will help to foster this intuition for signals in general, and for the impulse responses and frequency responses of LTI systems in particular。  **Lab results & Analysis**：  **4.6 Amplitude Modulation and the Continuous-Time Fourier Transform**  Question(a)    Results    Analysis  The picture is the signal that corresponds to the letter 'Z' in Morse code,  Question( b)    Results    Analysis  This is the low pass system.  Question(c)    Results    Analysis  The picture contains ydash and ydot along with the original signals dash and dot.  Question(d)    Results    Analysis  The upper one is y signal, and the other one is yo signal. It is noticed that the range of y is much larger than the range of yo.  Question(e)    Analysis  X1(jw) = (1/4)\*[M(j(w - 4\*pi\*f1)) + 2\*M(jw) + M(j(w + 4\*pi\*f1))];  X3(jw) = (1/4j)\*[M(j(w - 2\*pi\*f1)) - M(j(w + 4\*pi\*f1))];  X2(jw) = (1/4)\*[M(j(w - 2\*pi\*(f1 + f2))) + M(j(w - 2\*pi\*(f1 - f2))) + M(j(w + 2\*pi\*(f1 -f2))) + M(j(w = 2\*pi\*(f1 + f2)))];  Question(f)    Results&Analysis  As we can see, t is from 0 to 2 while the N is from 0 to 8000. So the tau must be 1/4000. Then we could get the picture of the CTFT of X(jw).    As we could know from the (e), the major part of M1(jw) is around +- 800pi and 0.    So we could get the M1(jw) by using the filter. Of course we only target at the M1(jw) which is around 0.    As we could see, it is [dash dot dot], which is the letter “D”.  Question(g)    Results&Analysis  To get m2, we need to shift the signal by x(t)\*exp(j\*400pi\*t) to get the M2 around 400pi. And then we need to only get the imaginary part of m2 as x(t) has been transformed into complex vector. Then we have:    The m2 is [ dot dot dot], which means letter ”S”.  As for the m3, it has a j in its M3(jw). so it should be found in imaginary part of X(jw). After shifting it by exp(j800pi\*t), we get:    This is m3, which stands for[dot dash dash dot], the letter ”P”.  So the answer is “**DSP**”.  **Note**: Please indicate meaning of the symbols in all expressions. Please indicate the coordinate and unit in all figures. | |
| **Experience**  4.6 is an interesting problem. Using International Morse Code to recognize letters is interesting.  39d469c2966ea3611fd87a47be7583c2_  24f7a6572b2f8e3dcea3530f7eb246c9_2238a382a3bcfa85d3e549baa8d5d67c_  You can write your experience with this project. Any comment and suggestion on this course are also very welcome. | |
| **Score** | 90 |

Code

4.6

(a)

clc;clear;

load('G:\信号和系统\ctftmod.mat');

z = [dash dash dot dot];

plot(t,z);

xlabel("0<=t<=2");ylabel("'Z'");

(b)

clc;clear;

load('G:\信号和系统\ctftmod.mat');

h = freqs(bf,af);

stem(real(h));

xlabel("0<=x<=200");ylabel("h = freqs(bf,af)");

(c)

clc;clear;

load('G:\信号和系统\ctftmod.mat');

ydash = lsim(bf,af,dash,t(1:length(dash)));

ydot = lsim(bf,af,dash,t(1:length(dot)));

figure(1);

subplot(2,1,1);

plot(dash,'r--');

hold on;

plot(ydash,'g');

legend([plot(dash,'r--') plot(ydash,'g')], 'dash', 'ydash');

xlabel("0,=t<=200");ylabel("the dash and ydash");

hold off;

subplot(2,1,2);

plot(dot,'r');

hold on;

plot(ydot,'g--')

legend([plot(dot,'r') plot(ydot,'g--')], 'dot', 'ydot');

xlabel("0,=t<=200");ylabel("the dot and ydot");

hold off;

(d)

clc;clear;

load('G:\信号和系统\ctftmod.mat');

y = dash.\*cos(2\*pi\*f1\*t(1:length(dash)));

yo = lsim(bf,af,y,t(1:length(y)));

subplot(211);

plot(y);

xlabel('0<=t<=2000');ylabel('y is the modifed signal');

subplot(212);

plot(yo');

xlabel('0<=t<=2000');ylabel('yo is the filtered y signal');

(f)

clc;clear;

load('G:\信号和系统\ctftmod.mat');

N = 8000;

tau = 2/N;

ftx = fftshift(tau\*fft(x));

w = [-(N -1)/2:(N-1)/2];

figure(1);

plot(w,ftx);

xlabel("-4000<=n<=4000");ylabel("the X(jw) from x(t)");

xc = x.\*cos(2\*pi\*f1\*t);

ftxc = fftshift(tau\*fft(xc));

figure(2);

plot(w,ftxc);

xlabel("-4000<=n<=4000");ylabel("the Y(jw) from x(t)\*cos(2\*pi\*cos(2\*pi\*f1\*t)");

z = lsim(bf,af,xc,t);

figure(3);

plot(z);

xlable('0<=n<=8000');ylabel("m1");

(g)

clc;clear;

load('G:\信号和系统\ctftmod.mat');

N = 8000;

tau = 2/N;

ftx = fftshift(tau\*fft(x));

w = [-(N-1)/2:(N-1)/2];

figure(1);

plot(w,ftx);

xlabel("-4000<=n<=4000");ylabel("the X(jw) from x(t)");

xc = x.\*cos(2\*pi\*f1\*t);

ftxc = fftshift(tau\*fft(xc));

figure(2);

plot(w,ftxc);

xlabel("-4000<=n<=4000");ylabel("the Y(jw) from x(t)\*cos(2\*pi\*cos(2\*pi\*f1\*t)");

xcm2 = xc.\*exp(j\*400\*pi\*t);

z = lsim(bf,af,xcm2,t);

figure(3);

plot(w,imag(z));

xlabel("-4000<=n<=4000");ylabel("m2");

xcm3 = xc.\*exp(j\*800\*pi\*t);

q = lsim(bf,af,xcm3,t);

figure(4);

plot(w,imag(q));

xlabel("-4000<=n<=4000");ylabel("m3");