**Lab 3**

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| **Introduction**  The lab guide us to learn about synthesizing signals with the discrete time fourier series(DTFS) and deal with some simple signals.  The lab also guide us to analyze first order recursive discrete time filters and do some practice based on two simple LTI systems.  **Lab results & Analysis**：  **3.5**  **Question(a)**  屏幕剪辑  **Yes, from the coefficients we can calculate x[n] to be purely real**  **Question(b)**  **屏幕剪辑**  **屏幕剪辑**  **N = 5, a0 = 1, a1 = a-4 , a3 = a-2**  **Question(c)**  **屏幕剪辑**  **屏幕剪辑**  **The value of x is as shown, the value of its imagine part is very small and can be ignored, and the result meets the prediction of (a).**  **Question(d)**  **屏幕剪辑**  **屏幕剪辑**  **The result is as shown.**  **Question(e)**  **屏幕剪辑**  **屏幕剪辑**  **The result is as shown.**  **We can calculate that a1(1) = 1, a2(1) = 0.5, a3(1) = 0.25, and they meet the result.**  **Question(f)**  **屏幕剪辑**  **屏幕剪辑**  **Question(g)**  **屏幕剪辑**  **屏幕剪辑**  **The result is as shown and we can see that the imagine part of x3\_all zero and x3\_all is real.**  **Question(h)**  **屏幕剪辑**  **屏幕剪辑**  **The result is as shown. And it does not display Gibb’s phenomenon.**  **Question(h)**  **屏幕剪辑**  **屏幕剪辑**  **3.8**  **Question(a)**  **屏幕剪辑**  **屏幕剪辑**  **From the description, we can know that a1 = 1, b1 = [1 -0.8], a2 = 1, b2 = [1 0.8]**  **Question(b)**  **屏幕剪辑**  **屏幕剪辑**  **From the result, we can see that System 1 is a bandpass filter and System 2 is a bandstop filter.**  **Question(c)**  **屏幕剪辑**  **屏幕剪辑**  **Analysis**  **For System 1, the component of frequency = 9 \*2\*pi /20 and 11\*2\*pi/20 will be amplified The component of frequency =1\*2\*pi/20 and 19\*2\*pi/20 would be attenuated.**  **For System 2, the component of frequency = 1\*2\*pi/20 and 19\*2\*pi/20 will be amplified The component of frequency =9 \*2\*pi /20 and 11\*2\*pi/20 would be attenuated.**  **Question(d)**  **屏幕剪辑**  **屏幕剪辑**  **The result is as shown.**  **Question(e)**  **屏幕剪辑**  **屏幕剪辑**  **As the figure shown, y1 has more low frequency energy and y2 has more high frequency energy and it confirms the answer of (c).**  **Question(f)**  **屏幕剪辑**  **屏幕剪辑**  **As the figure shown, the result agrees with the answer in (e), because a\_y1 has more low value and a\_y2 has more high value.** | |
| **Experience**  冯柏钧  C:\Users\16954\AppData\Local\Packages\Microsoft.Office.Desktop_8wekyb3d8bbwe\AC\INetCache\Content.Word\屏幕截图(16).png  C:\Users\16954\AppData\Local\Packages\Microsoft.Office.Desktop_8wekyb3d8bbwe\AC\INetCache\Content.Word\屏幕截图(26).pngC:\Users\16954\AppData\Local\Packages\Microsoft.Office.Desktop_8wekyb3d8bbwe\AC\INetCache\Content.Word\屏幕截图(24).pngC:\Users\16954\AppData\Local\Packages\Microsoft.Office.Desktop_8wekyb3d8bbwe\AC\INetCache\Content.Word\屏幕截图(19).png | |
| **Score** |  |

Code

2.10

Question(a)

Question(b)

a = [1,2\*exp(-j\*pi/3),exp(j\*pi/4), exp(-j\*pi/4),2\*exp(j\*pi/3)];

Question(c)

N = 5;

a = [1,2\*exp(-j\*pi/3),exp(j\*pi/4), exp(-j\*pi/4),2\*exp(j\*pi/3)];

for n = 1:5

sum = 0;

for k = 1:5

sum = a(k)\*exp(i\*2\*pi\*(k-1)/5\*(n-1)) + sum;

end

x(n) = sum;

end

subplot(2,1,1)

stem(0:4, real(x));

xlabel('x');ylabel(' real value');

subplot(2,1,2)

stem(0:4, imag(x));

xlabel('x');ylabel(' imag value');

Question(d)

N1=8;

N2=16;

N3=32;

l = [0:63];

s1 = [ones(1,8), zeros(1,8)];

s2 = [ones(1,8), zeros(1,24)];

x1 = [ones(1,8)];

x2 = [s1];

x3 = [s2];

%subplot(3,1,1),stem(l,x1),title('x1'),xlabel('x1'),ylabel('value');

%subplot(3,1,2),stem(l,x2),title('x2'),xlabel('x2'),ylabel('value');

%subplot(3,1,3),stem(l,x3),title('x3'),xlabel('x3'),ylabel('value');

Question(e)

a1 = (1/N1)\*fft(x1);

a2 = (1/N2)\*fft(x2);

a3 = (1/N3)\*fft(x3);

subplot(3,1,1),stem(0:7,abs(a1)),title('a1'),xlabel('a1'),ylabel('value');

subplot(3,1,2),stem(0:15,abs(a2)),title('a2'),xlabel('a2'),ylabel('value');

subplot(3,1,3),stem(0:31,abs(a3)),title('a3'),xlabel('a3'),ylabel('value');

Question(f)

x3 = [ones(1,8) zeros(1,24)];

a3 = 1/32\*fft(x3);

l = 1:32;

a3\_2 = [a3(1) a3(2) a3(3) zeros(1,27) a3(31) a3(32)];

x3\_2 = 32\*ifft(a3\_2);

a3\_8 = [a3(1:9) zeros(1,15) a3(25:32)];

x3\_8 = 32\*ifft(a3\_8);

a3\_12 = [a3(1:13) zeros(1,7) a3(21:32)];

x3\_12 = 32\*ifft(a3\_12);

a3\_all = [a3(1:32)];

x3\_all = 32\*ifft(a3\_all);

subplot(4,1,1),stem(l,x3\_2),title('x3-2'),xlabel('x3-2'),ylabel('value');

subplot(4,1,2),stem(l,x3\_8),title('x3-8'),xlabel('x3-8'),ylabel('value');

subplot(4,1,3),stem(l,x3\_12),title('x3-12'),xlabel('x3-12'),ylabel('value');

subplot(4,1,4),stem(l,x3\_all),title('x3-all'),xlabel('x3-all'),ylabel('value');

Question(g)

x3 = [ones(1,8) zeros(1,24)];

a3 = 1/32\*fft(x3);

l = 1:32;

a3\_2 = [a3(1) a3(2) a3(3) zeros(1,27) a3(31) a3(32)];

x3\_2 = 32\*ifft(a3\_2);

a3\_8 = [a3(1:9) zeros(1,15) a3(25:32)];

x3\_8 = 32\*ifft(a3\_8);

a3\_12 = [a3(1:13) zeros(1,7) a3(21:32)];

x3\_12 = 32\*ifft(a3\_12);

a3\_all = [a3(1:32)];

x3\_all = 32\*ifft(a3\_all);

%subplot(4,1,1),stem(l,x3\_2),title('x3-2'),xlabel('x3-2'),ylabel('value');

%subplot(4,1,2),stem(l,x3\_8),title('x3-8'),xlabel('x3-8'),ylabel('value');

%subplot(4,1,3),stem(l,x3\_12),title('x3-12'),xlabel('x3-12'),ylabel('value');

%subplot(4,1,4),stem(l,x3\_all),title('x3-all'),xlabel('x3-all'),ylabel('value');

subplot(2,1,1),stem(l,real(x3\_all)),title('x3-all'),xlabel('real part'),ylabel('value');

subplot(2,1,2),stem(l,imag(x3\_all)),title('x3-all'),xlabel('imag part'),ylabel('value');

Question(h)

function a = dtfs(x,n\_init)

N = size(x,2);

n = n\_init;

if(n\_init >= N ||n\_init < 0)

n = n\_init - floor(n\_init/N) \* N;

end

if (n\_init == 0)

X = x;

else

X = [x(N-n+1: N),x(1:N-n)];

end

a = (1/N)\*fft(X);

end

**3.8**

**Question(a)**

**a1 = 1; %input**

**b1 = [1 -0.8]; %output**

**a2 = 1; %input**

**b2 = [1 0.8]; %output**

**Question(b)**

**a1 = 1; %input**

**b1 = [1 -0.8]; %output**

**a2 = 1; %input**

**b2 = [1 0.8]; %output**

**N = [0:2\*pi/1024:2\*pi];**

**y1 = freqz(b1,a1,N, 'whole');**

**y2 = freqz(b2,a2,N, 'whole');**

**figure(1)**

**plot(N,abs(y1)),title('y1'),xlabel('freq'),ylabel('value')**

**figure(2)**

**plot(N,abs(y2)),title('y2'),xlabel('freq'),ylabel('value')**

**Question(c)**

**a\_x = [0,3/4, zeros(1,7), -1/2,0, -1/2, zeros(1,7), 3/4];**

**N = [0:2\*pi/20:2\*pi/20\*19];**

**stem(N,a\_x),xlabel('freq'),ylabel('value')**

**Question(d)**

**a\_x = [0,3/4, zeros(1,7), -1/2,0, -1/2, zeros(1,7), 3/4];**

**x\_20 = 20\*ifft(a\_x);**

**x = [x\_20,x\_20,x\_20,x\_20,x\_20,x\_20];**

**N = -20:99;**

**stem(N,x),title('x'),xlabel('index'),ylabel('value')**

**Question(e)**

**a\_x = [0,3/4, zeros(1,7), -1/2,0, -1/2, zeros(1,7), 3/4];**

**x\_20 = 20\*ifft(a\_x);**

**x = [x\_20,x\_20,x\_20,x\_20,x\_20,x\_20];**

**N = -20:99;**

**%stem(N,x),title('x'),xlabel('index'),ylabel('value')**

**a1 = 1; %input**

**b1 = [1 -0.8]; %output**

**a2 = 1; %input**

**b2 = [1 0.8]; %output**

**y1 = filter(b1,a1,x);**

**y2 = filter(b2,a2,x);**

**subplot(2,1,1),stem(0:99,y1(21:120)),title('y1'),xlabel('index'),ylabel('value')**

**subplot(2,1,2),stem(0:99,y2(21:120)),title('y2'),xlabel('index'),ylabel('value')**

**Question(f)**

**a\_x = [0,3/4, zeros(1,7), -1/2,0, -1/2, zeros(1,7), 3/4];**

**x\_20 = 20\*ifft(a\_x);**

**x = [x\_20,x\_20,x\_20,x\_20,x\_20,x\_20];**

**N = -20:99;**

**%stem(N,x),title('x'),xlabel('index'),ylabel('value')**

**a1 = 1; %input**

**b1 = [1 -0.8]; %output**

**a2 = 1; %input**

**b2 = [1 0.8]; %output**

**y1 = filter(b1,a1,x);**

**y2 = filter(b2,a2,x);**

**%subplot(2,1,1),stem(0:99,y1(21:120)),title('y1'),xlabel('index'),ylabel('value')**

**%subplot(2,1,2),stem(0:99,y2(21:120)),title('y2'),xlabel('index'),ylabel('value')**

**y1\_20 = y1(21:40);**

**y2\_20 = y2(21:40);**

**a\_y1 = (1/20)\*fft(y1\_20);**

**a\_y2 = (1/20)\*fft(y2\_20);**

**subplot(2,1,1),stem(0:19,abs(a\_y1)),title('a\_\_y1'),xlabel('index'),ylabel('value')**

**subplot(2,1,2),stem(0:19,abs(a\_y2)),title('a\_\_y2'),xlabel('index'),ylabel('value')**