**Lab 2**

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| **Introduction**  The lab guide us to learn about inverse filtering of LTI systems through the example of echo cancelling. We will load the given file and use MATLAB to process them and discuss the properties of LTI systems.  **Lab results & Analysis**：  **2.10**  **Question(a)**  **屏幕剪辑**  **屏幕剪辑**  **屏幕剪辑**  **Analysis**  **From the description, we can know that the result is as shown.**  **Question(b)**  **屏幕剪辑**  **Analysis**  **From y[n] = x[n] + ax[n - N](2.21) and z[n] + az[n - N] = y[n](2.22), we can derive that x[n] + ax[n - N] = z[n] + az[n - N] is true for all possible n, which means is apparent that z[n] = x[n] is a valid solution to the overall difference equation. Moreover, z[n] \* he[n] = y[n].**  **Question(c)**  **屏幕剪辑**  **屏幕剪辑**  **The result is as shown.**  **Question(d)**  **屏幕剪辑**  **屏幕剪辑**  **The result is as shown and the new output has no echo.**  **Question(e)**  **屏幕剪辑**  **Analysis**  **As the figure shown, the result is not an unit impulse. The reason is that the echo removal system has an infinite-length impulse response while he and her are both finite. There exists difference.**  **Question(f)**  **屏幕剪辑**  **Analysis**  **𝑅𝑦𝑦 [𝑛] = 𝑥 [𝑛] ∗ (𝛿 [𝑛] + 𝛼𝛿 [𝑛 – 𝑁]) ∗ 𝑥 [−𝑛] ∗ (𝛿 [𝑛] + 𝛼𝛿 [𝑛 + 𝑁])=**  **= 𝑅𝑥𝑥 ∗ ((1 + 𝛼2)𝛿 [𝑛] + 𝛼𝛿 [𝑛 – 𝑁] + 𝛼𝛿[𝑛 + 𝑁])**  屏幕剪辑  **Figure for y2 N should be 3123屏幕剪辑 Figure for y3 N1 should be 2808 and N2 should be 2197.**  **Note**: Please indicate meaning of the symbols in all expressions. Please indicate the coordinate and unit in all figures. | |
| **Experience**  冯柏钧  C:\Users\16954\AppData\Local\Packages\Microsoft.Office.Desktop_8wekyb3d8bbwe\AC\INetCache\Content.Word\1.pngC:\Users\16954\AppData\Local\Packages\Microsoft.Office.Desktop_8wekyb3d8bbwe\AC\INetCache\Content.Word\1.jpegC:\Users\16954\AppData\Local\Packages\Microsoft.Office.Desktop_8wekyb3d8bbwe\AC\INetCache\Content.Word\2.pngC:\Users\16954\AppData\Local\Packages\Microsoft.Office.Desktop_8wekyb3d8bbwe\AC\INetCache\Content.Word\3.pngC:\Users\16954\AppData\Local\Packages\Microsoft.Office.Desktop_8wekyb3d8bbwe\AC\INetCache\Content.Word\8.jpeg  C:\Users\16954\AppData\Local\Packages\Microsoft.Office.Desktop_8wekyb3d8bbwe\AC\INetCache\Content.Word\屏幕截图(13).pngC:\Users\16954\AppData\Local\Packages\Microsoft.Office.Desktop_8wekyb3d8bbwe\AC\INetCache\Content.Word\屏幕截图(11).pngC:\Users\16954\AppData\Local\Packages\Microsoft.Office.Desktop_8wekyb3d8bbwe\AC\INetCache\Content.Word\屏幕截图(10).pngC:\Users\16954\AppData\Local\Packages\Microsoft.Office.Desktop_8wekyb3d8bbwe\AC\INetCache\Content.Word\屏幕截图(9).png | |
| **Score** |  |

Code

2.10

Question(a)

he = [1 zeros(1,999) 1.5];

nhe = 0:1000;

stem(nhe, he);

xlabel('index');

ylabel('value');

title('he');

Question(c)

clc

clear

load lineup.mat

%sound(y,8192);

N = 1000;

he = [1 zeros(1,999) 1.5];

nhe = 0:1000;

d = [1 zeros(1,4000)];

A = [1 zeros(1,N-1), 0.5];

B = 1;

her = filter(B,A,d);

nher = 0:4000;

stem(nher, her);

xlabel('index');

ylabel('value');

title('her');

Question(d)

clc

clear

load lineup.mat

%sound(y,8192);

N = 1000;

he = [1 zeros(1,999) 1.5];

nhe = 0:1000;

d = [1 zeros(1,4000)];

A = [1 zeros(1,N-1), 0.5];

B = 1;

her = filter(B,A,d);

a = A;

z = filter(1,a,y);

plot(z);

xlabel('index');

ylabel('value');

title('z');

sound(z, 8192);

Question(e)

clc

clear

load lineup.mat

%sound(y,8192);

N = 1000;

he = [1 zeros(1,999) 1.5];

nhe = 0:1000;

d = [1 zeros(1,4000)];

A = [1 zeros(1,N-1), 0.5];

B = 1;

her = filter(B,A,d);

a = A;

z = filter(1,a,y);

hoa = conv(he,her);

plot(hoa);

xlabel('index');

ylabel('value');

title('hoa');

Question(f)

clc

clear

load lineup.mat

Ryy = conv(y,fliplr(y));

plot(Ryy);

xlabel('index');

ylabel('value');

title('Ryy');

clc

clear

load lineup.mat

Ryy2 = conv(y2,fliplr(y2));

plot(Ryy2);

xlabel('index');

ylabel('value');

title('Ryy2');

clc

clear

load lineup.mat

Ryy3 = conv(y3,fliplr(y));

plot(Ryy3);

xlabel('index');

ylabel('value');

title('Ryy3');