EE 301 Lab 3 – Convolution Part Deux

1 Introduction

In this lab we will gain experience with the conv function in Matlab. You will also play with an audio recording and see its response when it is convolved with another function.

2 What you will learn

This lab will focus on using MATLAB®'s conv function.

3 Background Information and Notes

None.

4 Guided Exercises

a. **Conv function:**
In the Matlab command prompt type **help conv**. You will see a description of how to use the conv function. Using this function, verify your results of HW3 Problem 5.

b. **Convolution with audio sample**

i. Download the zip file "IMDR1.zip" and save the audio file "IMDR1.wav" in a specified folder.

ii. Reproduce the following skeleton m-file script and save it in the same specified folder as in part i. This code will not run because there is one value missing.

```
% Demonstration of music convolved with various impulse responses.
% R Kozick modified by Satsuki Takahashi

fs = 44100; % Sampling freq, in Hz
T = 1/fs;

fc = 500;   % Desired cutoff freq, in Hz
wc = 2*pi*fc;

% Make impulse response length equal to ?? time constants
t = 0:T:(??/wc);
g = wc*T*exp(-t*wc);

% Read the original audio sample
f = wavread('IMDR1.wav');
```

```
fprintf('This is the original music . . . ');
sound(f,44100)
pause(3)

figure(1)
plot(t, g);
title('Impulse response g(t)');
xlabel('Time (sec.)');
ylabel('Amplitude');

fprintf('\nComputing -- please wait . . . ');
y = conv(f(:,1), g);
fprintf('\nThis is after convolution with g(t) . . . ');
sound(y,44100);
pause(3)

fprintf('\nComputing -- please wait . . . ');
h = [g, zeros(size(0:T:0.1)), .5*g];

figure(2)
th = (1:length(h))*T;
plot(th, h)
title('Impulse response h(t)');
xlabel('Time (sec.)');
ylabel('Amplitude');

z = conv(f(:,1), h);
fprintf('\nThis is after convolution with h(t) . . . ');
sound(z,44100);
fprintf('\n');

fprintf('To repeat the sounds:\n')
fprintf('sound(f,44100) is the original\n')
fprintf('sound(y,44100) is convolved with g(t)\n')
fprintf('sound(z,44100) is convolved with h(t)\n')
```

iii. Study the code and see if you can understand what is happening in the code. An audio signal is being read, stored and convolved with two different functions.

iv. What does the first impulse function g(t) look like? (Hint: see Lab 2) Can you determine an acceptable value for the missing time constant value? What is the value you chose? Then run the code.

v. What specific effect did the first convolution with impulse function g(t) have on the audio sample?

vi. What specific effect did the second convolution with impulse function h(t) have on the audio sample? What physical mechanism does the second peak of h(t) correspond to, in a real-life setting?

vii. Modify the code so that the second peak of h(t) occurs 1 second later from the first peak.

Using convolution, one can then simulate and recreate audio signal in a virtual space. Try your own audio sample, if you wish ☺

5 Review

1. None.

6 Lab Report

1. The first page of your Lab report should be a cover sheet with your name, USC ID and Lab #. Please note that all reports should be typed.
2. Answer all the questions which were asked in the lab report. Kindly display the code lines you executed to arrive at your answer along with figures to support them. Please give written explanation or put comment lines where necessary. Please note that each figure should have proper labels for the x and y axis and should have a suitable title.
3. Answer the review questions.
4. Submit a printout of your completed M-file documenting all the lab exercises.