Elec Eng 4TL4

Lab 2 – Resampling, Reconstruction, and Convolution

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TA:

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As a future member of the engineering profession, the student is responsible for performing the required work in an honest manner, without plagiarism and cheating. Submitting this work with my name and student number is a statement and understanding that this work is my own and adheres to the Academic Integrity Policy of McMaster University and the Code of Conduct of the Professional Engineers of Ontario. Submitted by [George Gill, Gillg62, 400327563]

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### Introduction

1. Create the discrete-time sequence:  
   x[n] = u[n] − u[n − 10]  
   where u[n] is the unit-step function (i.e., u[n] = 1 for n ≥ 0 and u[n] = 0 for n < 0). You  
   do not have to zero-pad x[n] (i.e., the vector you have should contain no zero elements).  
   Plot x[n] using stem() function

A graph of a number

Description automatically generated

1. Now, convolve x[n] over and over:  
   a[n] = x[n] ∗ x[n]  
   b[n] = a[n] ∗ x[n]  
   c[n] = b[n] ∗ x[n]  
   d[n] = c[n] ∗ x[n]  
   You can use the MATLAB function conv() with proper input parameters.
2. Plot a[n], b[n], c[n], d[n] using stem() function.

A screenshot of a graph

Description automatically generated

### Convolution of Signals and System Impulse Responses

1. Load the supplied acoustic impulse response of a room into MATLAB using the command:  
   [impr,fs] = audioread(’roomIR.wav’);  
   This impulse response was obtained by creating an impulsive noise at one position in the  
   room and recording (and digitizing) the sounds arriving at another position in the room
2. Plot the impulse-response waveform impr using the plot() command and listen to it  
   using the soundsc() command. What can you see and hear in the impulse response?

A graph with blue lines

Description automatically generated

The sound heard in the impulse response of the roomIR.wav file was similar to the sound of an object dropping in a room. After the peak of the impulse response at the beginning, there is a gradual decay of the sound instead of an immediate drop. This represents the signal being reflected and absorbed by the walls in a room.

1. Load the supplied speech signal into MATLAB using the command:  
   [y,fs] = audioread(’convolution.wav’);

A blue and white graph

Description automatically generated

1. Convolve the speech signal with the impulse response, and plot and listen to the resulting  
   signal. Describe what you see and hear, comparing it to the original speech signal y.  
   Explain what the convolved signal is physically equivalent to, according to the impulse-  
   response theory

A graph of a blue line

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