Department of Electronics and Electrical Engineering
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Lab Sheet 2

EE333: Communication and DSP Laboratory January 12, 2021

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1) Write a function to perform $lincon(h, x)$ to convolve two input sequences using the expression for liner convolution
2) Write another function $freqconv(h, x)$ to perform the linear convolution of convolve h and x using their ffts.
3) Write a function to generate 1000 samples of a periodic train of pulses, with a period T, specified by the user.
4) Define a vector $h = [1, 2, 3, 4]$ and convolve it with the a pulse train with periods T=1,2,3 and 4, what do you observe?
5) Sample your voice at 8kHz for 2 seconds and pass it through an arbitrary, length 16 FIR filter using
   a) Direct Linear convolution
   b) Linear Convolution using FFT
   c) The overlap-add method for block lengths: 64, 128, 256 and 512
   d) The overlap save method for block length: 64, 128, 256, and 512

   In each of the above cases, obtain the total number of required real multiplications, and using that as an indication of computational complexity, comment on the optimal block size for overlap add and overlap save implementation of linear convolution.
6) Write a function *myquant(x,L)* to quantize the input vector into L uniformly spaced intervals.
7) Use the mean squared error function defined in the previous lab sheet to plot the quantization mean squared error as a function of L. Write down your observations.
8) Take a five second audio sample of your choice and pass it through the quantizer designed in Question 6. Observe the effect of mean squared quantization error on the perceptual quality of the audio sample.
9) Modify the function *myquant(x,L)* to *lev_quant(x,v)* that takes another vector v as an input and quantizes the points in x around the points in v according to the nearest neighbors approach.
10) Extend *lev_quant(x,v)* to handle complex numbers. Write down the changes that you needed to consider in the notebook.
11) Use the function *myquant(x,L)* to plot the histogram of the input vector using only the for loop and the if statement.
12) Implement the $K - means$ vector quantization algorithm for an arbitrary set of input vectors.