TMA 10/5/20

Convolution Discussion

Write your answers to the questions in a word document to submit. Let us know if you have questions or we can help in any way.

Question 1) Define superposition.

The net response caused by two or more stimuli is the sum of the responses that would have been caused by each stimulus individually.

Recall from the previous lab that the gain b_0 = h[0], the gain b_1 = h[1], and the gain b_2 = h[2] where h[n] is the unit pulse response. This means that each of the gains affected an individual output period. Based on the convolution formula (1) below, formulas (2), (3), and (4) can be found.

$$y[n] = x[n] * h[n] = \sum_{k=-\infty}^{\infty} x(k) \cdot h(n - k) \tag{1}$$

$$y[2] = h[0] \cdot x[2] + h[1] \cdot x[1] + h[2] \cdot x[0] \tag{2}$$

$$y[3] = h[0] \cdot x[3] + h[1] \cdot x[2] + h[2] \cdot x[1] \tag{3}$$

$$y[4] = h[0] \cdot x[4] + h[1] \cdot x[3] + h[2] \cdot x[2] \tag{4}$$

Question 2) If n goes from 0 to 5, write the equations for y[0], y[1], and y[5].

Question 3) If I convolve an impulse function (delta function) with anything, what is the result? Why is this the result?

Q2

$n = 0 \text{ to } 5$

$$y(0) = \sum_{k=0}^{2} x(n-k)\,h(k) = \sum_{k=0}^{2} x(-k)\,h(+k)$$

$$= h(0)x(0) + h(1)x(-1) + h(2)x(-2)$$

$$y(1) = \sum_{k=0}^{2} x(1-k)\,h(k)$$

$$= h(0)x(1) + h(1)x(0) + h(2)x(-1)$$

$$y(5) \sum_{k=0}^{2} x(5-k)\,h(k) = h(0)x(5) + h(1)x(4) \geqslant h(2)x(3)$$

Q3

$$y(n) = x(n) + \delta(n)$$

$$= \sum_{k=-\infty}^{\infty} x(k)\,\delta(n-k)$$

$$= \sum_{k=-\infty}^{\infty} x(k) \big/ k=n \;=\; x(n)$$

$$x(n) \times \delta(n) = \underline{x(n)}$$

Question 4) Using Google or the Matlab tutorial windows, find how to convolve two signals in Matlab.

```
%Jacob Howard clc; clear;

x=[1 2 3 4];
 h=[1 1 2 1];

y=conv(x,h)
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These will be due by the start of your Convolution TIMS Wk 2 Lab. Please email your responses to your TA by then and have access to a copy of your responses at lab time to allow for a class discussion.

This will count as a week's lab grade.