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ECE 3304

Project 1

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Purpose:

The purpose of this report is to showcase results from project 1, in which several various signals were analyzed under various conditions. These signals were analyzed utilizing MATLAB.

Part 1: Utilizing the following equation:

$$f[n] = e^{-n/5} \cos\left(\pi n/5\right) u[n]$$

The signal was evaluated from -10 to 10 under various conditions:

f[n], f[-2n] and f[-2n+1] which can be seen below:

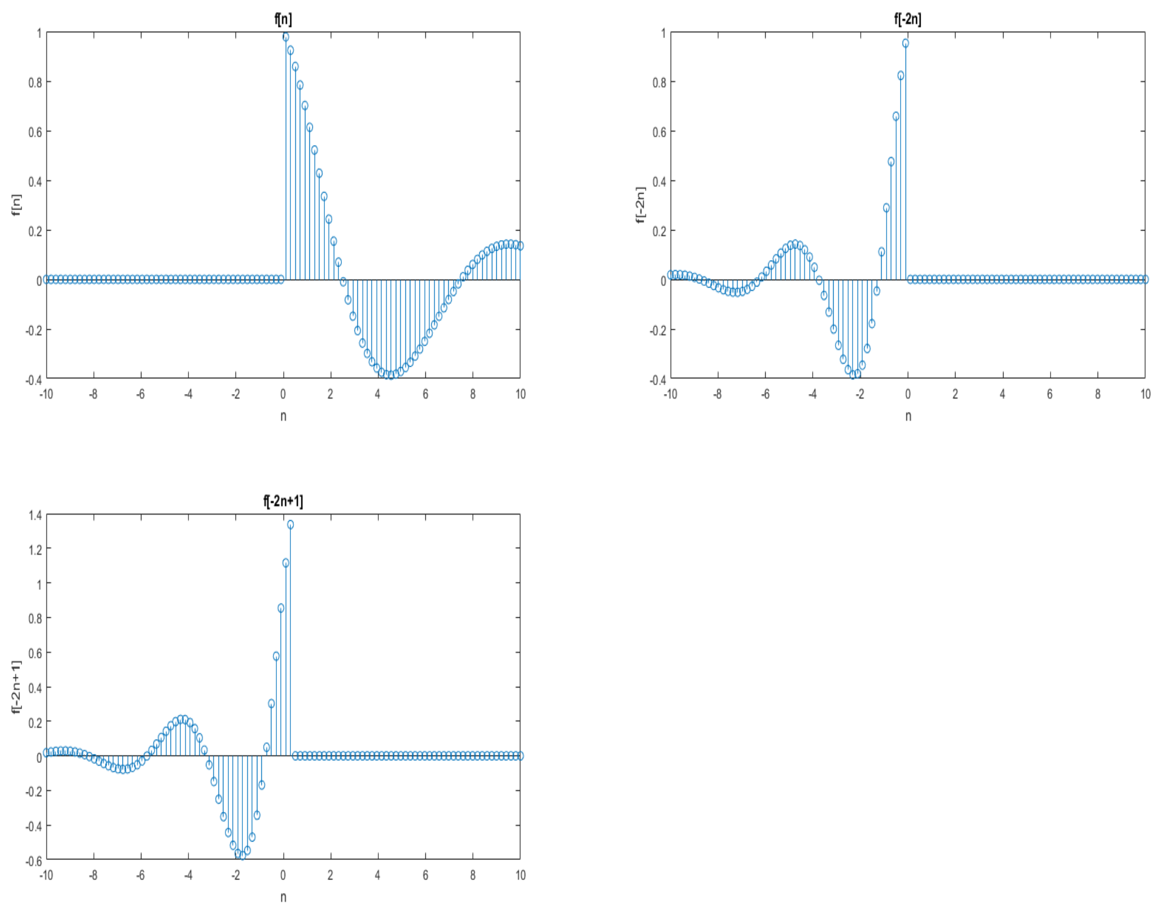


*Figure 1: part 1 graphs*

The functions were plotted using commands *stem* and *subplot*. An example of how the functions looked is like: `f(n) = exp(-n/5).*cos((pi*n)/5).*heaviside(n);`.

We can see how each respective “shift”, such as -2n and -2n+1, effects the graph. -2n causes a mirror image and the n values to be twice as much in magnitude, while -2n +1 causes a similar factor but by also adding 1 to the n values .

Part 2: Utilizing the following difference equation:

$$y[n] - y[n-1] + y[n-2] = x[n]$$

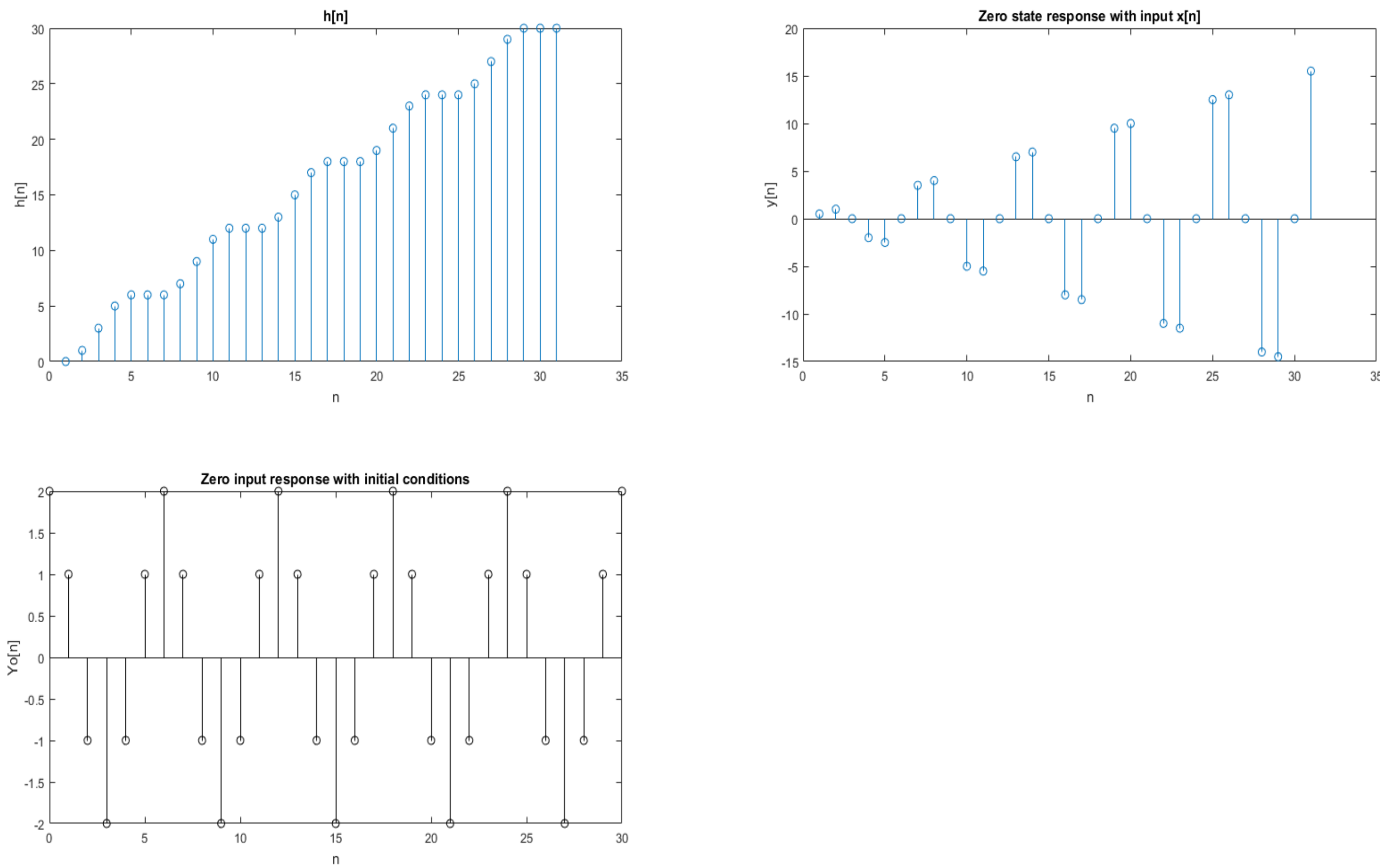


*Figure 2: part 2 graphs*

The functions were plotted using commands *stem* and *subplot* as well as *filter*. The *filter* command allows us to plot a difference equation, but, in order to do so you must break the equation down into its respective coefficients. This process was very easy. For example, with our difference equation we can see that the coefficients would simply be 1,-1,1 for the y values and 1 for the  x values. With the coefficients you use the filter command, along with a range such as 0 to 30 and then generator a plot.

From the plots generated we can see the system h[n] is BIBO marginally stable as it is a periodic function and approaches infinity and negative infinity at the same rate.

Part 3: Utilizing the following equations:

$$h[n] = \left\{\cos\left(\pi n/_3\right) + \frac{1}{\sqrt{3}}\sin\left(\pi n/_3\right)\right\}u[n]$$

$$x[n] = \cos\left(2\pi n/_6\right)u[n]$$

We can implement a discrete time convolution utilizing the command *conv*. Through this, with the impulse response, as defined h[n], and an input, as defined as x[n], we can calculate this respective convolution with ease which we will define as y[n].

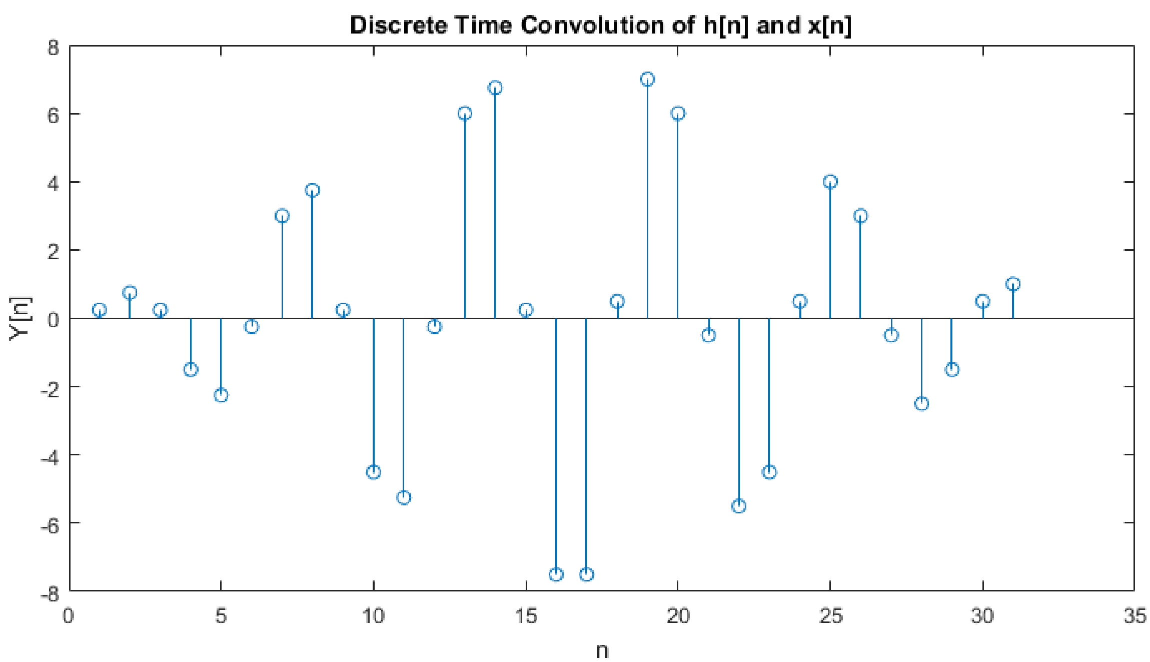


*Figure 3: part 3 graphs*

In figure 3 we can see the implementation of the discrete time convolution of the two signals h[n] and x[n]. This plot was generated utilizing the MATLAB commands *conv*, *stem* and *subplot.* The range was set to be generated from 0 to 30, which is pictured above. The function we see generated is very similar to that of the sinc(n) function.

Conclusion:

In conclusion, it can be seen that MATLAB is a very useful, perhaps even invaluable, tool to those who need to work with digital signal processing. It offers a wealth of commands and can be very useful to help identify signals that are and are not BIBO stable, as well as do mathematical computations such as the discrete time convolution we saw in part 3.