ECE 280L: Introduction to Signals and Systems
Lab 2: Introduction to SIMULINK

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Section:	ECE 280L-04L

I have adhered to the Duke Community Standard in completing this assignment.

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Contents

1 Objectives

The objectives of this laboratory was to provide an introduction on how to use and set up SIMULINK and to begin to understand its usefulness and abilities. Step by step the lab introduces different functionalities offered by each block type and how to combine them to produce a certain outcome. It also aims at teaching how to manually generate signals, apply operations to them and ultimately save the output of the signal in some kind of format and comprehend the data. It will finish with an exercise that encompasses all of the above techniques and knowledge.

2 Results and Discussion

2.1 Exercises 1-3

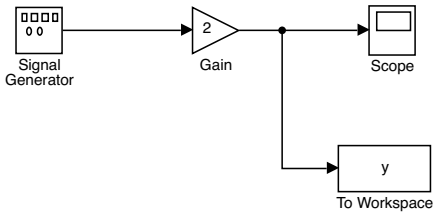

Figure 1: SIMULINK Model used in first 3 exercises)

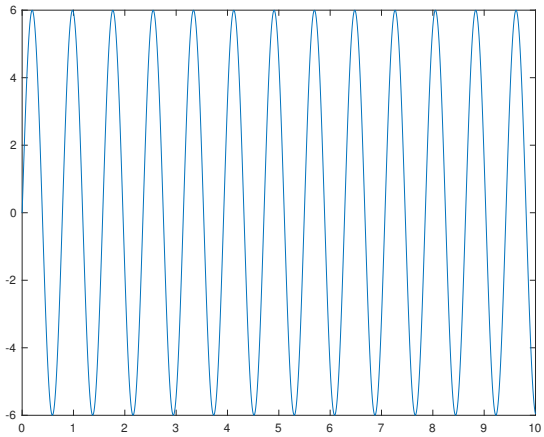

Figure 2: Plot of SIMULINK Model with max step size of 0.01)

2.2 Exercise 4: Simulate a Signal Mixer

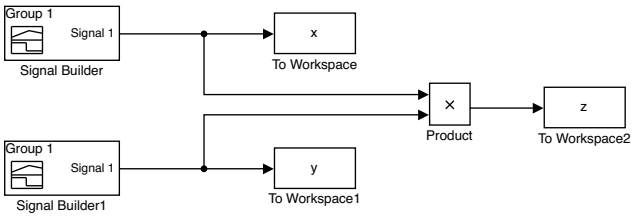

Figure 3: SIMULINK Model used in exercise 4)

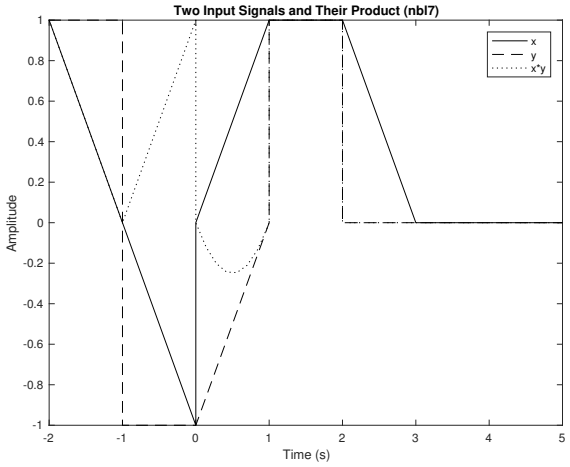

Figure 4: Plot of SIMULINK Model in exercise 4)

2.3 Exercise 5: Analysis of Stock Price and Data

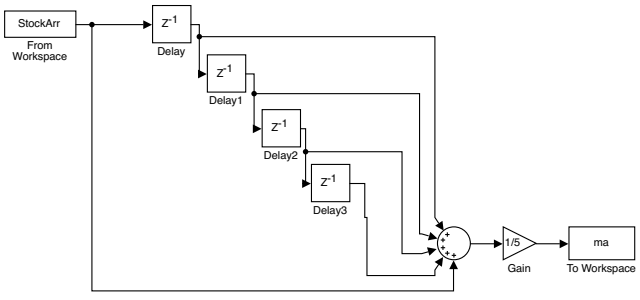

Figure 5: SIMULINK Model used in exercise 5)

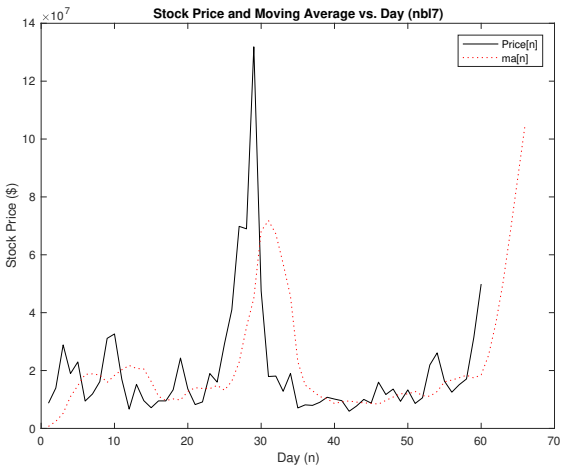

Figure 6: Plot of SIMULINK Model in exercise 5)

2.4 Answer questions from Exercise 5

1 `ma` is a vector of values with a length of 66, whereas `StockPrices` is a vector with a length of 60. This is because we have used a simulation time of 65 - which is derived from 60+`N` where `N` is the number of point moving average filter, in this case 5. As a sample time of 1 second was used this calculates a value for every second thus creating a vector of this length.

2 The first thing I noticed by looking at the graph itself is that the values of `ma` are a lot less erratic. They also do have spikes in values along with the values of `StockPrices`, however these spikes are a lot less dramatic, smoother and don't reach the price set by the max of `StockPrices`. This is because the system we have implemented takes an average of values over five points on the `StockPrices` data, meaning the average is always going to be lower than the actual spike which only occurs over a short period of time. The implementation of this averaging system also leads to this smooth curvature as only one new value is added/removed in the 5 point average calculation each time it is calculated, meaning the value of `ma` does not change too drastically. These effects are also noticeable in the initial values where `ma` is equal to 692400 USD and `StockPrices` is 8711500 USD. Here the average calculation isn't provided with enough data to produce an accurate average so is very far away from the real price.

3 The system is not casual as `ma` depends on the 'future' values of `StockPrices`, which if it were calculating on a day to day basis and not on historical data it would not have access to. It is time invariant as if we shifted the `StockPrices` data it would also cause a shift in the output. It is also linear as if we were to multiply `StockPrices` by a constant we would also see the same change in the output of the system. It is also not stable or memoryless as there is not a bounded input or output for `StockPrices` and it depends on future values, not just the current value.

3 Conclusion

In this laboratory I learned how to SIMULINK launch from MATLAB and access it's different blocks and understand their different functionalities. I then learned how to use these blocks to create a system with an input which I am capable of generating manually using a signal generator or importing from MATLAB. In addition to this I now know the possible ways to monitor and visualize the output of a system I've created and export the data to MATLAB or graphically to a local drive. I then had the opportunity to combine these abilities to apply operations onto signals such as multiplication, or replicating more complex systems such as the moving average filter, through the use of delay, summation and the gain of signals.

4 Extension

The moving average filter system could be used by engineers trying to make sense of a noisy, messy audio signal for example in context of their hypotheses. To get a quick fix that allows them to see patterns of the signal they could apply this to view it. Below I have experimented with different points for the moving average filter.

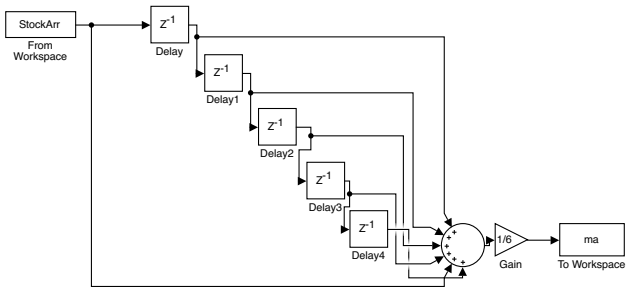

Figure 7: SIMULINK Model for 6 point moving average filter)

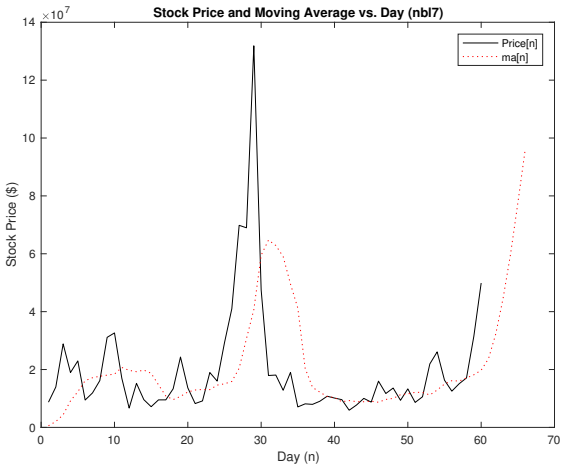

Figure 8: Plot of SIMULINK Model for 6 point moving average filter)

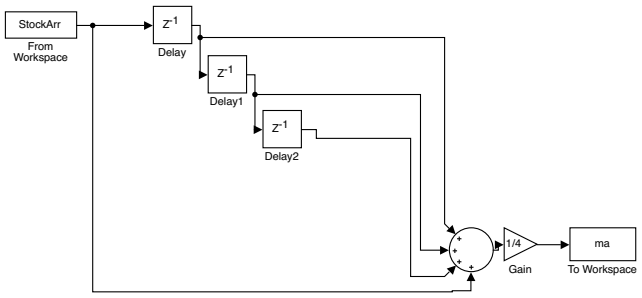

Figure 9: SIMULINK Model for 4 point moving average filter)

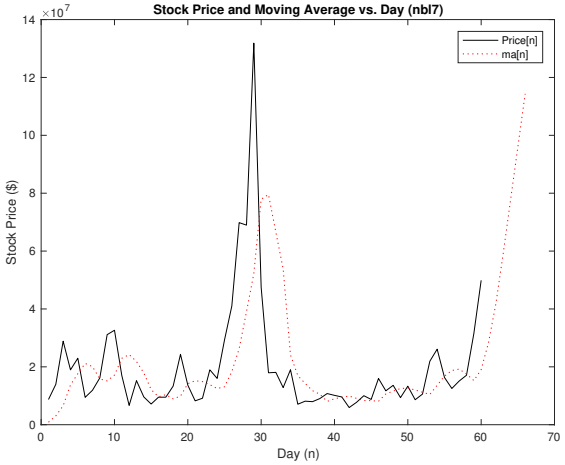

Figure 10: Plot of SIMULINK Model for 4 point moving average filter)

In the plots we can see that the output of the 6 point moving average filter is a lot less spiky, and smoother overall, whereas the 4 point moving average filter is more erratic in general.

Some stock analysis techniques out there involve using the moving average filter to remove noise from graphs so they know the best time when to invest. Typically for people trying to achieve this the SMA (simple moving average) method is used which is only taken over a span of 5 days, and the price every hour or so is used to calculate it as opposed to our method taking a span of 60 days which might be better for long-term investment.

References

Duke University ECE Department, Lab 2: Intro to Simulink Guide. Retrieved from Sakai, 2017.

University/School Laboratory Report Template. (2016, March 25). Retrieved from Chance Fleeting September 2017.