EE/CprE/SE 491 - sddec22-13
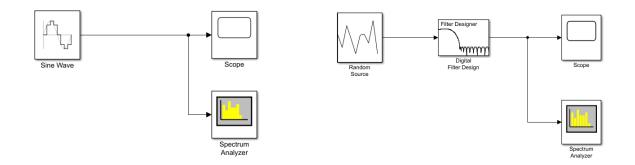**Simultaneous Call Transmission (SCT)**
Week 3
February 14th, 2022 - February 20th, 2022
Client: Collins Aerospace
Faculty Advisor: Dr. Andrew Bolstad

Team Members
- Hani El-Zein - *Digital Signal Processing Lead and Research*
- Sullivan Jahnke - *Project Manager and Lead Communicator*
- Tyler Mork - *Reports, Research, and Communications System Co-Lead*
- Json Rangel - *Communicator and Communications System Co-Lead*
- Austin Rognes - *Research and MATLAB Lead*

Week 3 Summary

Began our first bi-weekly meeting with faculty advisor Dr. Andrew Bolstad to discuss some possible paths to take during our research and what kind of information and exercises to practice and look for, in preparation to take on our project. Additionally, we practiced more with building systems in Simulink. We focused on displaying signals using the Spectrum Analyzer and Scope blocks in Simulink and observed a baseline of how high we should sample frequencies in order to get a proper display on the outputs.

Figures 1.1 & 1.2: Examples of systems built in Simulink for more basic practice. Figure 1.1 is a simple system with a discrete-time sine wave signal fed into a Scope and Spectrum Analyzer. This system was used to observe how sampling rate affects output. Figure 1.2 is a system simulating random noise. This system is primarily used to get an idea of how noise can affect our system when we build an example amplitude modulation system.
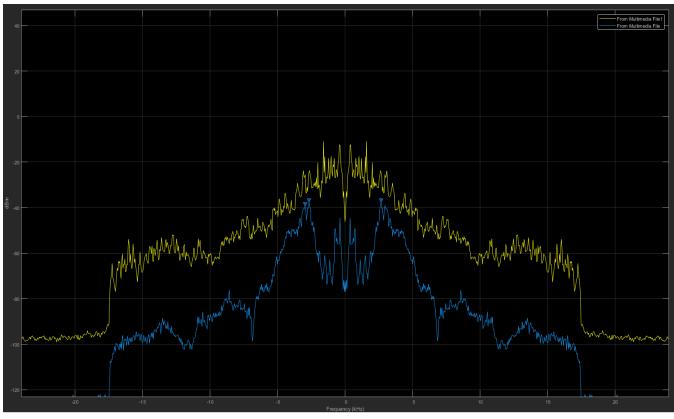
Block Parameters: Sine Wave ✕

Sine Wave

Output a sine wave:

O(t) = Amp*Sin(Freq*t+Phase) + Bias

Sine type determines the computational technique used. The parameters in the two types are related through:

Samples per period = 2*pi / (Frequency * Sample time)

Number of offset samples = Phase * Samples per period / (2*pi)

Use the sample-based sine type if numerical problems due to running for large times (e.g. overflow in absolute time) occur.

Parameters

Sine type: Time based ▾

Time (t): Use simulation time ▾

Amplitude:
1

Bias:
0

Frequency (rad/sec):
2*pi*1000

Phase (rad):
0

Sample time:
1/6000

☑ Interpret vector parameters as 1-D

OK | Cancel | Help | Apply

Block Parameters: Sine Wave ✕

Sine Wave

Output a sine wave:

O(t) = Amp*Sin(Freq*t+Phase) + Bias

Sine type determines the computational technique used. The parameters in the two types are related through:

Samples per period = 2*pi / (Frequency * Sample time)

Number of offset samples = Phase * Samples per period / (2*pi)

Use the sample-based sine type if numerical problems due to running for large times (e.g. overflow in absolute time) occur.

Parameters

Sine type: Time based ▾

Time (t): Use simulation time ▾

Amplitude:
1

Bias:
0

Frequency (rad/sec):
2*pi*1000

Phase (rad):
0

Sample time:
1/4000

☑ Interpret vector parameters as 1-D

OK | Cancel | Help | Apply

Block Parameters: Sine Wave ✕

Sine Wave

Output a sine wave:

O(t) = Amp*Sin(Freq*t+Phase) + Bias

Sine type determines the computational technique used. The parameters in the two types are related through:

Samples per period = 2*pi / (Frequency * Sample time)

Number of offset samples = Phase * Samples per period / (2*pi)

Use the sample-based sine type if numerical problems due to running for large times (e.g. overflow in absolute time) occur.

Parameters

Sine type: Time based ▾

Time (t): Use simulation time ▾

Amplitude:
1

Bias:
0

Frequency (rad/sec):
2*pi*1000

Phase (rad):
0

Sample time:
1/2000

☑ Interpret vector parameters as 1-D

OK | Cancel | Help | Apply

Figures 2.1, 2.2, and 2.3: Some examples of sine wave parameters with different sampling rates used the system shown in Figure 1.1.
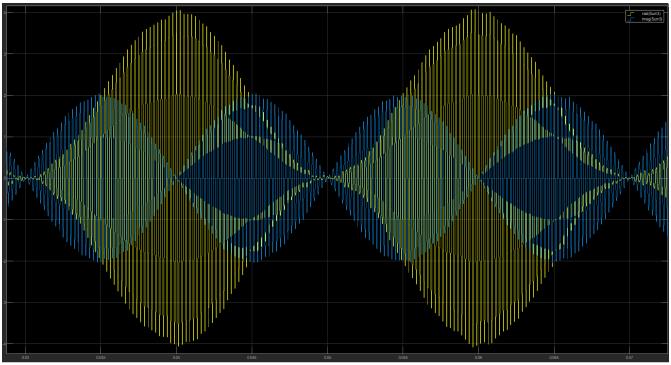
We also built off week 2's Simulink DSB-AM signal construct where instead of two monotone signals being generated, two audio waveforms were introduced into the system. Two audio signals with different voices were input as our input waveforms and run through the system to get our final transmission signal at what is presumed to be an example of what a receiver receives at the ground level. Figure 3.1 introduces the two new audio waveforms' frequency spectrums into the system whereas Figure 3.2 and Figure 3.3 describe the time domain response of the transmitted signal and the frequency response respectively.

It will be worth further questioning our client on the frequency spectrum of the signals we will be working with to get an understanding of the Bandwidth and other spectrum parameters we will be working with. This kind of information will help directly with the filter designs at the receiver end later on in the design process.
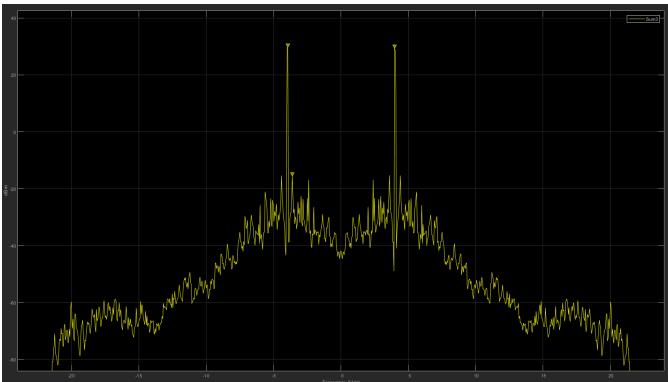
Figure 3.1

Figure 3.2

Figure 3.3

Past Week Accomplishments

The biggest step forward we had this week was getting a clearer picture and understanding of how to approach the project. Our meeting with Dr. Bolstad was extremely helpful, as he was able to give us a crash course on all aspects regarding the MATLAB and Simulink side of our project. Dr. Bolstad was able to point us in a better direction regarding machine learning. Collins Aerospace would like us to develop an algorithm using machine learning and since none of us have any prior experience nor knowledge on it, the high-level process of machine learning that Dr. Bolstad showed us was extremely helpful with the direction of the project.
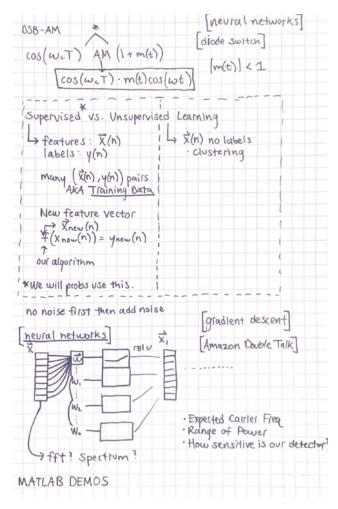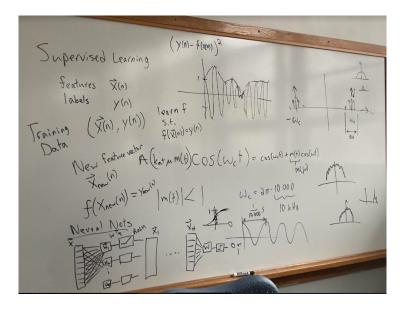
Figure 4.1

Notes taken from the meeting with Dr. Bolstad on the many concepts covered. Subjects surrounded by [ ] are to be researched further by the team.

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Hani El-Zein	Research into Machine Learning Methods, & Matlab practice	3.5	8.5
Sullivan Jahnke	Researched supervised machine learning, neural networks. Communicated with client and advisor about postponed meeting.	3	9.5
Tyler Mork	Further constructed Simulink DSB-AM signals representation to include real audio waveforms	3	10
Json Rangel	Additional practice with Simulink and further research on Amplitude Modulation	4	10
Austin Rognes	Matlab training certificate and basics of Simulink.	4	9

Plans for Upcoming Week

We will further our research and planning of our project and project timeline. We also plan to finalize individual team member's roles and responsibilities, and begin our decision of which techniques or methods we wish to pursue in implementation of the project and it's later stages. Finally, we plan to present our efforts and findings to our client.

Many more things need to be researched and discussed with our client on the technical scale of the project. It would be beneficial to us to know what kind of data we shall be looking for and/or what kind of frequency spectrum we shall be working with. This is all information we will need to obtain from our client. We plan to construct a document of system-based questions for our client to try and obtain any information that may pertain to current hardware and software settings.

Furthermore, a continuation of research into machine learning and algorithm design will be included as time permits. Our main concern as of now is to ensure we are modeling the test environment correctly in our simulation to ensure the validity of the test data. We are lacking the overall picture as of yet, and need to clarify some things before moving into the development phase of the coding.