EE/CprE/SE 491 - sddec22-13
Simultaneous Call Transmission (SCT)
Week 2

February 7th, 2022 - February 13th, 2022
Client: Collins Aerospace
Faculty Advisor: Dr. Andrew Bolstad

Team Members

- Hani El-Zein
- Sullivan Jahnke
- Tyler Mork
- Json Rangel
- Austin Rognes

Week 2 Summary

Obtained a case scenario resembling real world inputs from our client to familiarize ourselves with relevant matlab functions and Simulink blocks.

- *Constructed Simulink circuit consisting of multiple inputs representing radio signals.*

A sinusoidal input of 1000 Hz is created with a sampling rate of 48kHz and amplitude of 1. It is summed with an offset value of 1 which is equal to the absolute value of the peak negative amplitude of the message signal. This creates a proper condition for modulation indexing for DSB-AM signals. Through more research of DSB-AM signals, the DC offset present is to create what is known as an "envelope" in the signal communications world, allowing for retrieval of the transmitted signal at the receiver end without zero-axis crossover. The sinusoidal input is also required to be multiplied by a carrier signal where the carrier signal frequency is of greater value than the corresponding message signal's frequency. We used a carrier frequency of 10000 Hz for our simulation. The resulting product is a DSB-AM signal.
With this created DSB-AM signal, we were informed that due to real world accuracy in receivers, there may be a small frequency error in the received signal by up to 50 Hz depending on the receiver. A frequency error signal was created with a frequency of 50 Hz, Amplitude of 1, and was generated as a complex signal where a real and imaginary waveform exist (cos + jsin). This is assumed to be due to real world scenarios present within receivers. Multiplying our frequency error by our previously created DSB-AM signal results in a frequency shift of our DSB-AM signal by 50 Hz.
Lastly, we were to create a second DSB-AM signal using a frequency of 2000 Hz instead of 1000 Hz. We utilized the same procedure as for the first DSB-AM signal but without frequency shifting the signal. We then summed the first and second DSB-AM

signal together to obtain a resulting modulated transmission signal consisting of the two signals.
Simulation plots were obtained for the frequency spectrum and the time domain. The frequency spectrum merely plotted signal amplitude versus frequency with the frequencies relevant being the 10 kHz, 1kHz, and 2kHz for the carrier frequency, first DSB-AM signal, and second DSB-AM signal respectively.
Figure 1 represents the constructed simulink circuit.
Figure 2 represents the output of the summed DSB-AM signals in the time domain.
Figure 3 represents the output of the summed DSM-AM signals in the frequency domain

Figure 1:

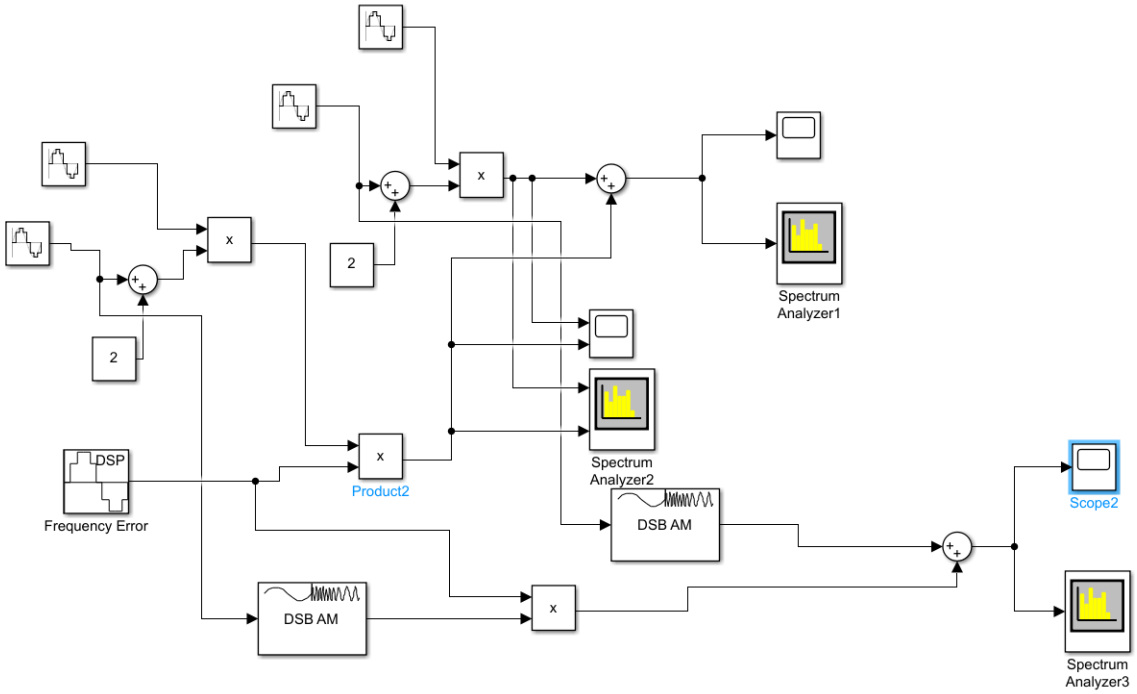


Figure 2:

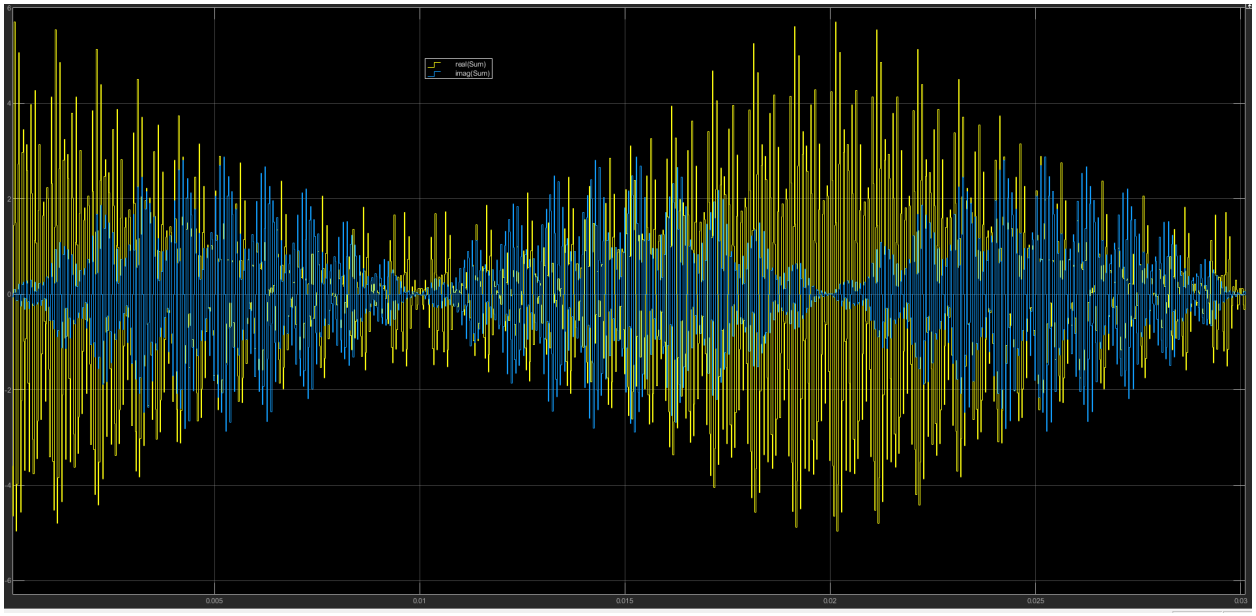
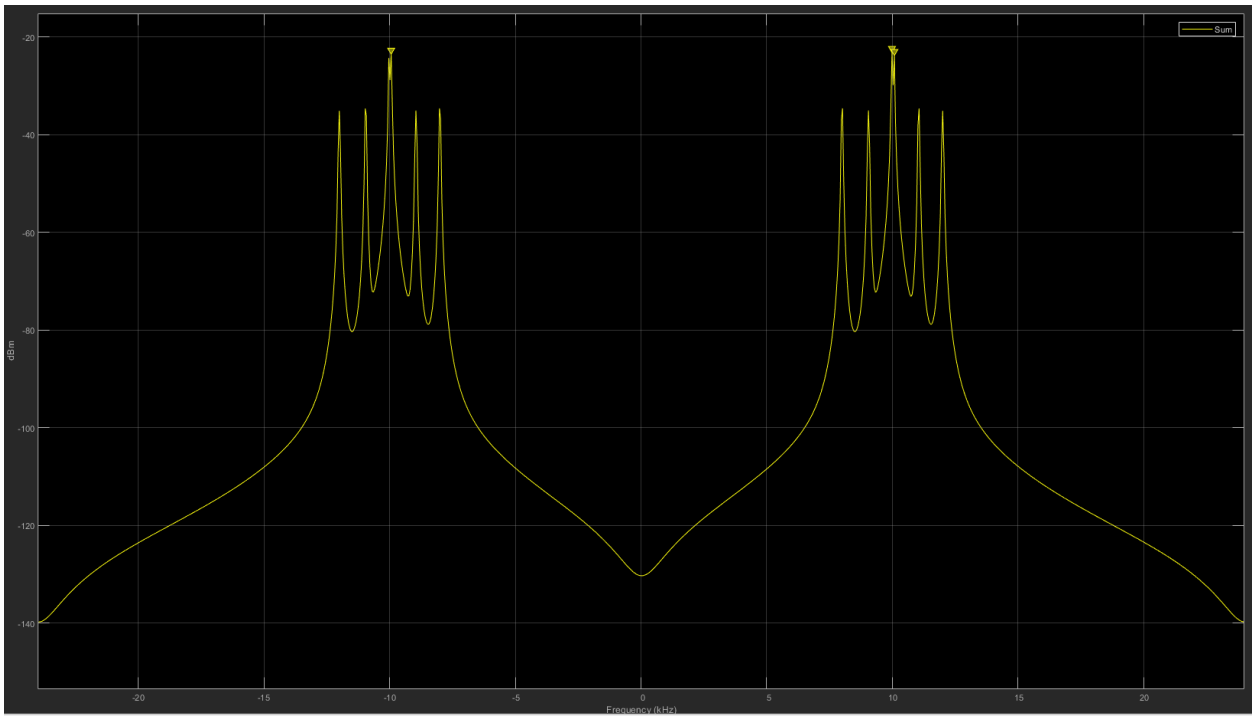
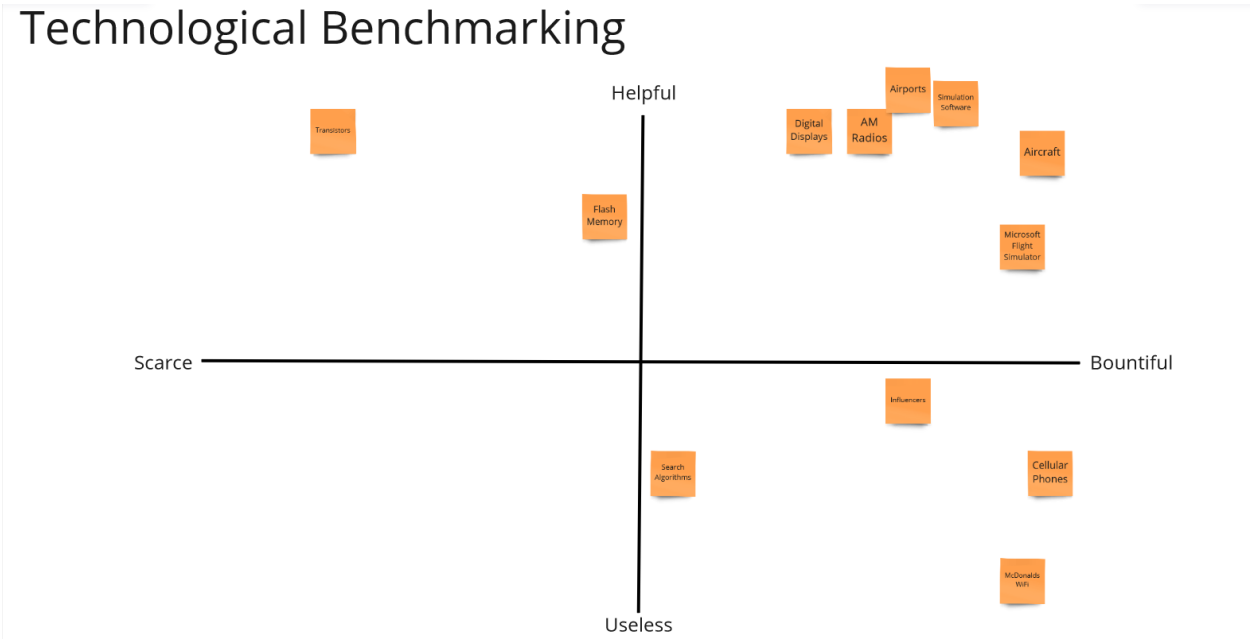


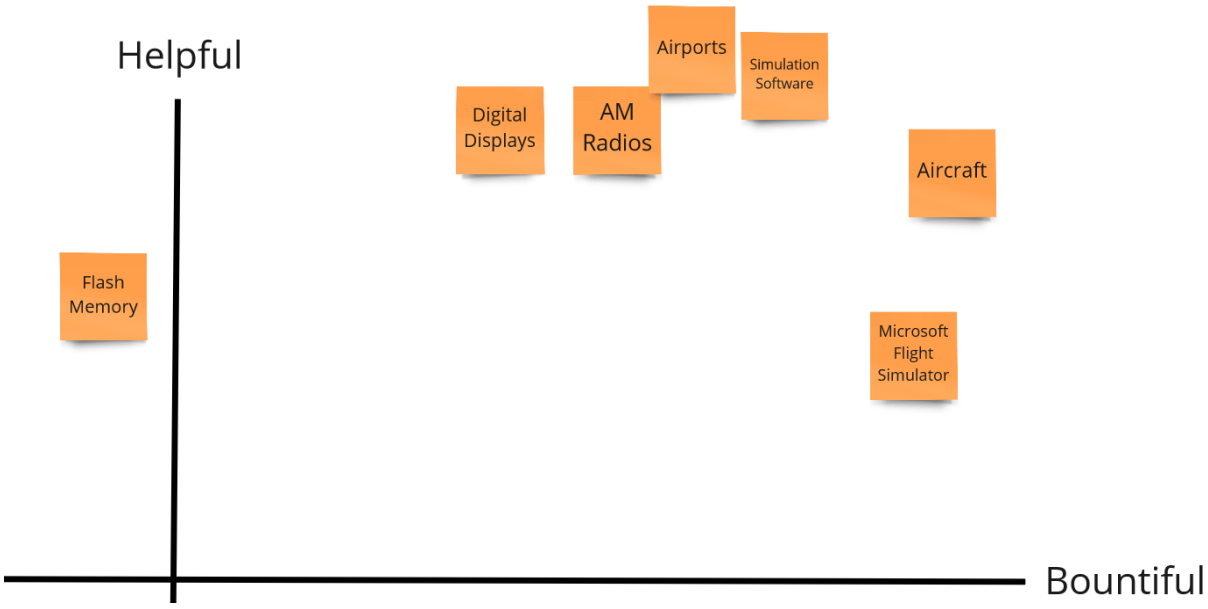
Figure 3:



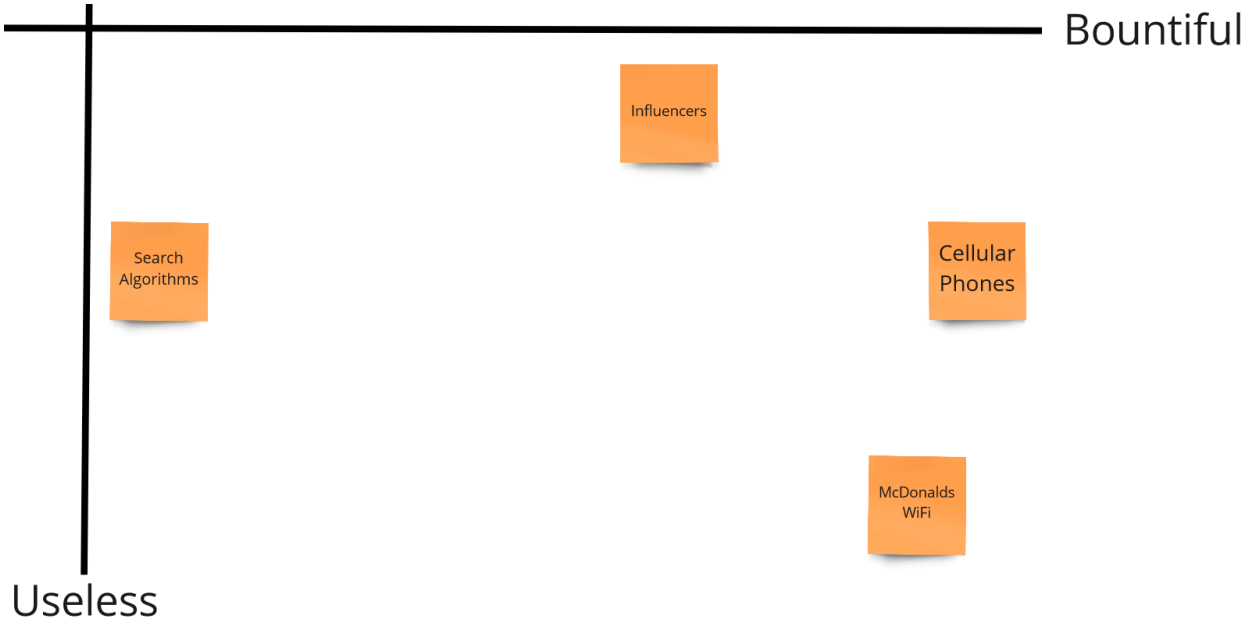
Miro Board



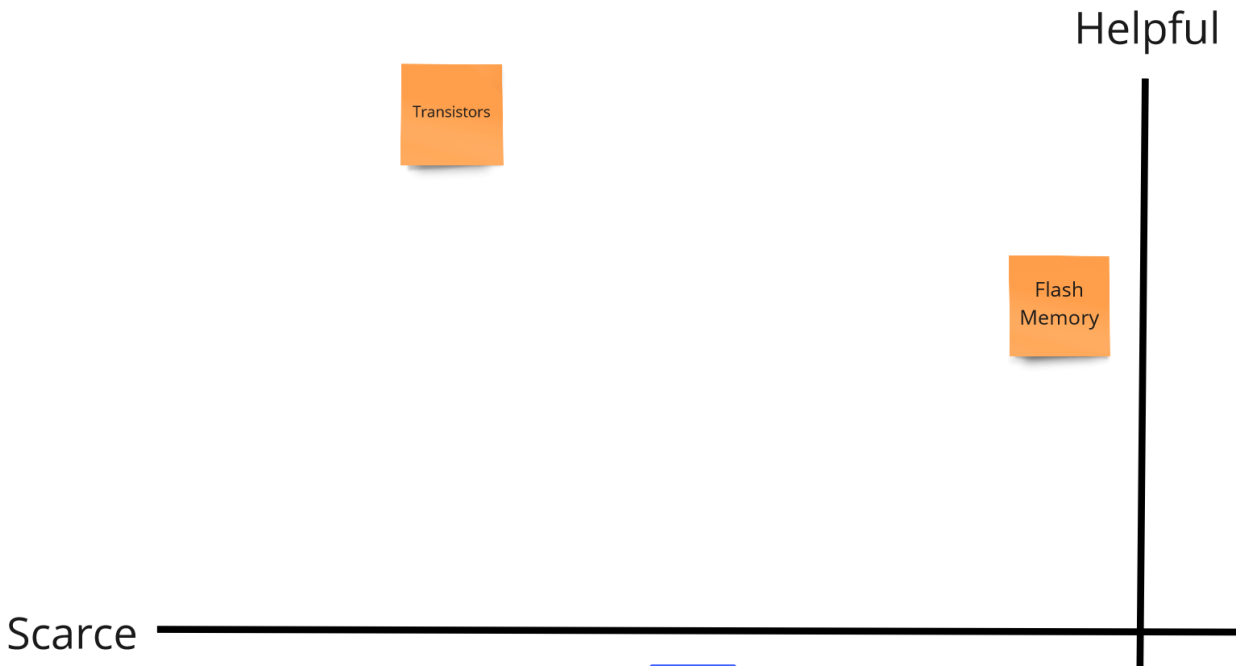
Full Board



Quadrant I



Quadrant IV



Quadrant II

Accomplishments from Previous Week

We created a rough outline of a schedule of target dates and goals for the project. This is a project that will be handed off to a future Senior Design group due to the complexity and time required to fully complete.

Additionally, we were able to familiarize ourselves with MATLAB and Simulink by working on a small system that our client, Collins Aerospace, wanted us to create just as an introduction to the programs. This small system also serves as a way to give us a small part of the conceptual level of SCT and give us a picture of the buildup to the project as a whole.

Finally, we met with Collins Aerospace to get more information on their wants for the project. In this meeting, they gave us additional information to work with signal processing and amplitude modulation (AM). Collins provided us with more info on how to create an AM system in Simulink and more details into an idea of the algorithm design.

Individual Contributions

Team Member	Contributions	Weekly Hours	Total Hours
Hani El-Zein	Further research into descriptives given by client.	2	5
Sullivan Jahnke	Additional Research in SCT, Download and setup of development environment, experimentation within environment, Communication between advisor/client	3	6.5
Tyler Mork	Created Simulink Construct as described by client	4	7
Json Rangel	Additional research into SCT, schedule planning, and experimentation in Simulink for a refresher.	3	6
Austin Rognes	Learning MATLAB, some research about SCT and AM.	2	5

Plans for Next Week

We intend to meet with our faculty adviser, Dr. Andrew Bolstad for additional guidance with the project. He is the *Signals & Systems I* Professor at Iowa State and has knowledge in digital signal processing and communication systems. The meeting will assist us in

Further into our constructed Simulink circuit, we intend to simulate the same circuit function and its corresponding construction through use of Matlab. This will allow for us to develop the syntax skills and familiarization of relevant functions for use in coding the algorithm in the future. The simulink outputs allow for a way to double check our Matlab code.

We also intend to research further into the receiver aspect of radio communications to determine common forms of filtering and their respective designs. From there, we may be able to develop a functional idea of how and where to integrate an algorithm into the process. We plan to brainstorm ideas as a group and then carry them with us into the meeting with Dr. Bolstad for further discussion.