



USING QAM-256 FOR ROBUST TRANSMISSION OF AUDIO FILES

Final Project for Digital Communications by Leonel
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A decorative graphic on the left side of the slide, composed of several overlapping geometric shapes and patterns. It includes a blue triangle with white diagonal lines, a light blue circle, a dark blue square with concentric circles, a dark purple triangle, a bright pink square with white concentric circles, and a grey square with a dark purple triangle and white concentric circles.

AGENDA


Review Objective

System Diagram

Results

Audio Comparison

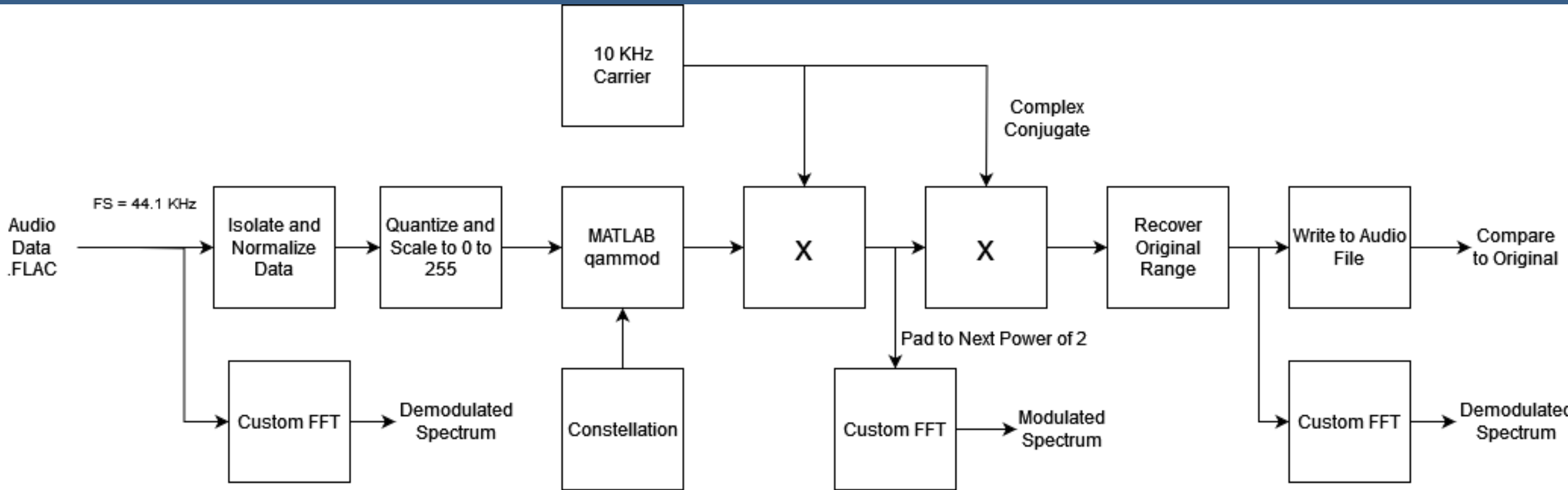
Future Work



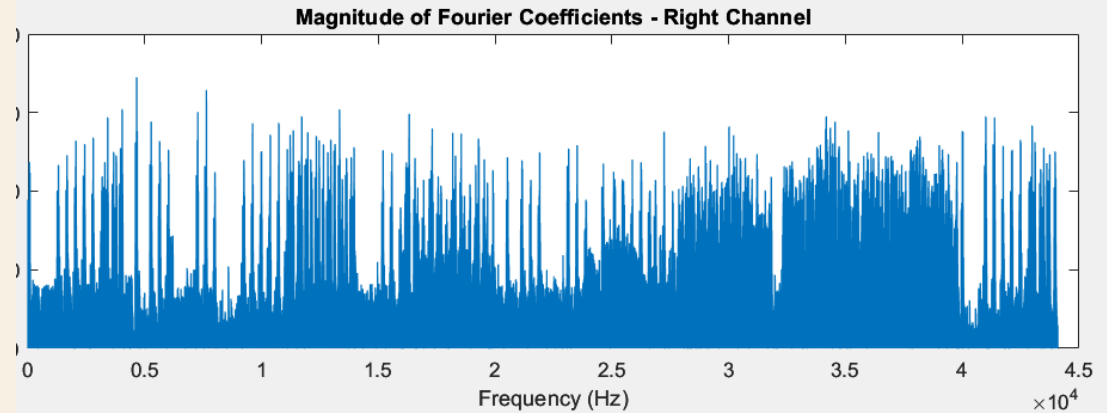
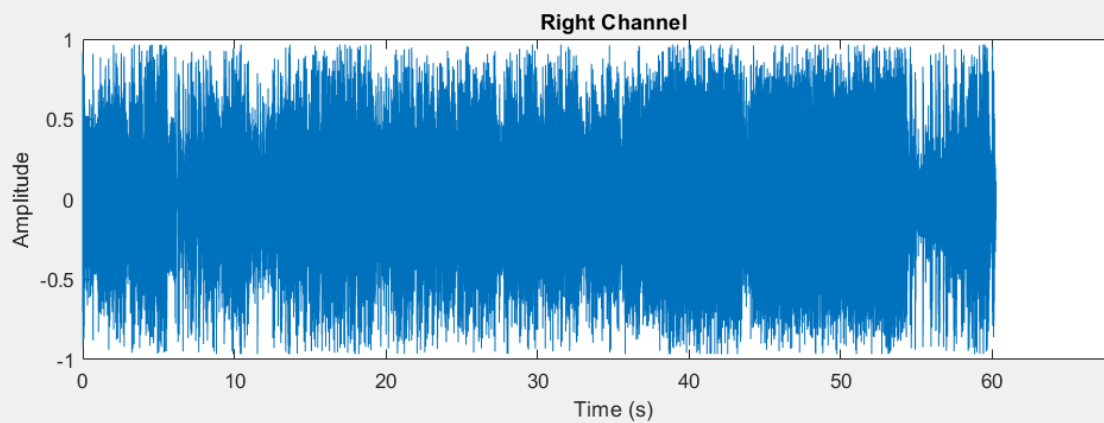
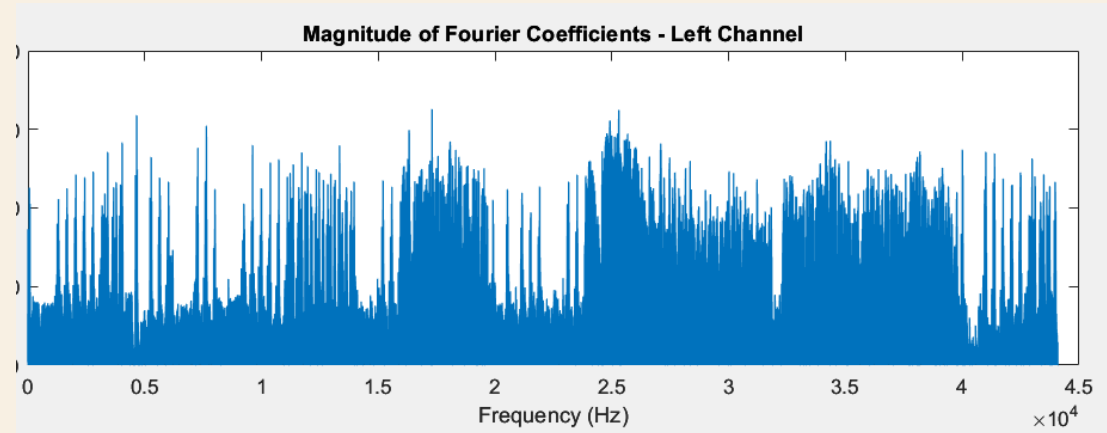
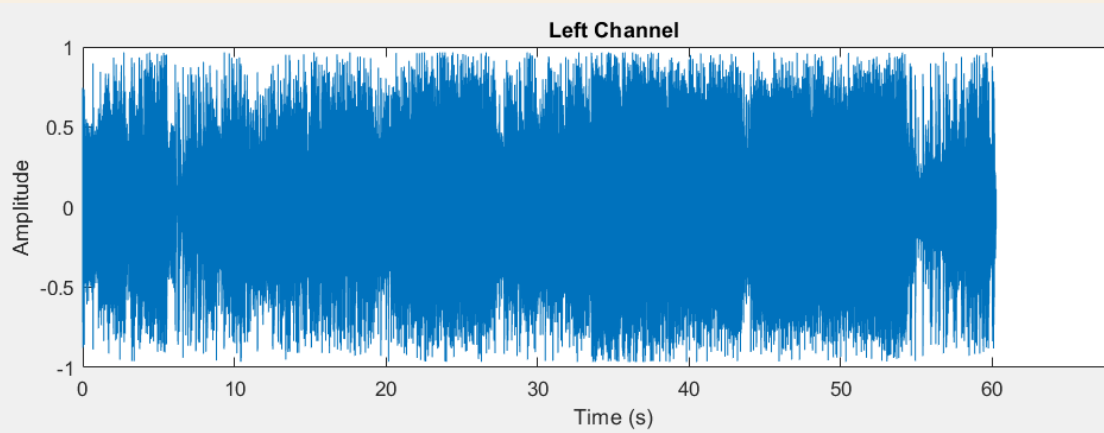
OBJECTIVE: ENCODE, MODULATE, AND DEMODULATE A .FLAC FILE USING QAM-256

Observe differences in frequency spectrums at various points, changes in audio, and robustness of QAM-256

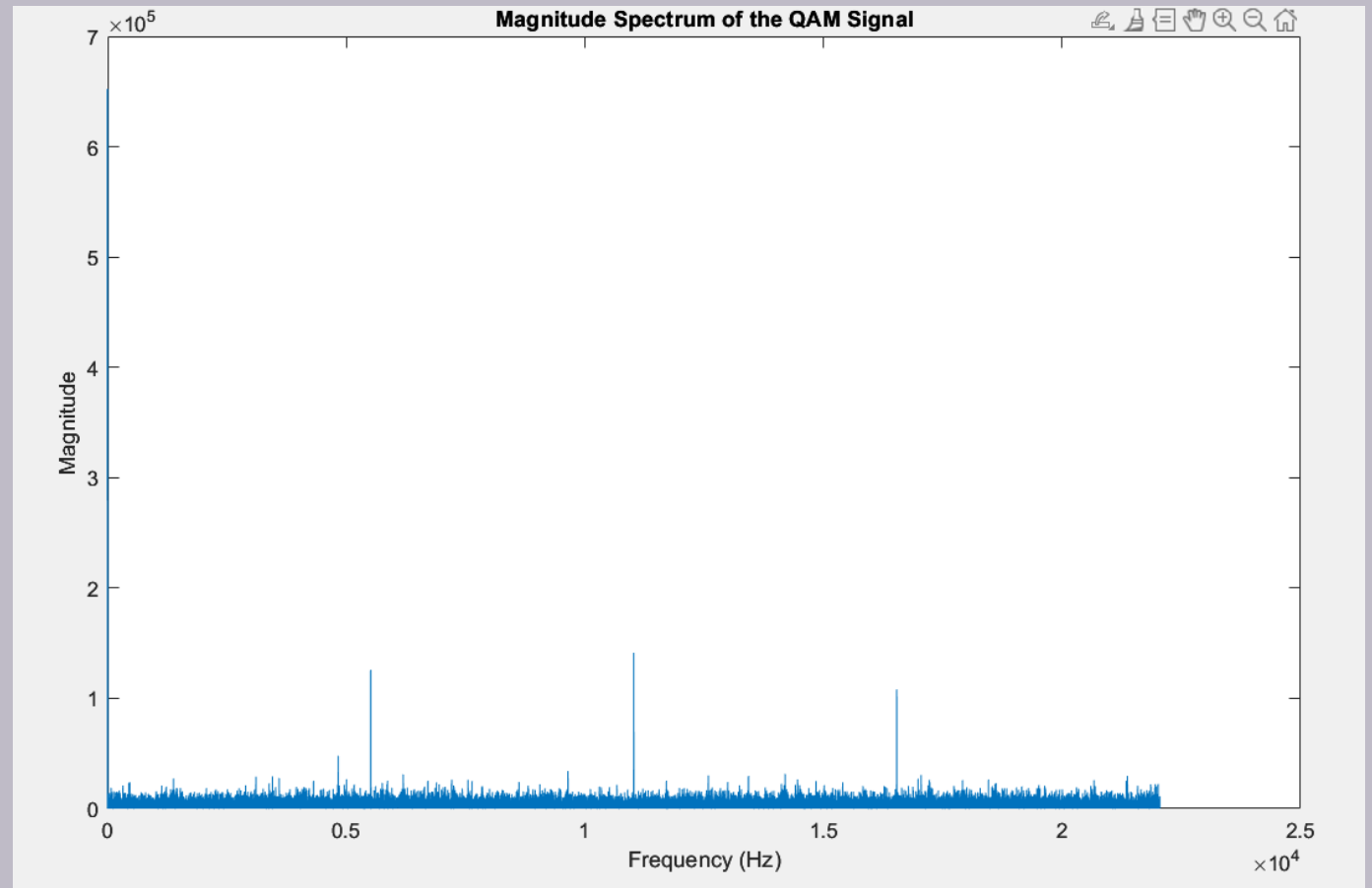
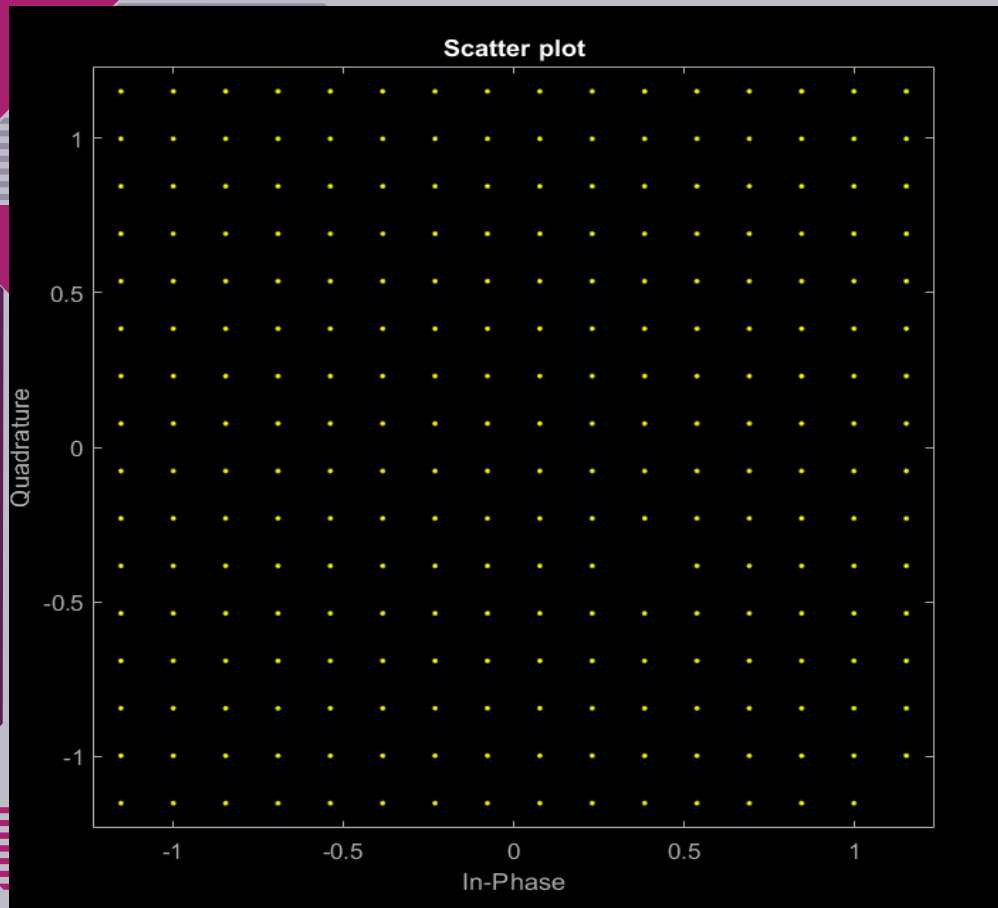
SYSTEM DIAGRAM



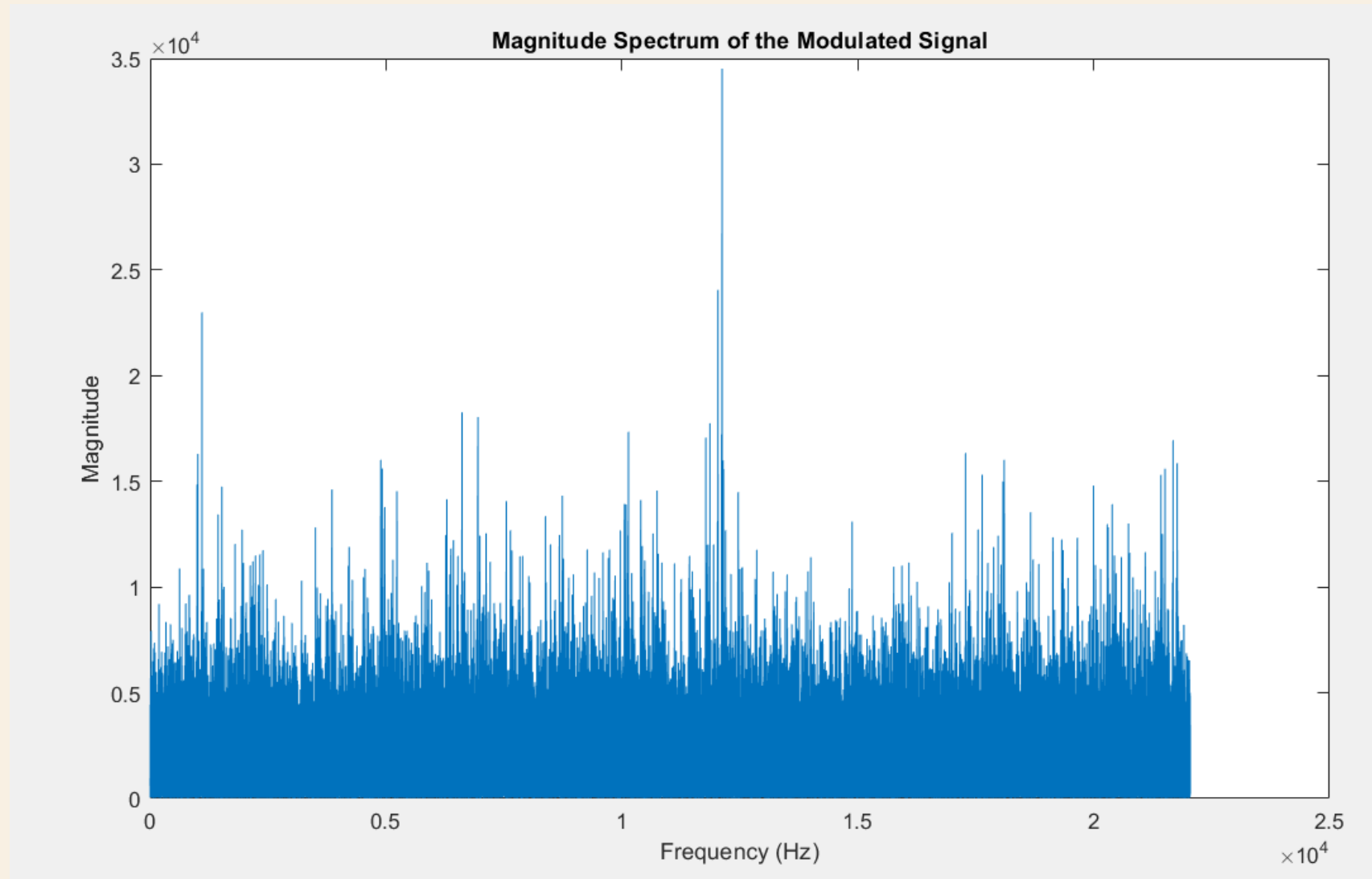
INITIAL TIME DOMAIN SIGNAL AND FREQUENCY SPECTRUM



QAM SPECTRUM AND CONSTELLATION

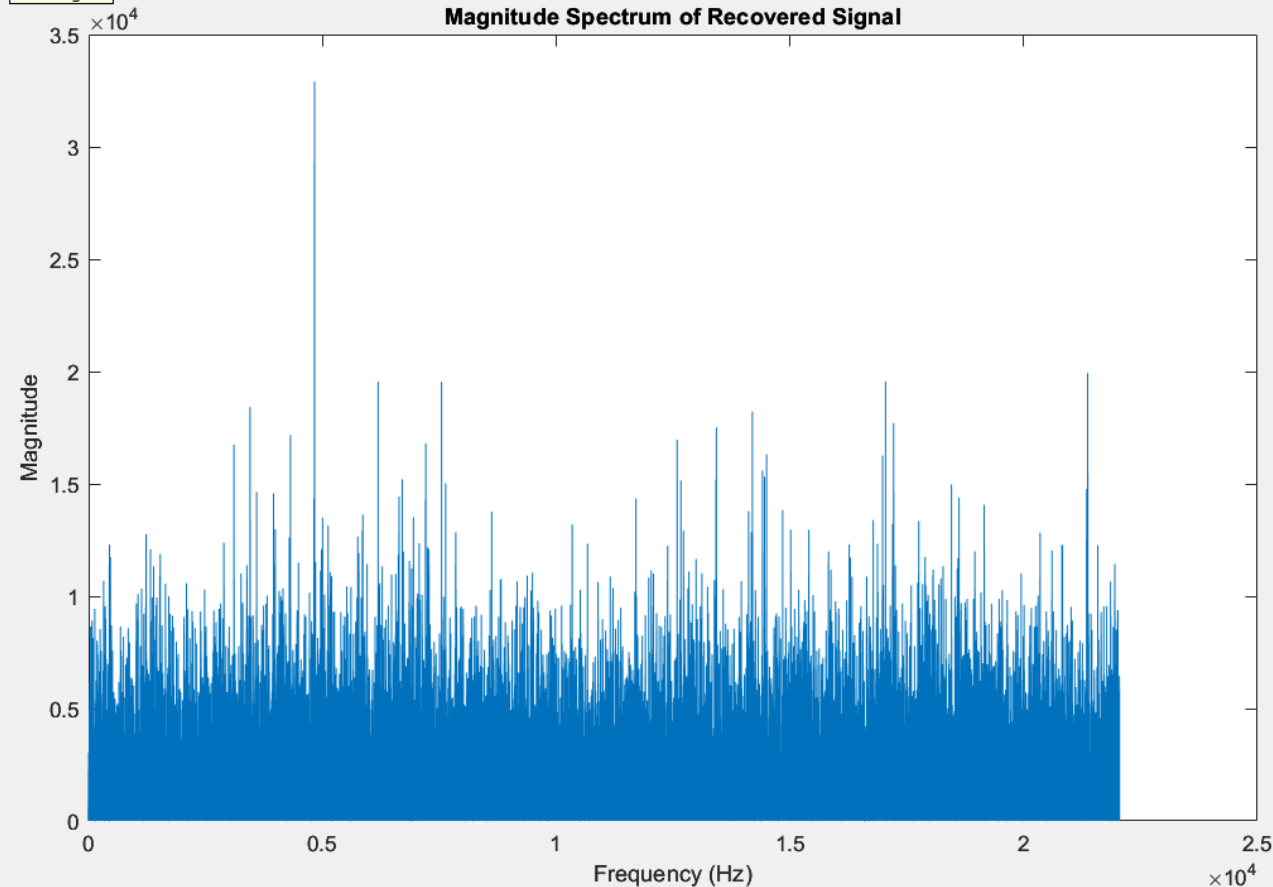


CARRIER MODULATION SPECTRUM



DEMODULATION AND RECOVERY

Print Figure



% Recover the original signal range

```
minValue = min(leftChannel); % Minimum value of the original signal
```

```
maxValue = max(leftChannel); % Maximum value of the original signal
```

```
recoveredSignal = normalizedSignalRecovered * (maxValue - minValue) + minValue;
```


AUDIO COMPARISON

Original Audio



Modulated Audio



Recovered Audio



Bonus Audio!



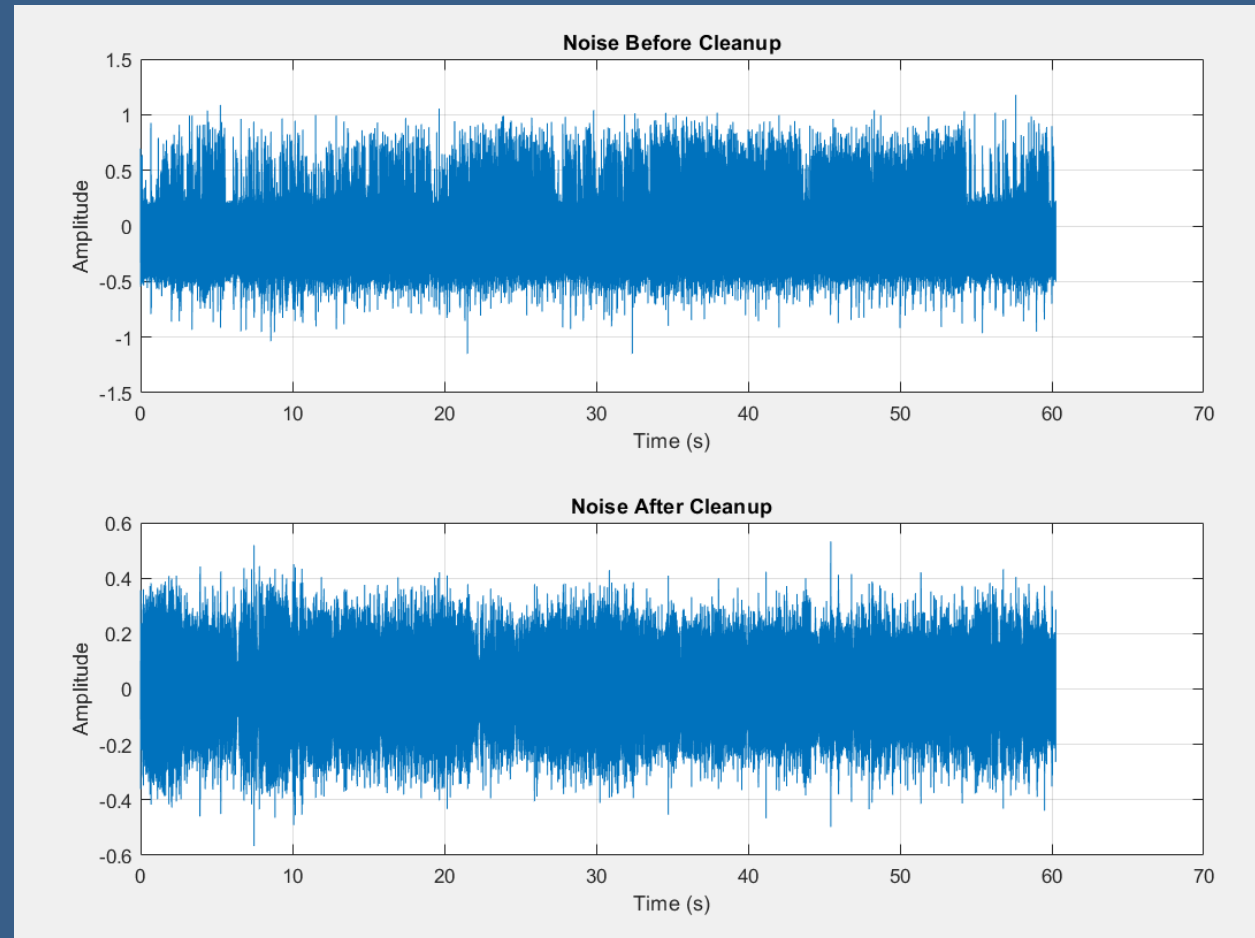
FUTURE WORK

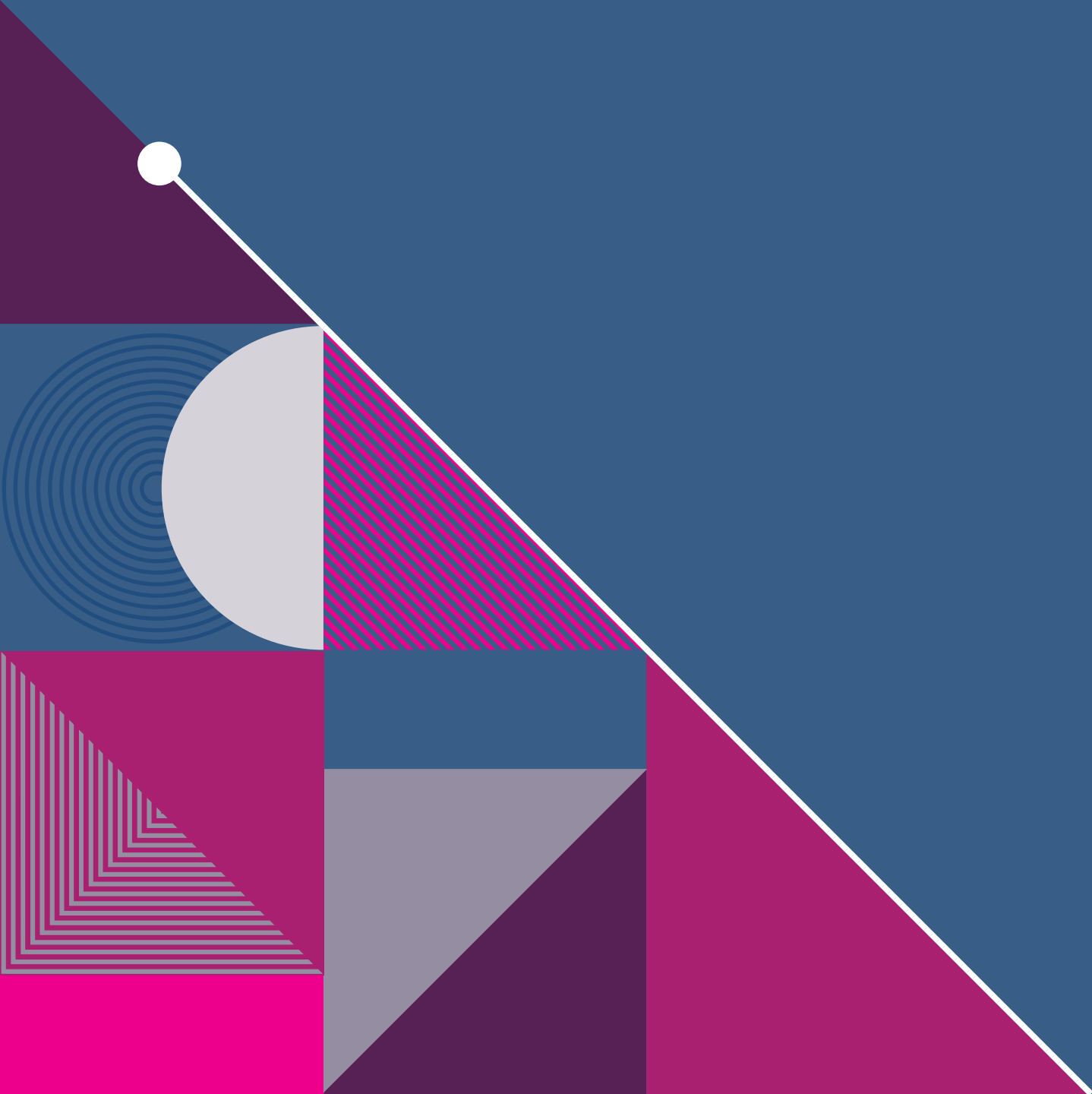
Impacting the recovered signal via noise, was difficult. There was very little effect.

1. Build stand-alone QAM

1. Investigate and implement stronger methods of noise injection

2. Consider Jamming Techniques





FIN!