Communication Theory Homework 2

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Load a short audio clip (either one you record, one from online or one built in to MATLAB) into MATLAB and call this signal $m(t)$. You will explore noise-free AM strategies using $m(t)$ as your message signal. Scale the message so that the maximum, in absolute value, is 1.

1. Plot $m(t)$ in time and its Fourier transform $M(\omega)$ (both amplitude and phase). What is the bandwidth of your message?

2. Generate a carrier signal over the same timespan to be used for DSB-SC AM and DSB AM. There is no one signal that will work here, but try to make it realistic! **Hint**: Think of the sorts of frequencies used in AM radio to come up with a carrier frequency if you are having trouble.

3. Generate the DSB-SC and DSB modulated signals with message $m(t)$ and plot them in the time and frequency domains. In one sentence, describe the difference.

4. Using the same carrier frequency, generate lower SSB and upper SSB AM signals, and plot them in time and frequency.

5. Using the same carrier frequency, create a conventional AM signal (ensure you choose the amplitude of the carrier correctly). Plot this signal in the time domain and frequency domain as well.

6. For the conventional AM signal, do demodulate we rectify and then apply a low-pass filter. In MATLAB, you should be able to rectify the signal in one line. Plot the rectified signal in time and frequency. Then, design a first-order low-pass filter (you decide the cutoff frequency) and apply it to the signal. You can do this using MATLAB filter functions, or through convolution in time/multiplication in frequency directly. Plot the resultant output signal in time and frequency and play the signal as audio.