25.108 Introduction to Engineering
Amplitude Modulation and Demodulation

Objectives: To create in MATLAB a software radio that will implement an AM modulator and demodulator. An additional goal is to provide you with applications of trigonometric identities in MATLAB.

Before entering the laboratory: Attend the lecture or watch the video on Amplitude Modulation

1. Create a 10 second time axis sampling at 10000 Hz (dt =0.0001 second). .
2. Create a 1000 Hz sinusoid , z, using the time axis. Plot (t,z) but plot only a few cycles of the carrier (a few hundred points). Call this waveform z.
3. Use the spectrum analyzer function to plot the spectrum of the carrier.
4. Create a second waveform which is a sinusoid of 100 Hz, using the same time axis. Plot a few cycles of it and listen to it on your sound card. Use the spectrum analyzer function to plot the spectrum of the modulating waveform. Call this waveform (sin1)
5. On a point-by-point basis multiply (1+sin1)*z to form an AM/ signal with modulation index 100%. Plot this. Zoom in and look at over several cycles of the modulating signal (first 300 points)
6. Using your spectrum analyzer as explained in class, observe what the AM modulated signal looks like. Use the expansion tool to expand the waveform around 1000 Hz. Note there are 3 components. One at the carrier frequency and one each at 1000-100 and 1000+100 Hz. These are the sidebands.
7. Use the Data Cursor, to measure the heights of the 3 components. Note that the two sidebands should be down by approximately 6 dB from the center carrier.

Now lets recover your signal two ways (coherently and non-coherently) First we will do it coherently.

8. .Multiply the modulated waveform by the vector containing the carrier.
    a. Plot the first few hundred points and look at it
9. Look at this intermediate form on your spectrum analyzer.
10. Low pass filter with pass band 200 Hz and cutoff at 300 Hz.
    a. Plot this waveform and compare to your original waveform. (you must start your plot at about point 1000 to get rid of transitory behavior)
    b. Listen to this on your sound card.

Envelope detection, just like in most radios

11. An envelope detector is a simple device consisting of a diode (ideal) and a low pass filter. Take your modulated waveform and form abs(x).
    a. plot a few cycles of this just like in the previous example
    b. Look at this intermediate form on your spectrum analyzer
12. Use the same low pass filter to filter the waveform until you recover the original waveform.
    a. Play it on the sound card.
    b. Look at in the time domain (starting at point 1000)
    c.