**ECE 3512: SignalS – Continuous and Discrete**

# Recitation No. 5: Fourier Transform Properties

In this laboratory we will demonstrate several properties of the Fourier Transform. We will use three simple signals to demonstrate these concepts:

1. 



1. 
2. 
3. The audio signal located here:

<http://www.isip.piconepress.com/courses/temple/ece_3512/recitation/2014_fall/rec_01/rec_01_speech.raw>

We will not explicitly require the use of MATLAB though we encourage its use. We will focus on results.

The tasks to be accomplished in this lab are:

1. For signals nos. 1-4, plot the magnitude spectra and compare your results. Justify the shapes that you see and any differences that you observe.
2. For signals nos. 1-3, time delay the signal by 0.0025 secs and plot the magnitude and phase spectra. Explain what you observe and whether this matches what the Time Delay Theorem predicts. Support your answers with theoretical results (e.g., apply the theorem).
3. For signals nos. 1-4, compute the derivative of the signal and the Fourier Transform of the derivative of the signal. Plot the magnitude spectrum and justify what you observe.
4. Multiply signal no. 1 by a 500 Hz sinewave and plot the magnitude spectrum of the resulting signal. Explain what you observe.
5. For signal no. 2, demonstrate that Parseval’s Theorem holds (e.g, you can compute energy in the time domain or the frequency domain and get the same result).
6. For signal no. 5, locate a section of the signal where the amplitude is highest. Plot the magnitude spectrum by selecting 256 samples of the signal and computing the discrete Fourier Transform (use a MATLAB function for this). Repeat this for a portion of the signal where the energy is low and the speaker is articulating a noise-like sound (e.g., “s”). Explain why these two spectra are so different. Now refer back to the spectrogram plot we did earlier in the semester. How would you go about recognizing what sound was spoken from the spectrogram?