**ECE 3522: Stochastic Processes in Signals and Systems**

# Computer Assignment (CA) No. 5: COVariance and COrrelation

The goal of this assignment is to introduce you to covariance and correlation calculations. For this task, we will only use the audio signal, which you will recall was sampled at 8000 Hz.

The tasks to be accomplished are:

1. Define a vector, **x**, of length 240 (30 msec) that contains the 240 samples of the signal starting at t = 0.9 secs. Define a second vector, **y**, which also represents 240 samples, but consists of samples shifted by k samples (e.g., k = 1 implies **y** starts one sample later than **x**). Plot the statistical correlation between **x** and **y** for k = 0, 1, ..., 512. Can you explain what you observe? (Hint: think about what would happen if the signal were a sinewave.)

Repeat this for t = 3.0 secs. Compare the two functions and relate them to properties of the audio signal.

The function you are plotting is known as the autocorrelation function. It is a minimum phase version of the actual signal. You can learn more about that in a course on digital signal processing.

1. Again, start at t = 0.9 secs. Take the first 16 samples as a vector: **x** = [x1 x2 x3 ... x16]. Compute the covariance matrix using 240 samples. Each element in the matrix is governed by the equation:



where i is defined over the range [0, 15] and j is defined over the range [0, 15]. Do this for t = 1.1 secs and t = 3.0 secs. Compare the two matrixes and explain why they are different.

Correlation and covariance form the basis for most statistical modeling algorithms, including regression.