Assignment 4

Digital Signals Analysis and Applications - IEC239
Deadline at 11:55pm on 13th April, 2017

- **All questions are compulsory. Follow the instructions carefully.**
- **If copy cases are found, a zero will be given for this assignment.**
- **Do NOT hard code any of the paramameters.**

Problem 1

Write a MATLAB script to compute the spectrogram of a given audio file. Use window size and the length of the stride as the input to your function. Test your code on the in built laughter and train audio files in matlab [load laughter; sound(y) or load train; sound(y)]. Compare your results with the inbuilt spectrogram function in matlab. (Hint: Explore colormap). Prepare a short report on the implementation.

Problem 2

Consider a straight road of 100m with a car at x = -50. After 6s the car will be at x = 50. You are standing at x = 0 from t = 0s to t = 6s. The car horn emits a frequency of 400Hz. Take the sampling rate to be 8000 samples/sec. Using the formula for signal at x = 0:

$$Y = \frac{1}{d[t]} cos(w[t] * t) \tag{1}$$

where *d[t]* is the distance at time = t seconds and *w[t]* is the apparent frequency in radians/s; construct the sound wave that will be heard by you (the observer). **The final sound should be an audiofile saved using *wavwrite/audiowrite*** The final audio wav file must be included in submission zip.

Problem 3

Compression is a throuoghly investigated field in Digital Signal Analysis. We explore a new way to compress images- By removing the unneccesary eigenvectors.
Suppose you are given an image **Im** and you have to calculate its eigenvalues by the equation $\mathbf{ImV} = \lambda\mathbf{V}$ where λ is a diagonal matrix.

Reconstructing would be multiplying both sides by $\mathbf{V}^{-1}$ (Or however you write inverse).
A) Reconstruct the image back zeroing out different percentages of eigenvalues.
B) Deleting which eigenvalues help?
C) How much compression ratio can be achieved? (What percent of the matrix can be made zero before causing noticable degradation of the image?)

Apply this to >5 grayscale images of your choice. Try to capture as much variation as possible from full grayscale images to simple shapes, backgrounds. Write a report with observations and conclusions.