Assignment 2

Digital Signals Analysis and Applications - IEC239
Deadline at 11:55pm on 7th March, 2018

- **All questions are compulsory. Follow the instructions carefully.**
- **All coding questions have to be done in MATLAB only.**
- **Ensure that submitted assignment is your original work. Please do not copy any part from any source including your friends, seniors and/or the internet. If any such attempt is caught then serious action will be taken.**
- **The submission - Roll_number.zip - should contain the below files in the directory roll_number with only 7 files : q1.m, q2.m, q3.m,q4.m, q5.m, q6.m, Report.pdf**
- **Report should contain details of algorithm implementation, results and observations and answers to the subjective questions(if any).**
- You are expected to use **vector operations** in all your matlab codes.

Problem 1

Implement 2D Fast Fourier Transform (Recursive Formulation).
In report pick any 3 images and show the output generated from your code and in-built function.

Problem 2

Standard two tone telephones play sinusoids at two different frequencies every time a key is pressed. This is to help visually impaired people dial numbers on standard telephones.

In this problem, you are given a file **q2.mat** with signal X and the sampling frequency, Fs. The signal consists of the sound played by a particular key of a two tone telephone. Your task is to find out the frequencies of this particular key, and clean the noisy signal as best as you can.

Please write a detailed report for this question, complete with the methods, choices(if any) and calculations you made for this task.

Problem 3

Write a matlab function to compute the spectrogram of a given audio file. (Use window size and the length of the stride as the input to your function.)

Write your observations by varying the window size and length of the stride in the report.

Test your code on the in built laughter and train audio files in matlab [load laughter; sound(y), load train; sound(y)]. Compare your results with the inbuilt spectrogram function in matlab.

Problem 4

Write your observations on doing FFT over the images Img1a.png,Img1b.png,Img2a.png,Img2b.png in the report.
Also write a MATLAB code to remove noise from Img3.png.

Problem 5

Youve just spotted the most wanted fugitive from the FBIs most wanted list. She is at a phone booth and has pressed a few numbers on the phones keypad. Youve tampered with the phonebooth and have an audio recording of the numbers that she has dialed. Help the FBI in chasing her partner down by identifying which numbers she has dialed. Note that all the numbers have been pressed for the same duration. Write a function with following definition:

$$function\ [\ number\ ]\ =\ Eavesdrop\ (\ audio\ filename\ )$$

This function should take in an audio file and return the number dialed. For example:

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>> Eavesdrop(Police.ogg);
100
```

Youve been given the audio files for the sounds of the individual dial tones.

Problem 6

Ishan is interested in hacking. He wants to decrypt the encrypted voice signals he is eavesdropping on a phone line. A signal is encrypted as follows. Let the frequency domain be x-y. The frequency domain is divided equally into n parts and then rearrange according to a key. For eg:- Consider n=3, x=10,y=18 then A=10-12,B=13-15,C=16-18. Original Signal has frequency domain ABC. But now we reconstruct the signal according to frequency domain CAB. The reconstructed signal is the encrypted message. Since Ishan was unable to decrypt the messages he came to you for decrypting the messages. He eavesdropped on 3 messages. Each message as different key but same n=4 (No of sub-frequency domains). Can you decrypt the messages and help Ishan.(Hint :- Each message is a meaningful statement. You can use brute force approach. Any other approach is welcomed.) Messages are given in the zip file named as message1.wav,message2.wav,message3.wav.