

Signal Processing 2017

Projects

1. Biomedical signal denoising (ECG, EEG, EMG etc.)

The purpose of this project is a denoise of some biomedical signal (like ECG, EEG, EMG and others)[1].

To get sample of these signal you can use a "PhysioBank database". It's available on <https://www.physionet.org/physiobank/>. physiobank is a large dataset on biomedical signals. Choose one or more case (ex. normal ECG signal) and try denoising it's.

To import sample into Matlab you will need a *WFDB toolbox*. It's available on Physionet web page.

[1] Alternatively you can assume that the noise is caused by 50Hz power line interference.

2. Equalizer for audio signals.

Equalization is the process of adjusting the balance between [frequency](#) components within an electronic [signal](#). Equalizer consists of set of band-pass filters and signal multiplier circuits. The purpose of this project is develop on Matlab (or other software) a simple audio equalizer.

3. Background noise reduction.

The objective of the project is to design a digital filter that could be used to reduce a noise in audio signal.

In most cases the background noise present in audio recordings can be approximated as a white noise[2]. White noise refers to a statistical noise model that has a more or less constant power at all frequencies.

[2] Alternatively you can assume that the noise is caused by 50Hz power line interference.

4. Vocal Removal / Vocal Isolation

The objective of the project is to design a digital filter that could be used to get rid of any vocals present in the audio file while retaining as much as possible of the instrumental part (a.k.a. the Karaoke effect).

Perform the FFT and analyse the spectrum of each file / signal sample. Consider what frequencies are necessary to convey the sounds of a human voice. To fully complete this project redesign your filter so that it would be capable of getting rid of any voice present in the audio file based on the information about what frequencies are necessary to convey / suppress the sounds of a human voice only.

5. Step counter

The main purpose of this is create an algorithm for step count. The source of signal is free (it's could be a smartphone or whatever source from internet).

Paper [2] presents a method for counting the number of steps taken by a user, while walking at any variable speed, using smartphone-based accelerometer.

[2] N. Z. Naqvi, A. Kumar, A. Chauhan, and K. Sahni, "Step counting using smartphone-based accelerometer," International Journal on Computer Science & Engineering, vol. 4, p. 675, May 2012. Published online: <http://www.enggjournals.com/ijcse/doc/IJCSE12-04-05-266.pdf> [Retrieved 2014-10-11].

6. Remove of periodic noise from 2D images.

Periodic noise on images is a special type of noise. Usually It has a form (light or dark) of lines / curves. The example of different periodic noise you can see on fig. 1.

There are two important parameters of periodic noise: frequency (period / distance between curves) and direction. Both could be easy to find on 2D FFT image.

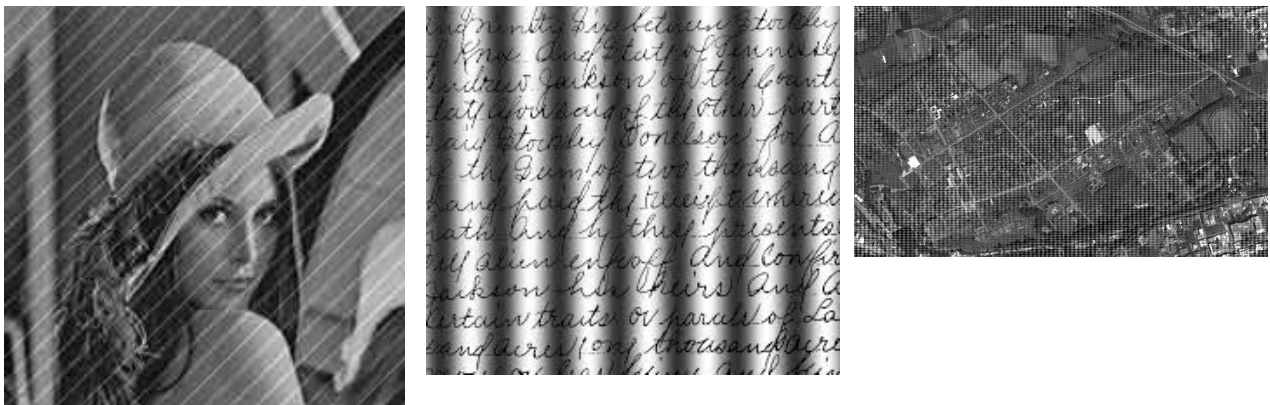


Fig 1: Example of periodic noise.

Fig. 2 present a example of power spectrum (result of 2D FFT) for image with contain a periodic noise. Bright points are corresponding to periot noise. Try figure out how this type of noise could be removed from image.

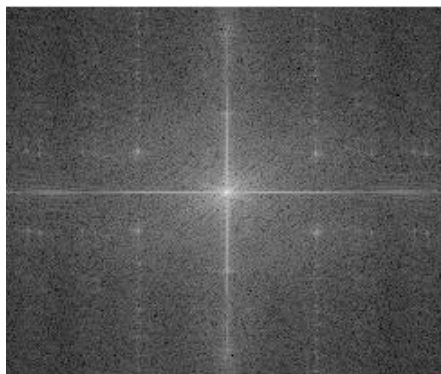


Fig 2. Example of power spectrum.