

ELL720: Advanced Digital Signal Processing

Design Problem 2

Due date: 19th March 2023

18th February 2023

Pitch Detection

Pitch detection refers to determining the pitch or fundamental frequency of a signal, usually a digital recording of speech or musical note, which is very important for many speech processing applications. For example, sound-editing softwares often include pitch estimation routines that are used for pitch-shifting and time-scaling operations. Some speech recognition systems use pitch tracking for tone recognition.

A variety of algorithms exist for pitch detection which can be broadly classified into:

- Time domain detection: autocorrelation method, maximum likelihood method, average magnitude difference function method, and
- Frequency domain detection: cepstral method, harmonic product spectrum method, maximum likelihood method.

In this assignment you will evaluate the efficacy of two of the above methods:

- Choose one time domain and one frequency domain method for pitch detection (from the above list) and implement them using Matlab (or other software). Compare the two methods for pitch detection.
- You can use the speech samples provided here: http://privateweb.iitd.ac.in/~seshan/speech_samples.rar to test your implementation of the pitch detection algorithms. This folder contains four speech samples and for two of these samples (**s1.wav** and **s2.wav**) the corresponding pitch estimates (in Hz), for every 10 msec of the speech segment, are provided in the MAT-files (**p1.mat** and **p2.mat**), respectively. A zero value indicates that the speech segment is unvoiced (or silence), and a non-zero value is the pitch frequency (in Hz) when the segment is voiced.
- Determine the pitch estimates (in Hz) for the speech samples **s3.wav** and **s4.wav**, and plot the pitch tracking results. Compare the performance of the two pitch detection methods.

You should prepare a report, giving a brief description of the algorithms you have implemented, compiling all your results and your interpretation of them, along with your overall conclusions. In particular, you should attempt to answer all of the questions posed above. Any graphs or other visualisations should also be included in the report.