Speech Signal Processing
EC5.408

Assignment 3

Sep 6, 2023

Guidelines

- Do not copy or plagiarise. If you're caught for plagiarism, the penalty will range from **zero** in the assignment to **F** grade in the course.
- Cite your sources (be it images, papers or existing libraries) when necessary.
- Mention clearly if any assumptions are being considered.
- Only MATLAB or Python can be used for the coding part.
- Theory answers (in report) should be typed unless mentioned otherwise.

Submission Format

Make a directory using the naming format **SSP_A3_RollNo**. The submission might include codes **(.py/.m)** to answer the coding problems, reports **(.pdf)** to answer and plot the theory questions or notebooks **(.ipynb)** to answer both coding and theory questions together. Place the files in their respective folders and zip the main directory using the naming format **SSP_A3_RollNo.zip** and upload this zip file to Moodle.

This is how the final directory structure might look like

```
SSP_A3_RollNo
├── codes
│   ├── code_1.py
│   ├── code_2.ipynb
│   └── code_3.m
├── reports
│   ├── report_1.pdf
│   └── report_3_4.pdf
└── wavs
    ├── audio_1.wav
    └── audio_3.wav
```

Questions

[Maximum marks: 17]

1. Explain briefly about the following **[5]**
   (a) UBM [1]
   (b) LP Residue [1]
   (c) Spectral Subtraction [1]
   (d) Mel Filter bank [1]
   (e) Cepstrum [1]
2. Record your name, compute MFCC on the frame level. Then take the first 13 coefficients of each frame and plot it. Comment on the plots. **[4]**
3. Using the given audio file, do the following, **[8]**

   First, choose a voiced region from the audio and create a voiced frame using a Hamming window of length 512
   (a) Compute the auto-correlation of the frame and plot it. [2]
   (b) Compute the magnitude spectrum of the frame and plot it. [2]
   (c) Compute the LP spectrum of the frame and plot it. [2]
   (d) Estimate **pitch** using the above three methods. Which method provides a better **pitch** estimation? [2]

NOTE: The report can be one (or separate, your preference) **PDF** with all the theory answers and plots or you can also chose to do the entire assignment in one python notebook **(.ipynb)** by answering theory in markdown and code directly in it.