Speech Signal Processing (EC5.408)

Assignment 3

February 7th, 2025 - February 20th, 2025

Guidelines

- Do not copy or plagiarise. If you're caught for plagiarism, the penalty will range from zero in the assignment to an F grade in the course.
- Always cite your sources (be it images, papers, or existing libraries).
- Mention clearly if any assumptions are being considered.
- Only MATLAB or Python can be used for the coding part.
- For this assignment, you might use Audacity or Wavesurfer software.

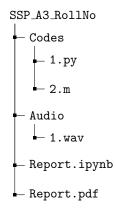
Submission Format

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 the theory questions.
- 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.

Example Directory Structure



Questions:

(a) Briefly explain the following concepts:

- LP Residue
- Spectral Subtraction
- Mel Filter Bank
- Cepstrum

(b) MFCC Extraction and Analysis:

- Record your name as a speech signal.
- Compute the Mel Frequency Cepstral Coefficients (MFCC) at the frame level using any speech processing library.
- Extract the first 13 MFCC coefficients for each frame and plot them.
- Comment on the plots and the variations observed.

(c) Speech Prosody Analysis:

- Define speech prosody and explain its importance.
- Record the following sentence with four different emotions of your choice:

"I can't believe I won the last slice of pizza!"

• Extract the pitch contour for each recording using Praat software and comment on the pitch variation across different emotions.

(d) Pitch Estimation and Analysis:

- Using the given audio file, select a voiced region and create a voiced frame using a Hamming window of length 512.
- Perform the following tasks on the voiced frame:
 - (a) Compute and plot the auto-correlation of the frame.
 - (b) Compute and plot the magnitude spectrum of the frame.
 - (c) Compute and plot the Linear Prediction (LP) spectrum of the frame.
 - (d) Estimate the pitch using the above three methods and compare the results. Discuss which method provides a better pitch estimation and why.

—— End of Assignment ——