

## EE-414 Speech Processing Lab

### Lab-9

#### AIM

- To compute LP coefficients and LP residual of a given speech signal.
- To compute the formant parameters by LP analysis.
- To compute the excitation parameters like pitch by LP analysis.
- To compute the normalized error curves for voiced and unvoiced segments of speech.

#### PROBLEM STATEMENT

Record (16kHz, 16bit) the word “**speech signal**”; truncate long silence regions.

- A. Estimating Linear Prediction (LP) coefficients from the speech.
  - a. Select a frame (25 ms long) at the center of a voiced segment. Estimate the LPCs of the segment using the autocorrelation method.
- B. Computing LP residual
  - a. Using the computed LPCs, derive the LP residual signal.
- C. Pitch estimation from LP residual:
  - a. Estimate the pitch from the estimated LP residual using autocorrelation.
- D. Formant estimation from LP spectrum:
  - a. Explain, step by step, the procedure of computing the LP spectrum from LPCs.
  - b. Demonstrate the same on the voiced frame selected above.
- E. Normalized Error
  - a. Select the 25ms frame at the center of the voiced and unvoiced frame respectively. Compute the normalized LP residual error as a function of the order of LP prediction. Plot normalized error curve against the prediction order for both voiced and unvoiced frames
  - b. Comment upon the choice of optimal prediction order for the segments.

#### SUBMISSION

- Submit a single pdf file, consisting of the following for each problem:
  - Theory
  - Procedure to carry out the experiment
  - Code (Matlab/Python)

- Plots of the signal in the time domain and the magnitude spectrum.
- Observations/Explanations wherever asked.

### **SUBMISSION FORMAT**

- Submit a single pdf file, having the name as your roll number, Eg: **170010037.pdf** OR Submit a single zip with name as your roll number (**Eg: 170010037.zip**) containing the report and the codes. Note: Don't create a zip of the files directly. Submit the zip of a folder containing the files.

**DEADLINE: 5:00 PM 28/03/2021**