EE-414 Speech Processing Lab
Lab-7

AIM

- To understand the limitation of DTFT for the spectral analysis of speech.
- To understand the development of short-term Fourier transform (STFT) representation.
- To understand the difference in the nature of linear and log magnitude spectra.
- To understand the difference among the spectra of voiced, unvoiced and silence regions of speech.
- To plot the STFT of a speech signal.
- To understand the difference between true and convolved spectra.
- To understand the effect of rectangular, Hamming and Hanning window functions on short term spectral analysis.
- To understand the effect of frame size on short term spectral analysis

PROBLEM STATEMENT

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

A. DTFT of and its limitation:
    a. Plot the linear and log magnitude spectrum for the entire speech.
    b. Plot log-magnitude spectrum of voiced, unvoiced and silence regions in the recorded speech and explain the difference between log-spectrum of all three cases.
    c. Comment on the limitation of DTFT.
B. Need for Short Time Fourier Transform(STFT):
    a. How can you solve the above problem using STFT? Plot the STFT of one speech frame at the centre of above three regions. Write your observations.
C. Concept of true and convolved spectra:
    a. Create a sine wave of 200Hz and compute DTFT of the whole signal. Now also compute the STFT by taking a 20-30ms short term segment of the sine wave. Explain your observation and difference between the true and convolved spectrum.
D. Effect of windowing function and window size on short term spectral analysis:
    a. Plot short term log magnitude spectra of a 30 ms voiced speech segment using a rectangular, hamming and hanning window functions. Compare and write your observations in all the three cases.

b. Plot a short term log magnitude spectra of the voiced segment using a frame size of 3 ms, 30 ms and 300 ms. Compare and write your observations in all the three cases.

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 14/03/2021