EE-414 Speech Processing Lab
Lab-3
24/01/2021

AIM
- To identify optimal sampling frequency for speech signal processing.
- To identify optimal bit resolution for speech signal processing.
- To understand the significance of telephone bandwidth.
- To understand the difference between narrowband and wideband speech.

PROBLEM STATEMENT
Note plot log magnitude along the y-axis of the spectrum.
  A. Study of Sampling Frequency
      a. Record the word **'Speech'** using a sampling frequency of **44.1kHz** save it in a .wav file. Plot the complete speech signal and the frequency spectrum for different sounds.
      b. Resample the above speech signal to **16kHz** and plot the complete speech signal along with the frequency spectra for different sounds. Comment on the intelligibility of the speech signal sampled at 16kHz as compared to the speech signal sampled at 44.1kHz and whether this is a good choice for the sampling frequency.
      c. Resample the speech signal obtained from (a) to **8kHz** and plot the complete speech signal along with the frequency spectra for different sounds. Comment on the intelligibility of the speech signal sampled at 8kHz comparing it to the above signals and whether this is a good choice for the sampling frequency.
      d. Resample the speech signal obtained from (a) to **4kHz** and plot the complete speech signal along with the frequency spectra for different sounds. Comment on the intelligibility of the speech signal sampled at 4kHz comparing it to the above signals and whether this is a good choice for the sampling frequency.
  B. Study of Bit Resolution
      a. For this study, record the word **'Speech'** using a sampling frequency of 16kHz and a bit resolution of **16 bits/sample**. Plot the complete speech signal and the frequency spectrum of different sounds using the bit resolution of 16 bits/sample.
      b. Now, using the same speech signal sampled at 16kHz, now use a bit resolution of **8 bits/sample**. Plot the complete speech signal and the frequency spectrum of different sounds. Comment on the frequency spectrum of the different sounds, intelligibility and quality of the speech signal comparing it with the above speech signal obtained using 16 bits/sample.

c. Using the same speech signal sampled at 16kHz, now use a bit resolution of **4 bits/sample**. Plot the complete speech signal and the frequency spectrum of different sounds. Comment on the frequency spectrum of the different sounds, intelligibility and quality of the speech signal comparing it with the above speech signals.

d. Using the same speech signal sampled at 16kHz, now use a bit resolution of **1 bit/sample**. Plot the complete speech signal and the frequency spectrum of different sounds. Comment on the frequency spectrum of the different sounds, intelligibility and quality of the speech signal comparing it with the above speech signals.

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 31/01/2021