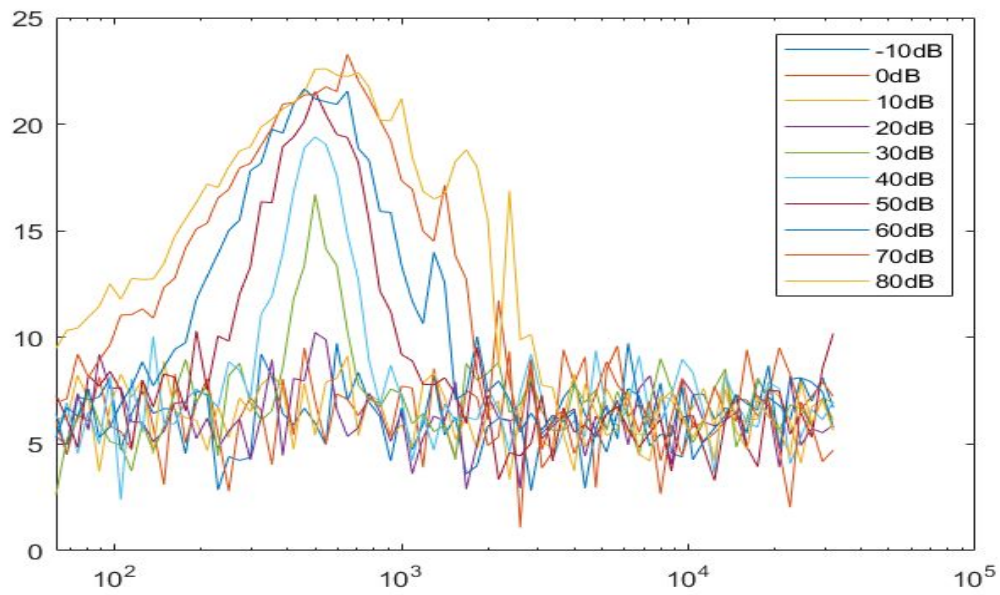


PART A

1.

Rate

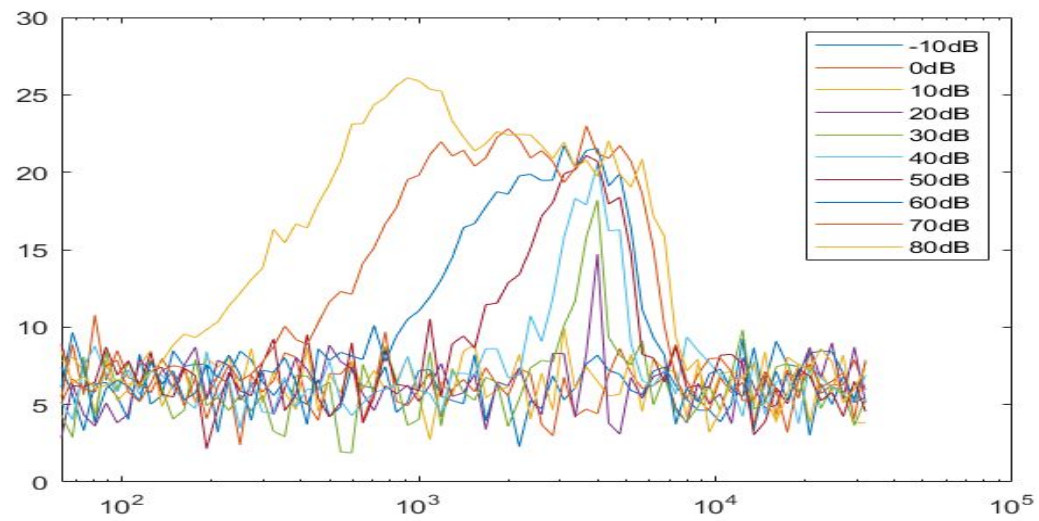
BF= 500Hz(figure1)



Frequency of tone->

Rate

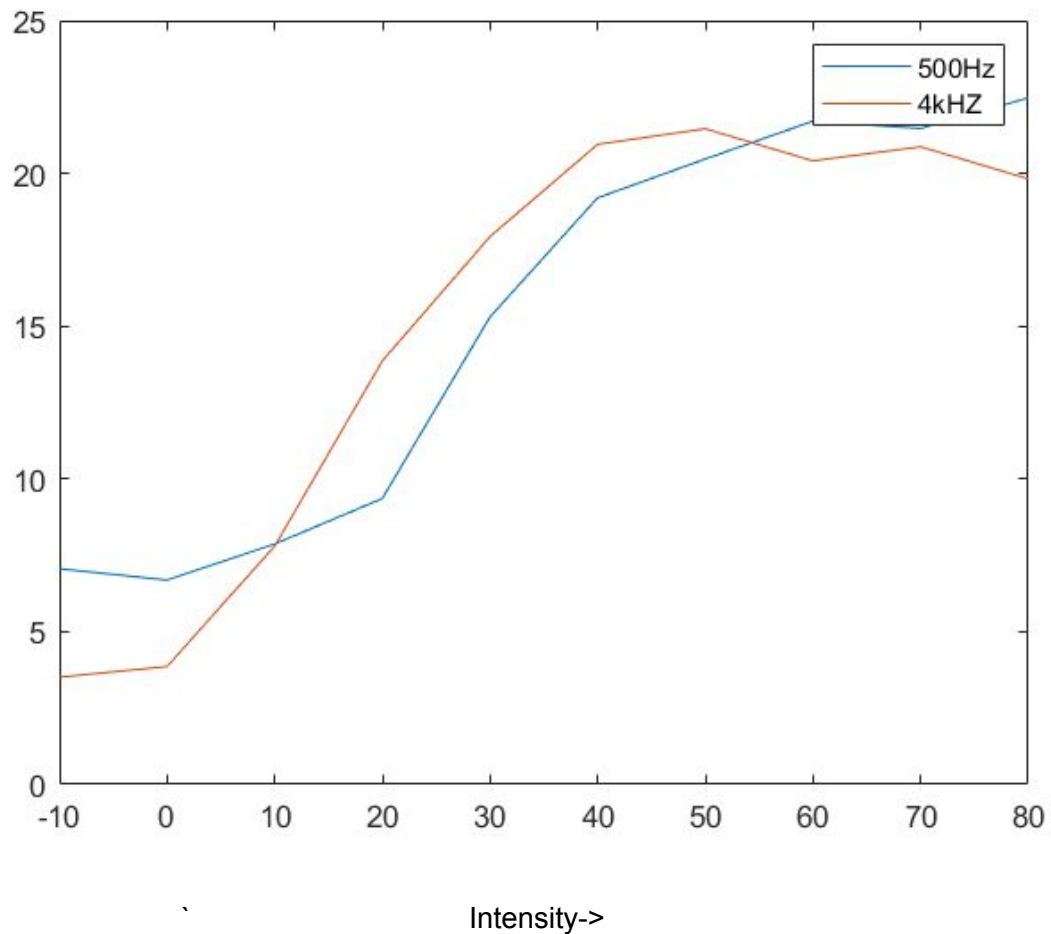
BF= 4KHz(figure 2)



Frequency of tone->

Rate

Figure 3



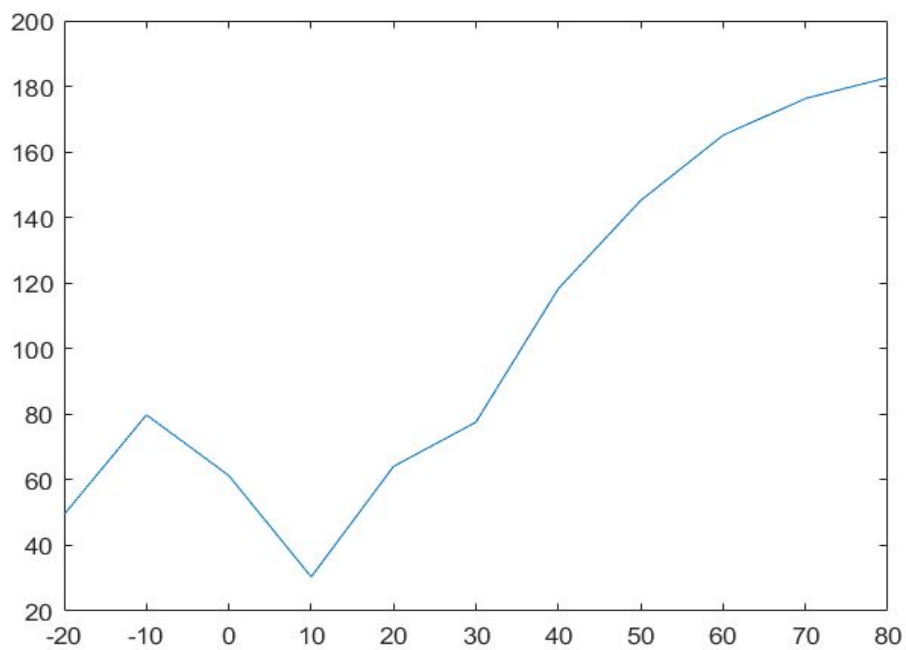
It is observed that the ANFs show maximum rate at Characteristic frequency only when the Intensity is above a certain threshold(20dB here).

At higher intensities, the rate saturates and a larger window of frequencies have increased rate.

For 4kHz ANF, the maximum rate shifts left form Characteristic frequency as the intensity increases.

2.
Rate

Figure 4



Intensity->

From the above plot, the threshold is determined as 10dB , active range from 20 to 60dB and saturation from 70dB onwards.

Figure 5(Spectrogram of the 'ah' sound)

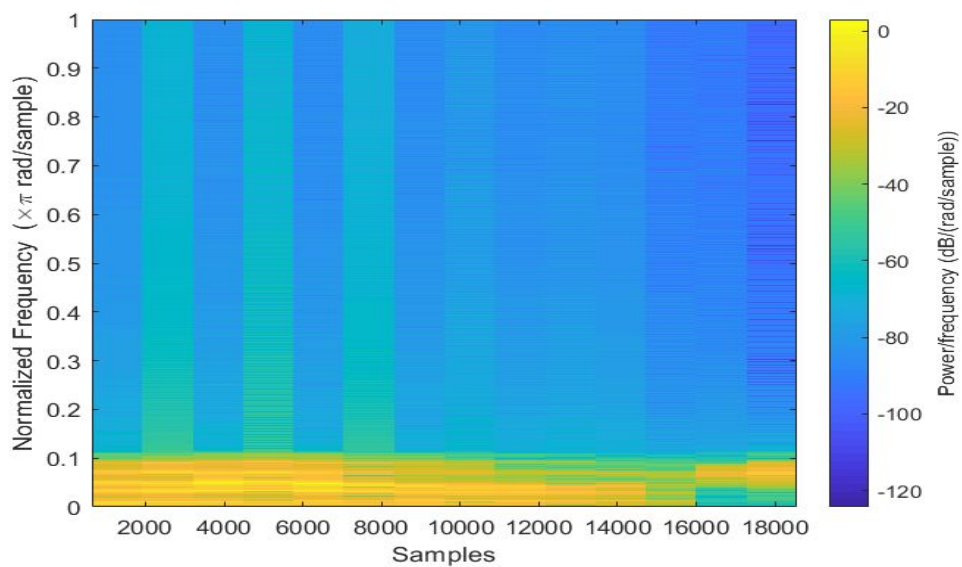


Figure 6A(4ms window)

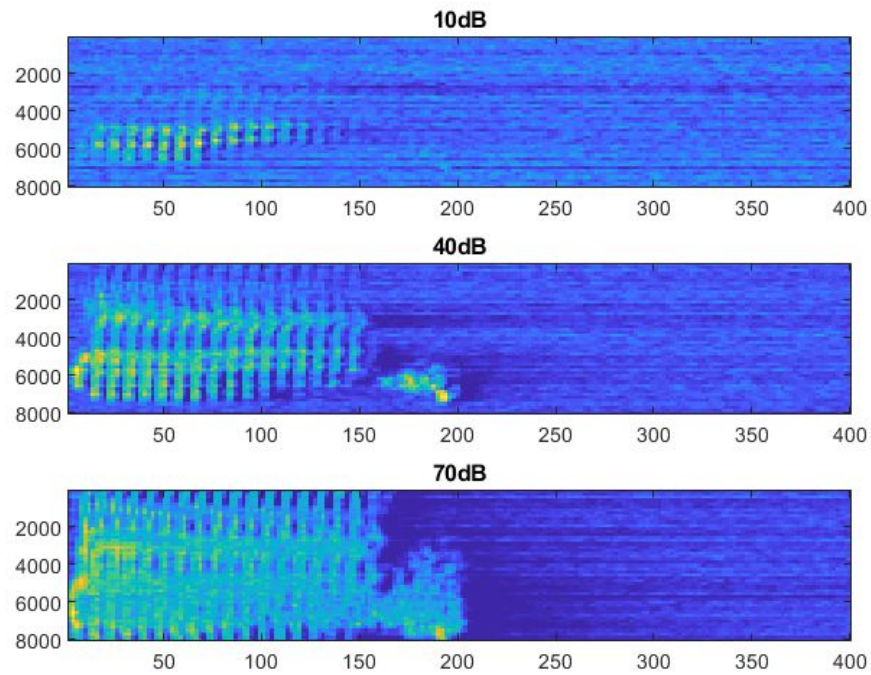


Figure 6B(8ms window)

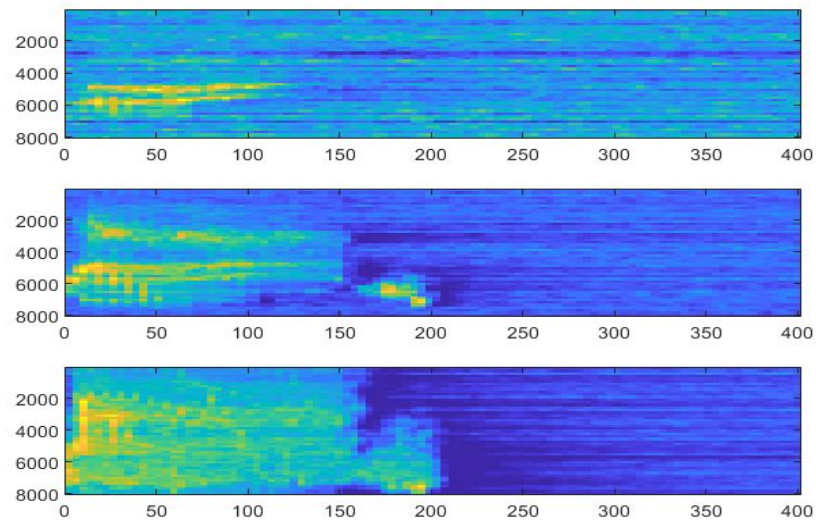


Figure 6C(16ms window)

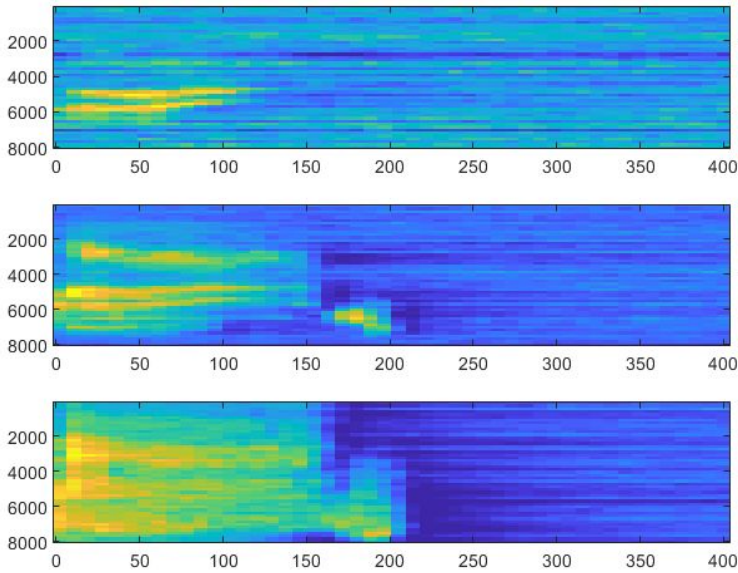


Figure 6D(32ms window)

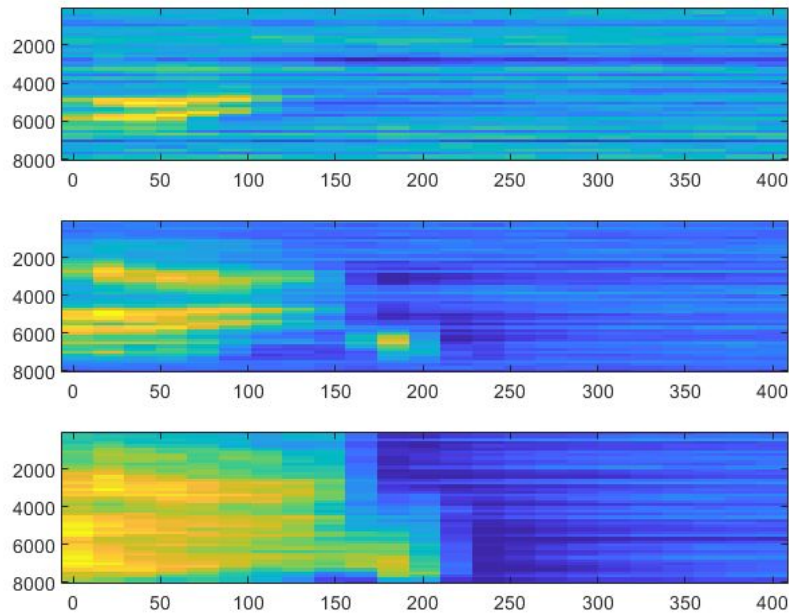


Figure 6E(64ms window)

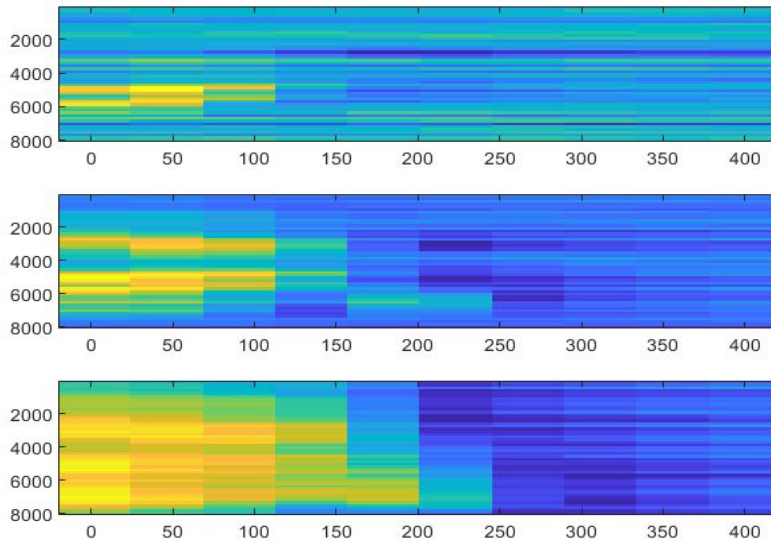
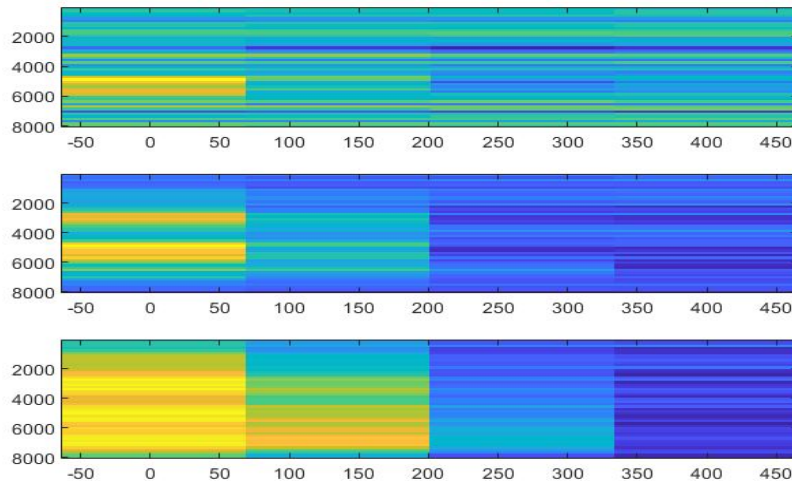


Figure 6F(128ms window)



The time duration of the modulated signal is 200ms. So only the first 200ms response is considered.

In the spectrogram of 'ah' sound, the frequency with considerable amplitude is in the range $0-0.1 \times 100000 = 0-10000\text{Hz}$.

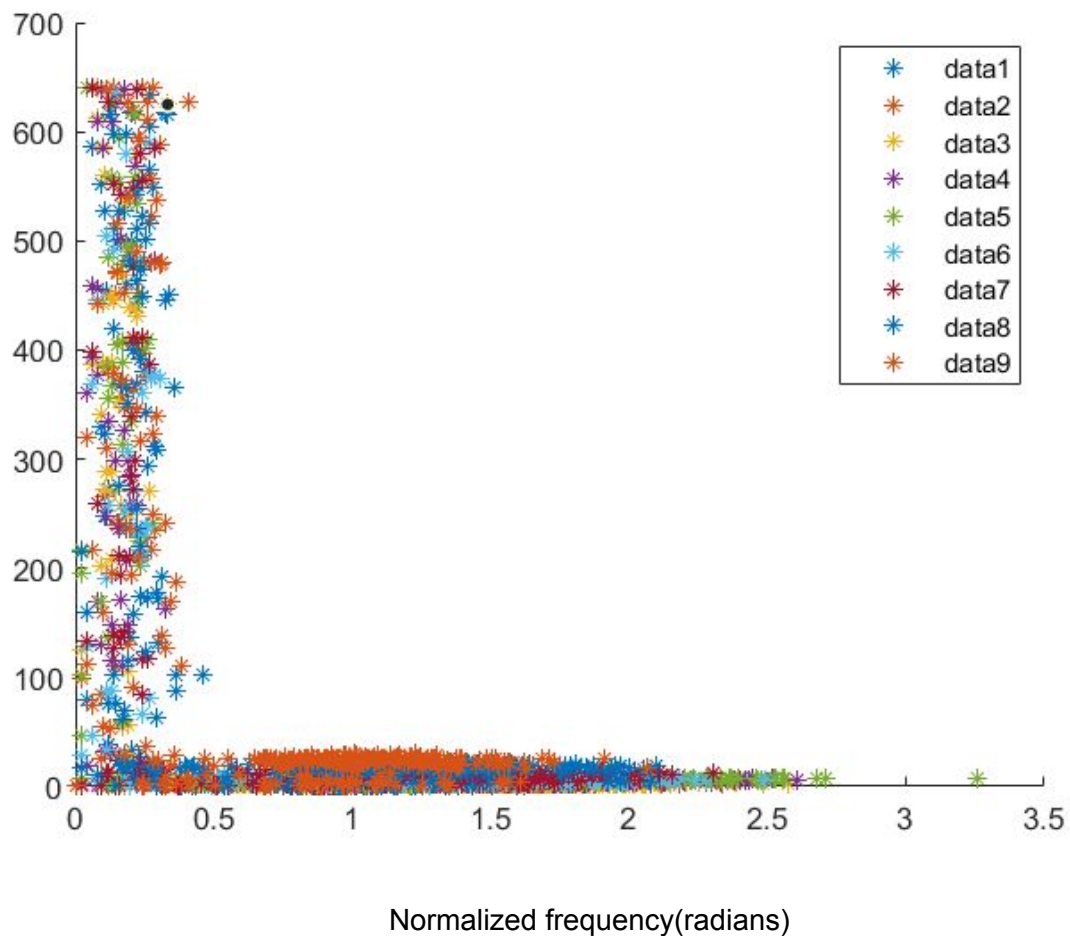
In general, it is seen that just above the threshold, spiking occurs at higher amplitudes.

In the active region, the spiking rate at a particular ANF is proportional to the amplitude of the signal.

In the saturation region, the spiking rate increases for all ANFs.

ANFs with $\text{BF} < 2000\text{Hz}$ do not show much amplitude modulation and rate only increases in saturation region.

3. time



All the ANFs at frequency from 125 Hz to 2kHz are seen to fire in the frequency range around 0.25 radians. So they fire in phase locked fashion at 0.25 rad of a pure tone.

Apart from this, while the ANFs with BFs < 2000 Hz do not show amplitude modulation as in part 2 but show phase locking as seen by the vertical line in plot.

PART B:

The intelligibility of the sound increases as the number of bands is increased. At lower no. of bands of below 8 bands, the sound is not intelligible but we can make out that the overall variation in sound is similar to the speech signal given.