

Q1 (a) Dark horizontal bands ^{correspond to} ~~are~~ the position of the frequencies with larger amplitudes in the magnitude spectrum, i.e., the position of the resonance frequencies or formant frequencies.

Since there are vertical lines, this is a wideband spectrogram analysis so typical window size is 5 ms.

(b) /k/ and /p/ are two unvoiced phones.

We see in the waveforms that both of these phones are followed by /a/ phone which is voiced and has more ~~to~~ amplitude. We see that in the utterances of both of them, there is a pause or a closure ^(silence) ~~and~~ at the starting and then followed by a little impulse or a bit of noise. This attributes to the fact that both are plosives. We also see that there is no starting lower frequencies, ^(a bit noisy and low amplitude) as would have been in the case of voiced consonants ^(explosives) as these are unvoiced. ^{The lower amplitude noise in /k/ corresponds to the burst in plosive.} We also see that the duration of these phones are much lower than ^{following /a/} vowels.

They have different formant frequencies corresponding to different place of articulation.

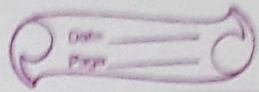
The burst is not very evident in /p/ phone as much in /k/.
/h/ is also unvoiced phone. It is different from both of them as it has a lower amplitude waves in ~~the~~ waveform (random fluctuations) as this is aspirated. There is no closure/silence before this. In similarity, it also does not have large amplitudes like vowels.

(c) The silences correspond to /k/ and /p/ phones, both of them are unvoiced, unaspirated plosives.

(d) In the final word we see that the formants of /a/ move toward the formants of /n/ nasal. F1 of nasal is lower than /a/ so it moves down and ~~F~~ F2 is larger than that of /a/ so it moves up. We also know

Shruthi Laddha

180070054



that nasals are weak so there is sharp decrease in the amplitude of especially the F2 formant frequency.

In terms of place of articulation, since (n) is a nasalised consonant that means the velum will be open as nasal cavity will be open. This will get coupled with the utterance of /a/ phone as an vocal tract will begin taking shape during /a/ only. This is also attributed to the fact that vowels have a high tendency of co-articulation.

We also know that nasals have very low tendency of co-articulation so we do not see any co-articulation between /n/ and /i/.

(c) If by male speaker, we expect

1. The pitch frequency to reduce. So in the waveform, the period frequency will reduce (^{time} more) and in spectrogram, we expect the spacing between harmonics to reduce.

2. We also expect the formant frequencies to shift towards lower values a bit due to changes in characteristics of speaker. These formant frequencies to shift by different amounts for different phones.

The ~~shifting~~ change in formant frequencies will mean that the shape of waveforms will also change a bit as the hidden envelope changes.