Auditory Computation

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Laboratory 4: Speech processing

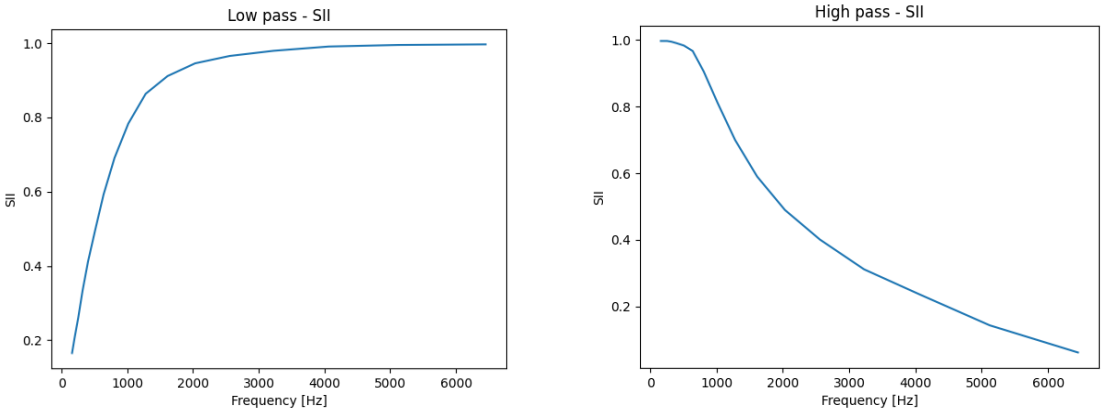
Part 1: Spectral properties of speech material

The data containing 20 concatenated sentences is better to use for the purpose of getting more robust information. Performing the analysis with only one short sentence may biases the outcome as it reduces the number of different sounds, and therefore frequencies and intensities, that the dataset has. Characteristics such as intonation, speed, number of vowels and consonants can vary from sentence to sentence, and thus, it is better to average it in a way by incrementing the number of phrases analyzed.

Part 2: Speech processing -High- and lowpass filtered speech

A logarithmic spaced array was used for the cut-off frequencies. This decision was implemented knowing that we will be working with decibels, which are formulated on a logarithmic scale.

Part 3: Test your speech reception threshold



(a) (b)

Figure 1. Calculated SII values for Low pass (a) and High pass filtering in Python

Comparing results for the BB, LP, and HP conditions:

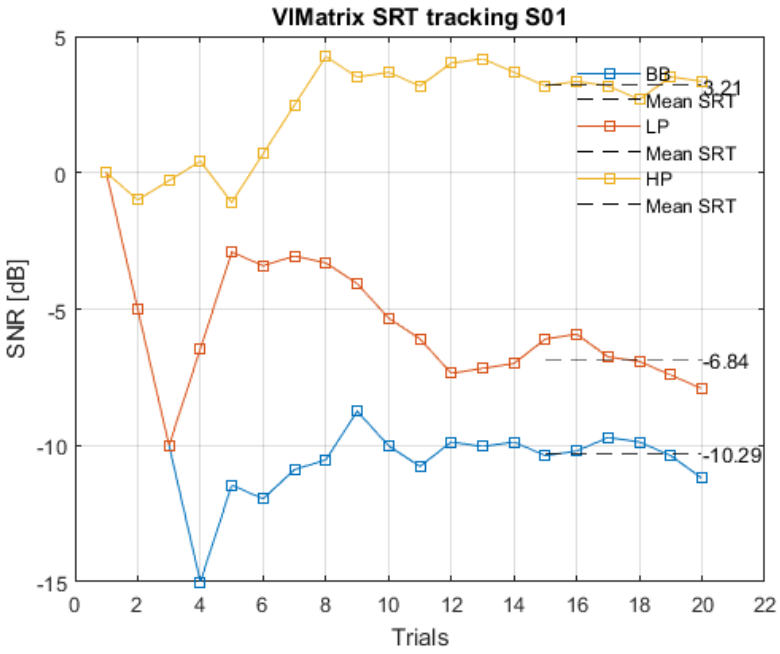


Figure 2. Test results for the Matrix.

It can be observed that for the *Binaural Bable* (BB) the results indicate that the speech recception threshold of the subject improves as the SNR presents less noise. However, it only improves up to a certain point where the SRT stabilizes around a value of SNR close to -10dB.

For the HP values, it can be interpreted from the results that the subject's speech reception threshold presents less variation when the SNR is higher (close to 0dB). It is worth noting that the HP values present the highest SRT value, meaning that the subject needs a louder signal to be able to understand the speech.

For the Lp values, the subject's speech receptino threshold improves as the SNR presents less noise (as expected). However, after values close to -10dB, the mean SRT decays with the SNR getting less favorable, which results in a decline in speech understanding.

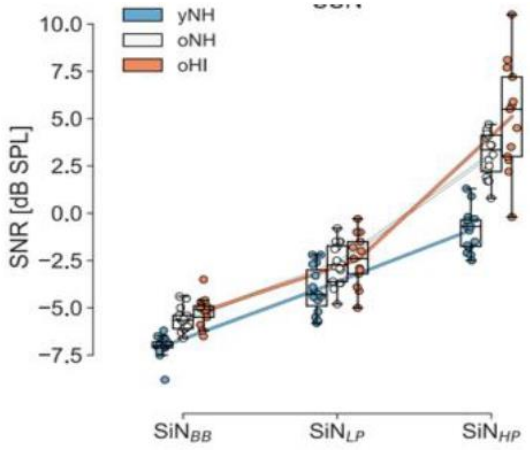


Figure 3. Literature values for young Normal Hearing (yNH), old Normal Hearing (oNH), and old Hearing Impaired (oHI) subjects.

From the figure above, it can be observed that the SRT values for BB, HP and LP are situated among the young normal hearing (yNH) group. This can be observed as the mean value for BB corresponds to -10.29. The values for LP and HP also fall into the yNH category, but are also close to the oNH one.

Lab Exercise 4.2: AM detection threshold

exppar1[Type]	exppar2[n/a]	expvar[dB]	
120.00000000	1333.00000000	-23.33333333	0.74535599

Table 1. Results for modulation index César Zapata.

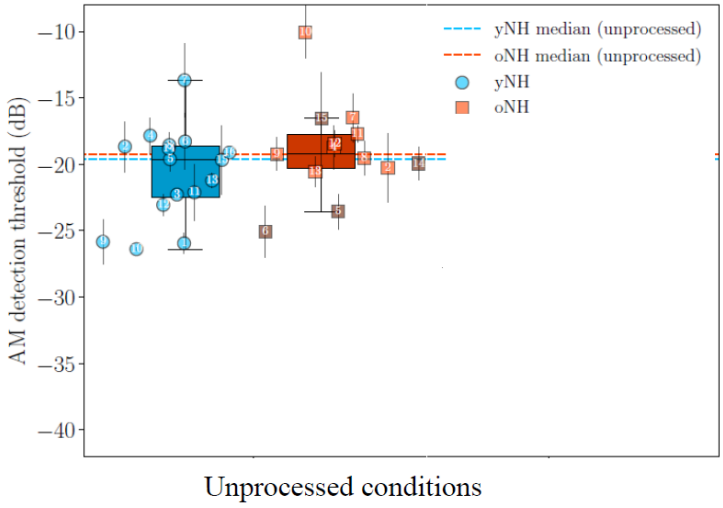


Figure 4. Normal hearing data from literature.

The *expvar* value (dB) represents the mean modulation index (in dB). This number indicates the minimum amount of modulation required for a listener to reliably perceive or discriminate a specific speech feature. The index obtained in the results is *-23.333*, which locates me inside the range of values of the young normal hearing population from the literature.

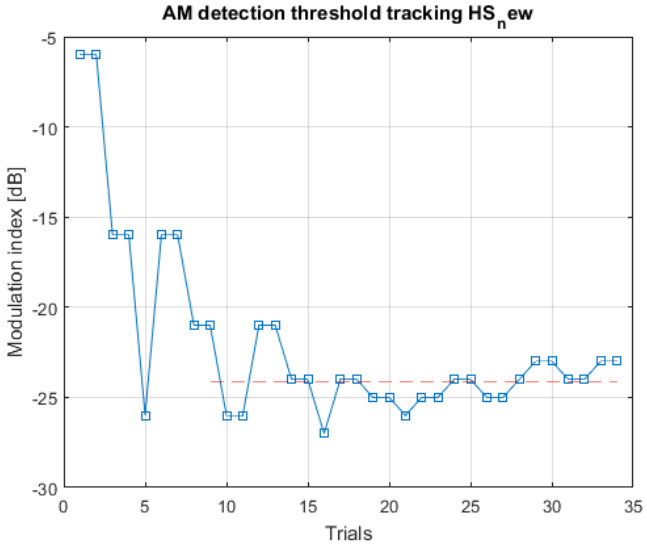


Figure 5. AM detection threshold tracking.

A threshold of -23.3 indicates that the subject is sensitive to the changes in modulation of the presented signal, even at low levels of modulation, and thus can attributed to a healthy discrimination ability and a high level of perceptual accuracy in perceiving the feature of the signal that is being tested.