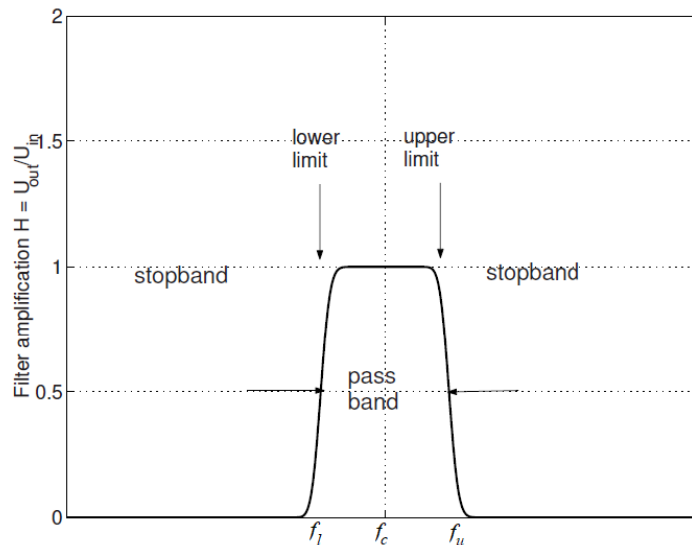


Use the IR Data from open database: https://www.openair.hosted.york.ac.uk/?page_id=36

- 1) **Design a filter bank** with bands of 1/3 Octaves, for example, according IEC 61260 and IEC 61672 standards, such as in the pyfilterbank: <http://sigggue.github.io/pyfilterbank/index.html>

The specs of each filter are illustrated in the figure 1 and the complete frequency list of 1/1 and 1/3 octave bands are shown in figure 2.

Filtros Passa Banda* em Oitava e 1/3 de Oitava



(*) N = 11 frequências definidas na IEC 61672:
 $f_c = 16, 31.5, 63, 125, 250, 500, 1k, 2k, 4k, 8k, 16kHz$

$$f_c = \sqrt{f_l f_u}$$

Largura de Banda em Oitava: $f_u = 2f_l$

Logo: $f_c = 2f_l$,

$$\Delta f = f_u - f_l = f_l = f_c / \sqrt{2}$$

Largura de Banda em 1/3 Oitava:

$$f_u = \sqrt[3]{2} f_l = 1.26 f_l$$

$$f_c = \sqrt[6]{2} f_l = 1.12 f_l$$

$$\Delta f = 0.26 f_l$$

Figure 1. Specification of each filter in the bank analysis according IEC 61672.

Faixa Audível em Oitavas e 1/3 Oitavas

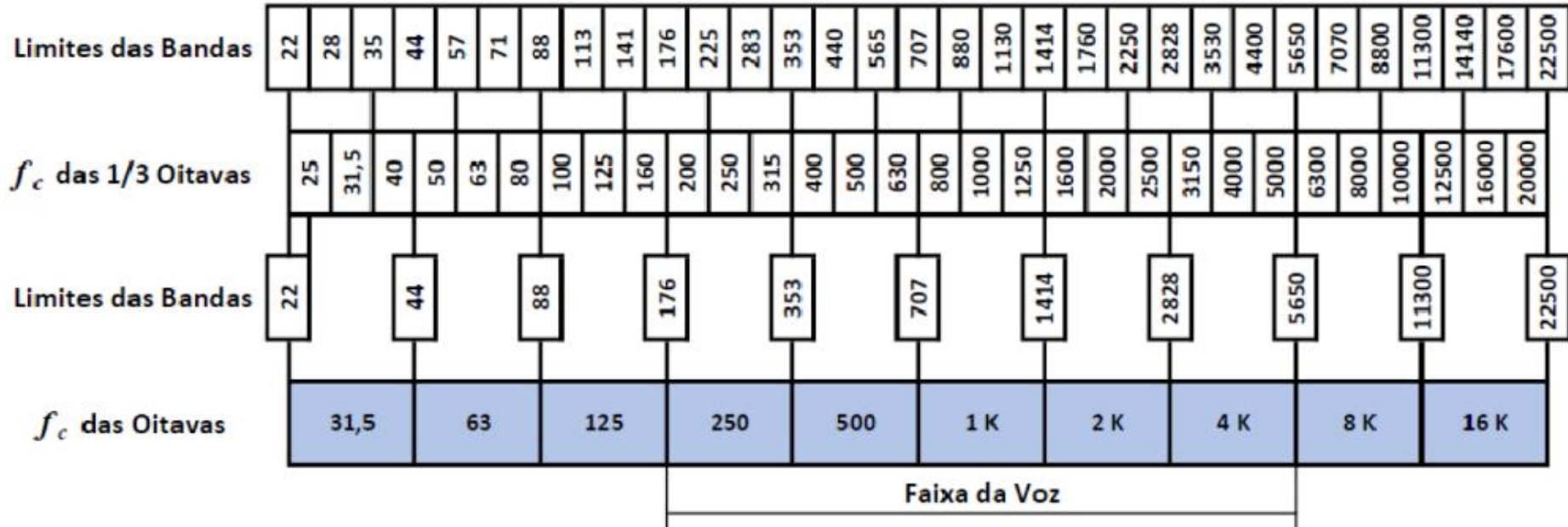


Figure 2. 1/1 Octave and 1/3 Octave frequencies according IEC 61672.

The figures 3 and 4 shows the log-magnitude plot responses of pyfilterbank package.

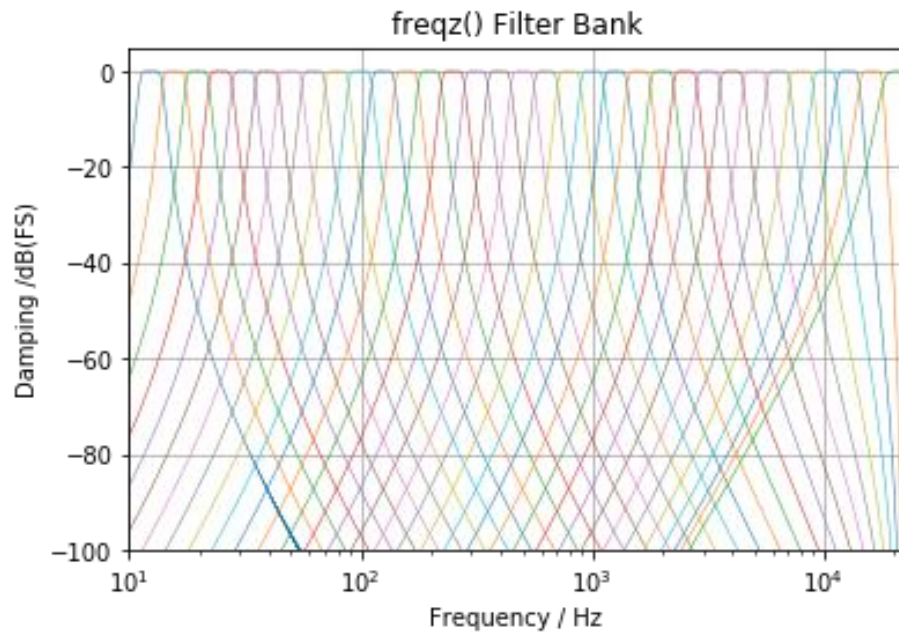


Figure 3. Audio filterbank Log-magnitude response, by pyfilterbank package.

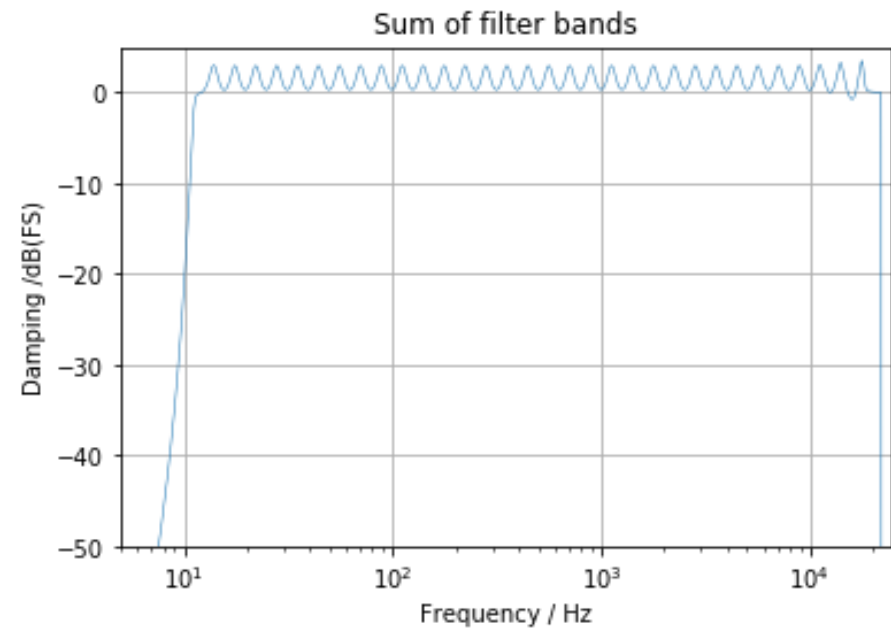


Figure 4. Sum of filter bands by pyfilterbank package.

2) **Simulated Reproductions:**

- a. Choose three different “rooms” (e.g. Huge Auditorium, medium size room, and a church).
- b. Compute the Reverberation Time (T_{30} or T_{60}) in the bands 125Hz, 250Hz, 500Hz, 1kHz, 2kHz and 4kHz to each case. Compare with the data available in the web site (when possible).
- c. Compute the Clarity (C_{80}) and Definition (D_{50}) to the same bands. Compare with the data available in the web site (when possible).
- d. Analyze simulated reproduction in these three “rooms” (as in the 3th class) using these different music styles and comment on the results:
 - i. Outdoor classical orchestra: Candide (Introduction of “Overture Candide”, Vienna Philharmonic, summer night outdoor program)
 - ii. Brazilian Samba: Roberta Sá (Introduction of “A vizinha do lado” song)
 - iii. Jazz: Nat King Cole (Introduction of “What a Wonderful World” song)
 - iv. Broadcast radio goal narration record: Ulisses Costa (Neymar goal narration by Ulisses Costa, Band FM Radio, 90.9 MHz, Santos x Internacional)
 - v. One of your preference.

TIPS: (i) Do not forget to turn these musical programs into mono files and (ii) attention to the different sample rate of each IR data.

- e. Compute the BR and TR measures of each chosen “room” and organize your perceptual analysis (last item) in a comparative table.