Multimedia Systems

(Homework)

FEUP 2019/2020 – António Sá Pinto 18/05/2020

---

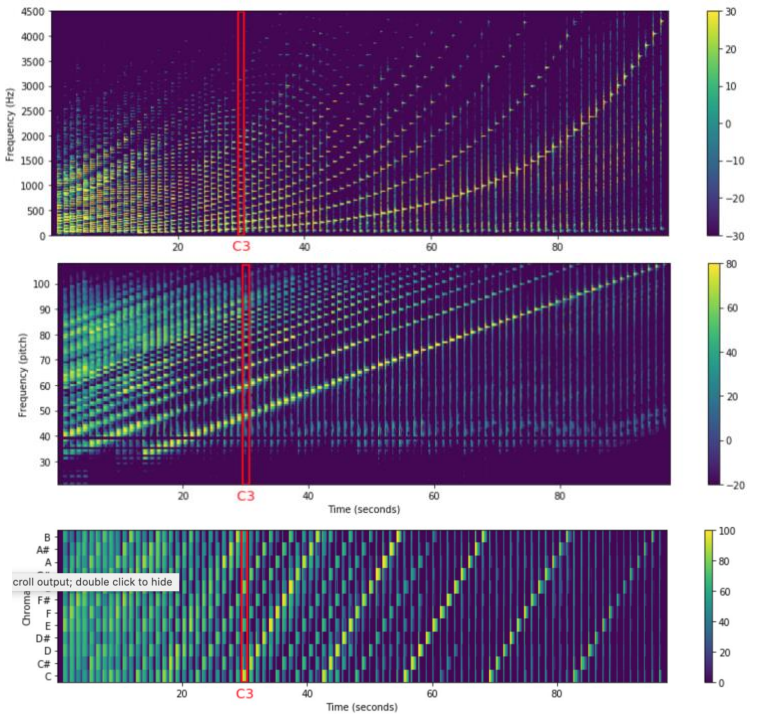
1. Task1 (Sonic Visualiser)

(5 mins)

- Try to reproduce the graphs from class with sound file FMP_C3_F03.mp3

*Note: After the class, for a detailed explanation, you can/should go to the FMP corresponding notebook - **Log-Frequency Spectrogram and Chromagram**, Section 3.1.1 of [Müller, FMP, Springer 2015]*

(Possible) Answer:



Spectrogram

Log-Frequency Spectrogram

Chromagram

Goal:

- *Understand and apply the "transformations" needed to obtain a chromagram (departing from the spectrogram), and that the chromagram is just another spectral analysis tool, very similar to the spectrogram and obtainable from the spectrogram.*

2. Task2 (Sonic Visualiser)

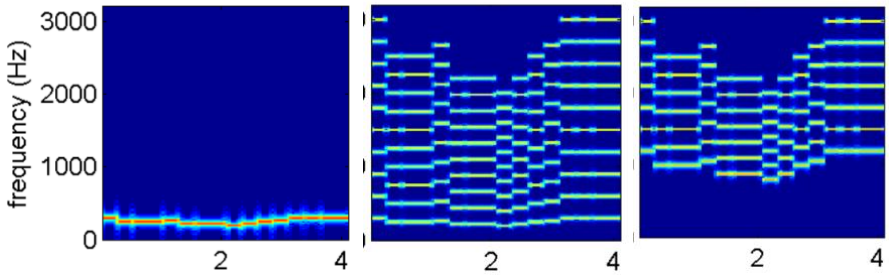
(15 mins max)

Download “class9_sounds.zip” and analyse the 3 sounds with the signal analysis tools you consider better for the job.

- In which ways are the 3 sounds similar and dissimilar? (ie, what are the similar characteristics, and what are the different characteristics) - (*paragraph with figures if you find them helpful*)
- Do you have any explanation for what is happening? (*short paragraph*)
- In what way is this related to today’s class? (*short paragraph*)

(Possible) Answer:

- The 3 sounds present the exact same melody (pitch and duration) with somewhat different timbre. By inspecting their spectrograms, we understand that the 1st is a pure tone; the 2nd is that exact sound with the same fundamental frequency plus 9 harmonics (a complex sound); and the 3rd has only harmonics from 4 to 10.



- The melodies (thus the pitches*) are the same, even if the overall frequency content, and therefore the "timbre", of these sounds is different. The 1st 2 sounds do however share the same fundamental frequency: the 2nd sound is literally the sum of the first one plus the contributions of the higher 9 harmonics.
- Although it may be tempting to think that the presence of the fundamental frequency that determines the pitch, the 3rd sound proves that we can take the fundamental frequency out, and pitch remains the same. This follows the greatest common divisor theory of pitch perception. (This “effect” is known as virtual pitch).
- Today’s class main content was pitch, and this is an effect related to pitch.

Goals:

- *Prove that pitch <> fundamental frequency*
- Another goal of both exercises was to encourage you to explore *FMP notebooks,* which provide detailed explanations and examples for both these tasks!!

Additional Note:

- A good **heuristic** (but nevertheless it’s only an heuristic!) to find if the pitches are the same, is when you try to sing some notes (and a sequence of notes is a melody), if you use the same note → the pitch is the same.