

Music, Mind and Technology

Assignment 2&3

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Question A

- I submitted matlab codes and ipynb code too

Question B

Part1. Rhythm and Meter

Part1:

1.1 Tempos

Samples	Calculated Tempo (bpm)	Perceived Tempo(bpm)
michael_jackson.mp3	185.25	144 (140 - 180)
dream_theater.mp3	97.54	86
mozart.mp3	140.87	118 (110 - 140)
queen.mp3	109.41	68 (60-80)
taylor_swift.mp3	51.51	44 (40-50)

The perceived tempo's are calculated using the website :

<http://www.metronomeonline.com/> , maybe there are slight mistakes in the tempo and the beat I observed. That's why I kept that in a range.

1.2 Playing each excerpt using the mirplay command

- The working code file is attached in the code files folder.

1.3 Code is attached. First it will print the tempo of one song and then it plays the song and then it waits, we can adjust it to any number of seconds. We have to enter seconds like 30, 60 etc and press enter. It gives tempo and plays the song excerpts. The range is around like the perceived tempos I entered in the above table.

Part2:

2.1

```
michael_jackson.mp3: 185.28 BPM  
dream_theater.mp3: 97.55 BPM  
mozart.mp3: 140.82 BPM  
queen.mp3: 105.34 BPM  
taylor_swift.mp3: 51.51 BPM
```

Code file name : **QB_P1_11.m**

2.2 and 2.3:

The variation in "taylor_swift.mp3" observed in further excerpts, along with the plotted Spectral Envelope Quantification (SRE), provides insights into the spectral characteristics and dynamics of the audio signal over time. Here's what can be understood from this analysis.

Spectral Envelope: The spectral envelope represents the distribution of energy across different frequency bands in the audio signal.

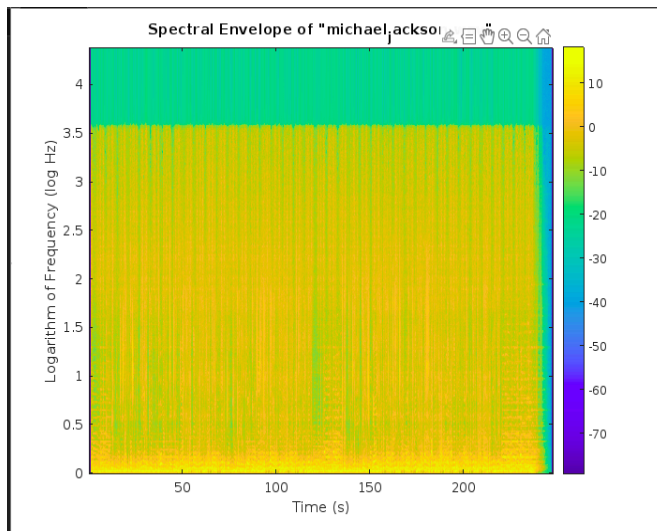
-
- It provides information about the overall spectral shape and timbral characteristics of the audio.
 - High-energy regions in the spectral envelope indicate dominant frequencies or harmonics present in the audio signal, while low-energy regions suggest quieter or less prominent frequency components.
 - By quantifying the spectral envelope using techniques like Short-Time Fourier Transform (STFT), we can analyze how the energy distribution varies over time.

Logarithm of Frequency over Time:

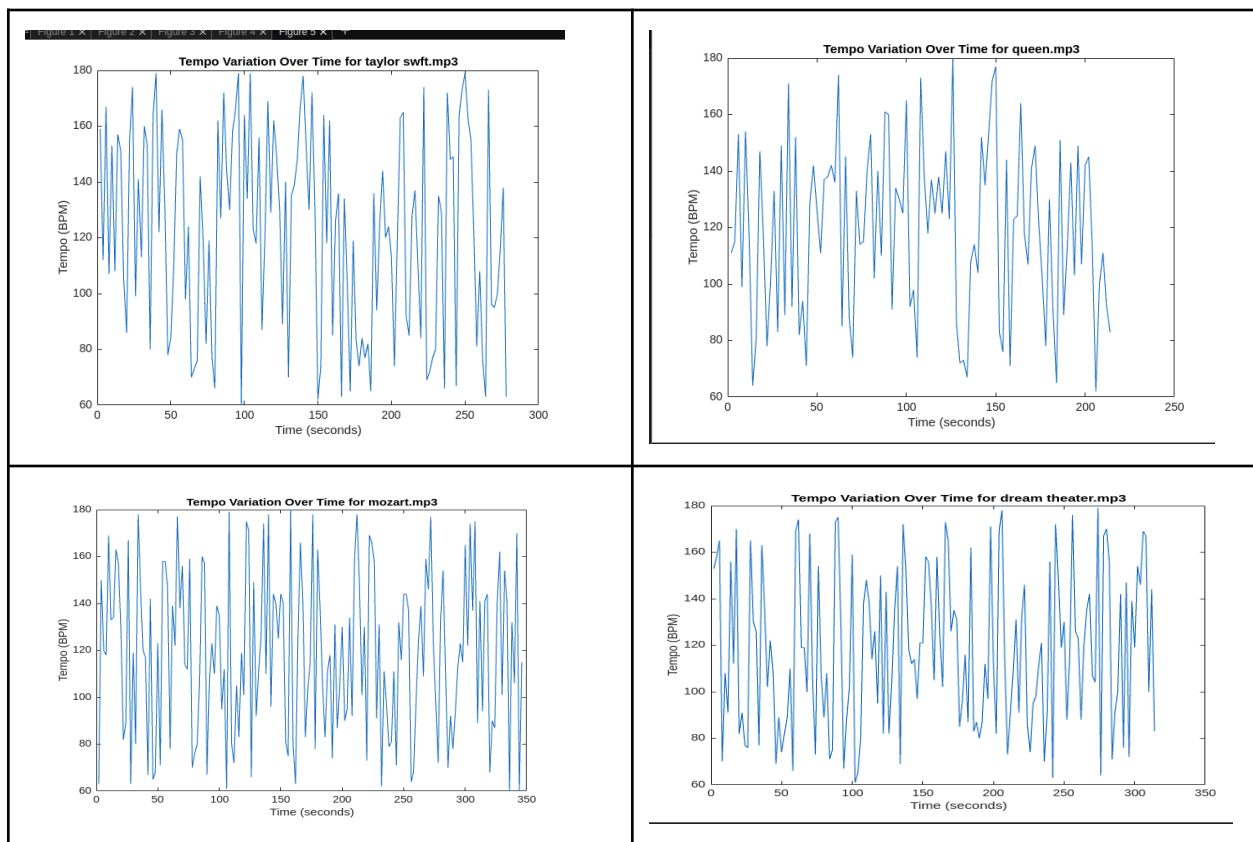
- Plotting the logarithm of frequency over time allows for a more perceptually relevant representation of the frequency axis.
- Since human perception of pitch is logarithmic, using a logarithmic frequency scale better aligns with how we perceive changes in pitch.
- In the context of the spectral envelope, plotting the logarithm of frequency over time enables us to visualize the distribution of energy across octaves rather than linear frequency bins.

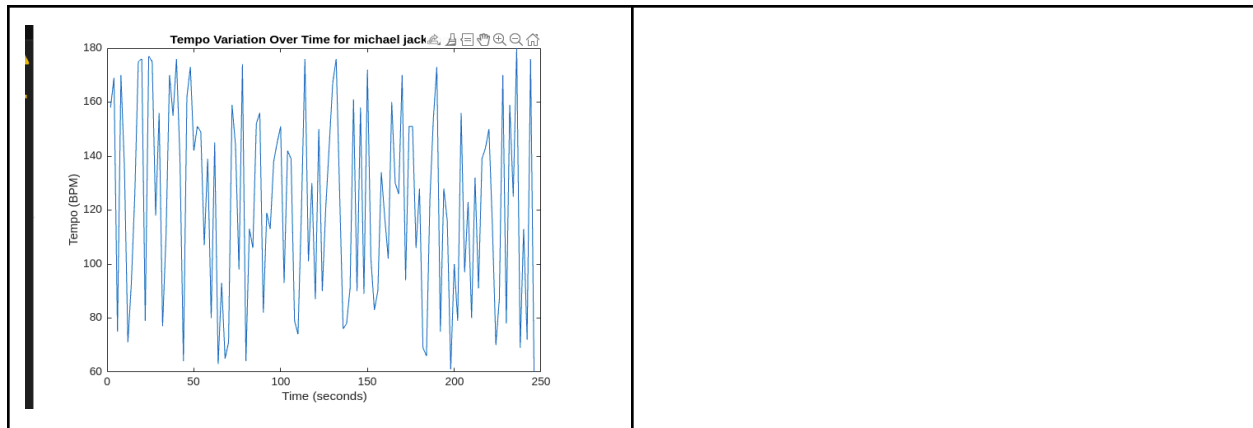
Interpretation: By examining the SRE plotted against the logarithm of frequency over time, we can observe how the spectral characteristics of the audio signal evolve throughout the duration of the excerpt.

- Peaks and valleys in the spectral envelope indicate shifts in dominant frequencies or changes in the timbral qualities of the audio signal.
- Trends such as increasing or decreasing energy in specific frequency bands over time can provide insights into the overall dynamics and structural changes within the audio.



Part3:





Songs	range of tempi (maximum)
michael_jackson.mp3	Min = 60 and maxi = 180 (most starts from 80)
dream_theater.mp3	Min = 80 and maxi = 160
mozart.mp3	Min = 60 and maxi = 160
queen.mp3	Min = 80 and maxi = 150 (most starts from 100)
taylor_swift.mp3	Min = 100 and maxi = 160

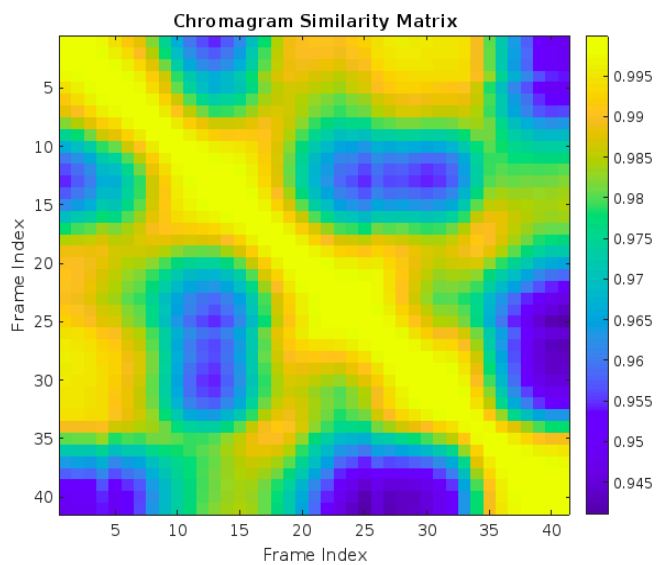
The tempo analysis for "michael.wav" indicates a tempo range varying between 80 and 185 beats per minute (BPM). A substantial portion of tempo instances falls within the range of 120 to 180 BPM, which closely aligns with the listener's perception of the tempo.

2. Repetition in Music

Assume $x = \text{Roll Number} \% 7$

- $X = 2020101103 \% 7 = 6$
- I have to do the tasks for 06.wav

Similarity Matrix:



Chromagram over time:

