FFT Workshop 2024

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Assignment1

In this part, I test the given example in document first and compute the Fourier transform and depict a spectrogram of the piano.wav .

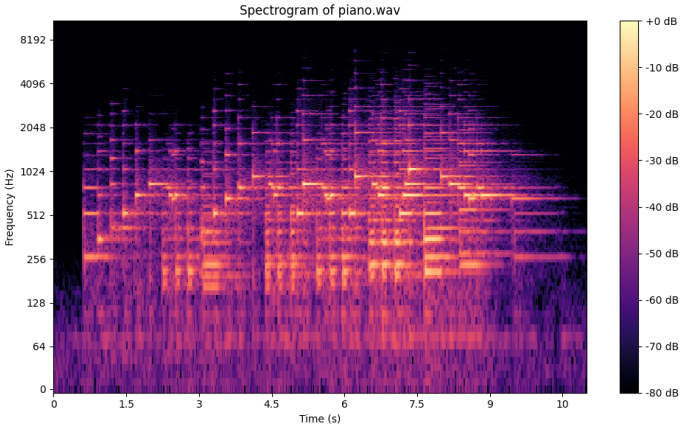

Figure 1: The spectrogram of piano.wav

- **Color scheme:** The colors represent the magnitude of the sound at various frequencies and times. Yellow areas indicate loud or prominent frequencies, while dark areas show quieter or less prominent frequencies in this case.
- **X-axis:** The horizontal axis represents time in seconds. It shows how the audio signal evolves over time. In this case, the time spans from 0 to 10.5 seconds, showing how the frequencies vary throughout the duration of the audio.
- **Y-axis:** The vertical axis represents frequency in Hertz (Hz). It is meaning that lower frequencies are more stretched out, while higher frequencies are more compressed. The frequencies range from 0 Hz to about 8192 Hz, covering the typical frequency range for many sounds.

Assignment2

In part a, I calculate these features for the piano.wav and saved them in a txt file. And I will do some descriptions for the part b.

Parameter	Value
`n_fft`	512
`hop_length`	512
`num_bands`	8
`bands`	[(0,1kHz), (1kHz,2kHz), (2kHz,3kHz), ..., (7kHz,8kHz)]

Table 1: Parameter choices for the analysis of piano music.

- **Window size:** with a sample rate of 16kHz, a window size of 512 corresponds to about 32 milliseconds of audio data. Piano notes have clear, distinct harmonics, and a window of 32ms is short enough to capture changes in pitch and harmonics but long enough to maintain frequency resolution.
- **Hop length:** By setting the hop length to 512 (same as the window size), the windows are non-overlapping.
- **Number of frequency bands:** This defines how many frequency ranges we divide the signal into. 8 bands effectively cover the piano's harmonic range without being too complex.
- **1kHz-wide frequency bands:** These frequency bands divide the spectrum into 8 equal ranges of 1kHz each, from 0-1kHz, 1-2kHz, ..., up to 7-8kHz. The piano's sound has significant energy below 4kHz, so these bands ensure that we capture the most relevant parts of the frequency spectrum for piano music.