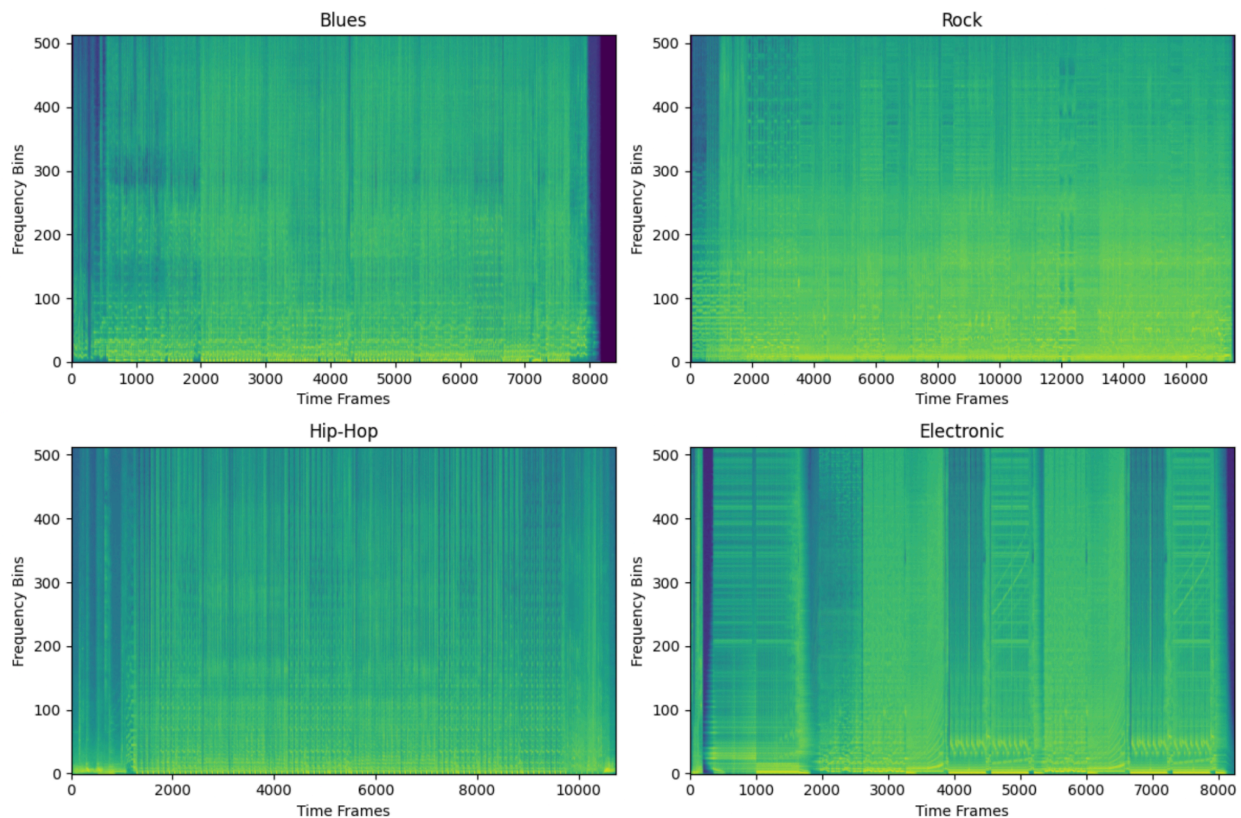


Spectrogram Analysis of 4 songs (Blues, Rock, Hip-Hop, Electronic)

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The spectrograms have distinct characteristics in their **frequency content, time variations, rhythmic patterns, and harmonic structures.**



Frequency Content and Energy Distribution

- Blues
 - The frequency distribution is more balanced, with significant energy in the **low to mid-frequency range**.
 - The transitions appear **gradual**, suggesting smooth instrumental and vocal harmonies.
 - There are **occasional variations** in frequency intensity, corresponding to melodic shifts.
- Rock

- The spectrogram exhibits a **broader frequency range** with high-energy bands.
- Noticeable high-frequency components likely come from **distorted electric guitars and cymbals**.
- The **density of spectral content** is higher than blues, indicating a more complex texture.
- Hip-Hop
 - There is a **strong presence in the low-frequency range**, signifying heavy bass and drum beats.
 - The **mid-frequency range is relatively stable**, suggesting a focus on rhythmic patterns rather than melodic variation.
 - Frequent vertical stripes indicate **sharp attacks**, possibly representing kick drums and hi-hats.
- Electronic
 - The spectrogram reveals **high-intensity periodic bursts** with wide frequency coverage.
 - There are **sharp, distinct frequency bands**, suggesting the presence of synthetic sounds and modulated beats.
 - Repetitive patterns are evident, characteristic of **loop-based music production**.

Time Variations and Rhythmic Patterns

- Blues
 - The transitions between different sections are relatively **smooth**, indicating fluid progression.
 - Less abrupt changes suggest a **more relaxed tempo and improvisational style**.
- Rock
 - There are **more fluctuations in intensity over time**, reflecting **dynamic shifts** between verses, choruses, and instrumental solos.
 - The **dense mid-to-high frequency components** suggest prominent electric guitars and vocals.
- Hip-Hop
 - The **consistent and periodic vertical lines** reflect a **strong rhythmic beat**.
 - There are **gaps between major beats**, emphasizing **syncopation and bass-heavy instrumentation**.
- Electronic
 - Clear **repetitive structures** indicate a **loop-based arrangement**.

- The presence of **high-energy bursts** suggests drop sections typical of electronic dance music (EDM).
- Rapid transitions between different frequency bands signify **synthesized arpeggios and modulations**.

Harmonic Structures and Timbre

- Blues
 - Shows **continuous spectral components**, indicative of **natural instruments** such as guitars, pianos, and brass.
 - Harmonic overtones are visible, aligning with **traditional melodic phrasing**.
- Rock
 - The **complex harmonic structure** suggests **distortion and overdrive effects on electric guitars**.
 - The **mid-high frequency range** is more pronounced, contributing to an energetic sound.
- Hip-Hop
 - **Strong low-frequency presence** represents **808 kicks and deep basslines**.
 - Less harmonic variation compared to blues and rock, with an emphasis on **drum-driven beats**.
- Electronic
 - The presence of **sharp and distinct frequency bands** indicates **synthesized instruments**.
 - **Digital effects, filters, and modulations** are visible, creating a futuristic and dynamic soundscape.

Conclusion

- Blues. Smooth transitions, natural instruments, moderate frequency range.
- Rock. Complex textures, high energy, dense mid-to-high frequencies.
- Hip-Hop. Dominant low frequencies, strong beats, periodic rhythmic patterns.
- Electronic. Sharp transitions, wide frequency range, synthesized elements.