Guitar Tuning Detection

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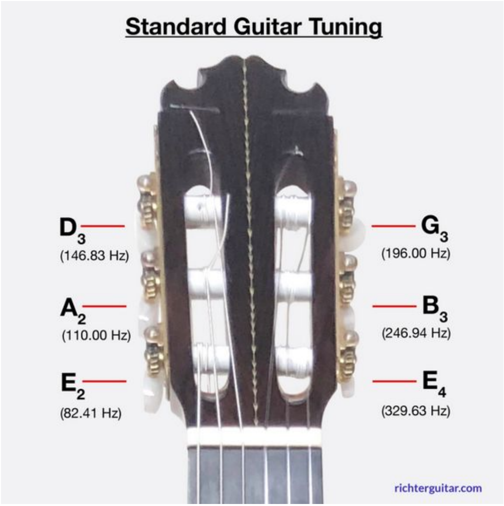
Guitar Tuning Background

- Using alternate tunings involves changing which notes the open strings on a guitar are tuned to

- It's essential for a guitarist to know before learning a song

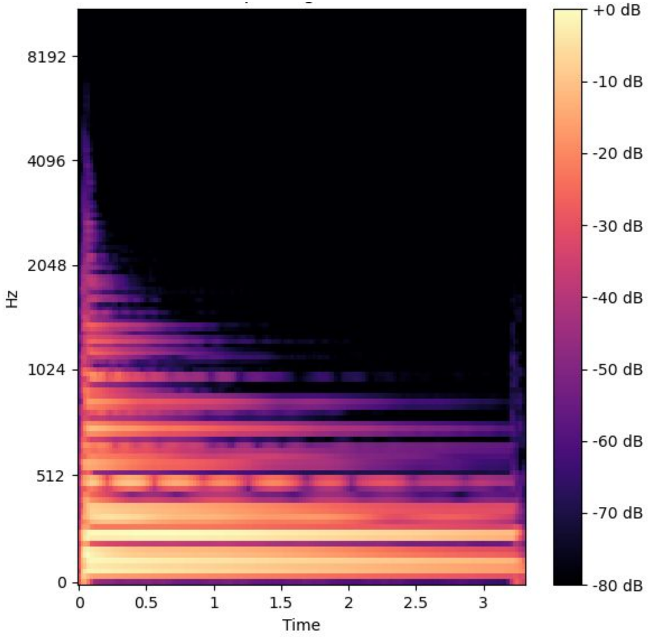
String	6	5	4	3	2	1
E Standard	E	A	D	G	B	E
Drop D	D	A	D	G	B	E
Drop C	C	G	C	F	A	D
D Standard	D	G	C	F	A	D
Open D	D	A	D	F#	A	D
Open G	D	G	D	G	B	D
F Maj 9	F	A	C	G	C	E



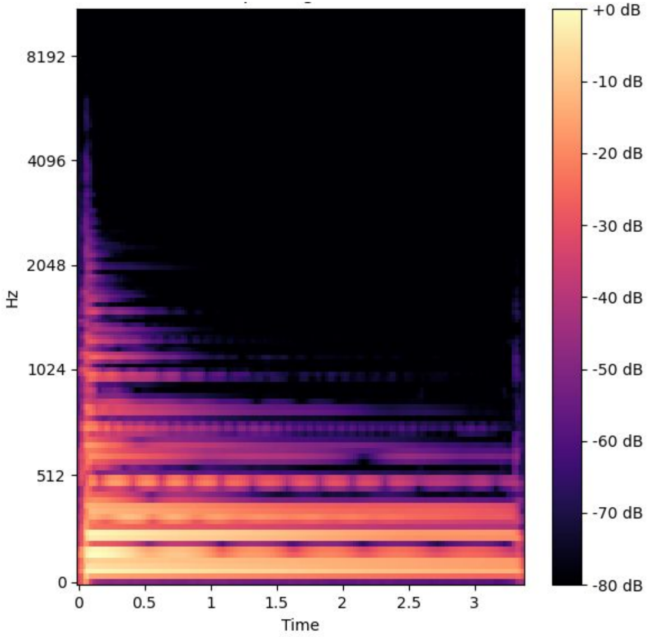
	E Standard	Drop C
Notes		
E Chord		

Nuances in Spectral Content Between Different Tunings

E2 Played in E Standard



E2 Played in Drop C



Goals

- Determine if a CNN and shallow classifier model is capable of distinguishing between different tunings using audio alone
  - We looked at the 7 different tunings
- Explore what might make tunings distinguishable
- Find ways to maximize the accuracy of the classifier
- Improve upon previous work, which found similar approach was promising with a limited dataset

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Drop C	C	G	C	F	A	D
D Standard	D	G	C	F	A	D
Open D	D	A	D	F#	A	D
Open G	D	G	D	G	B	D
F Maj 9	F	A	C	G	C	E

Dataset Collection

- No suitable dataset for our project existed, so we had to create our own
- All audio used contains only guitar as not to confuse the model in training
- Audio across all tunings contain clean tones, distortion, and other effects
- The dataset includes:
    - 96 ten-second clips of solo guitar, sourced from YouTube videos
    - 164 ten-second clips of stem-separated guitar, sourced from songs of many genres
- Clips were manually selected in an effort to make sure they were characteristic of their tuning

Model

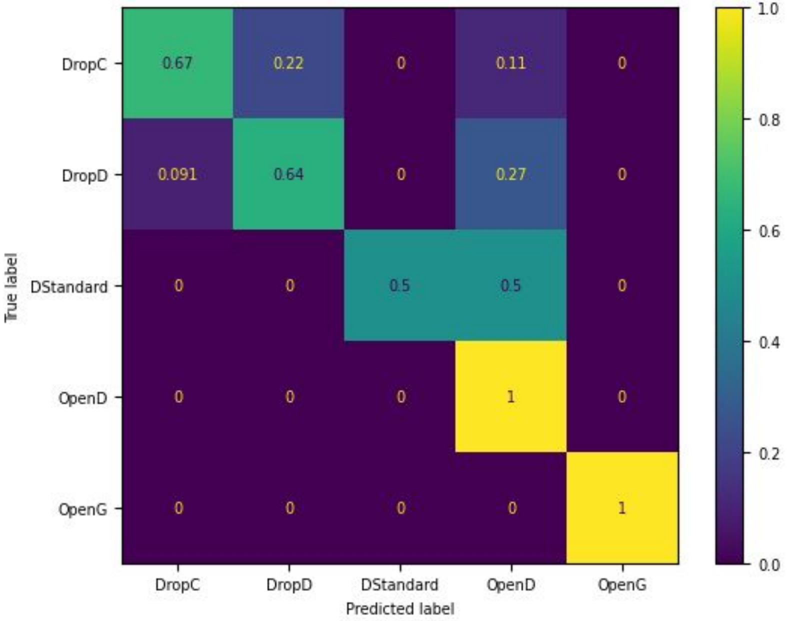
- Generate feature embeddings with pre-trained OpenL3 model (256 Band Mel Spectrogram, embedding dimensionality of 6144, .5 second hop, 1 second window)

- Classify each frame of embeddings with Support Vector Machine (polynomial kernel)

- We can train multiple classifiers based on lowest detected pitch

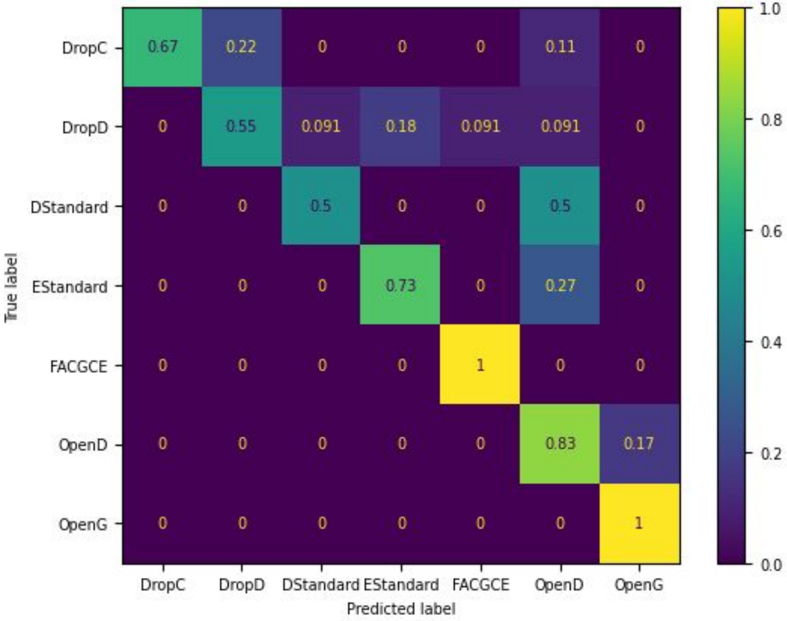
Results

Acc = 77.5%



Confusion Matrix of Classifier With Pitches Below E2

Acc = 71.7%



Confusion Matrix of Classifier With All Pitches

Conclusions

- Achieved moderate success, but may be hitting limits of OpenL3
- Our model was trained on short frames of audio, which may introduce error, especially with single notes
- Differentiating between closely related tunings (multiple strings tuning to same pitch) might require music theory and/or genre information
  - Open Tunings: predominantly major chords and Folk/Indie genres
  - Drop Tunings: predominantly power chords and Rock/Metal genres

References

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[5] Aurora Cramer, Ho-Hsiang Wu, Justin Salamon, and Juan Pablo Bello. "Look, Listen and Learn More: Design Choices for Deep Audio Embeddings", IEEE Int. Conf. on Acoustics, Speech and Signal Processing (ICASSP), pages 3852–3856, Brighton, UK, May 2019.

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