Playing Style-Based Guitar Effects Control with Deep Learning

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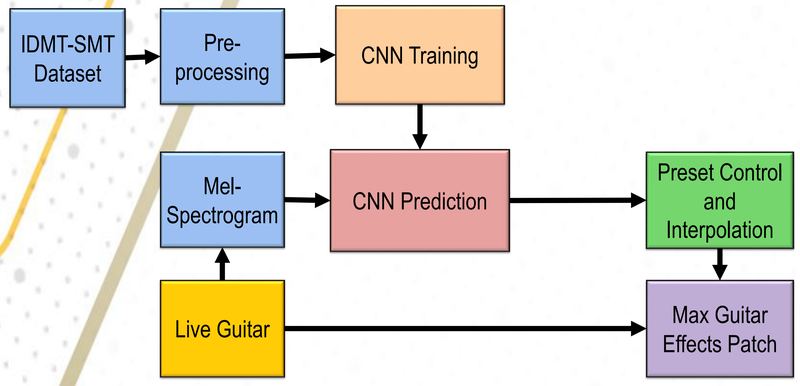
Background

What if guitar effects changed based on how you played?

Guitar effects have been around since the 1930s, evolving from foot-pedal boxes to digital recreations. While these digital recreations make sound design more accessible, they do not **advance the creative experience of the guitarist**.

This project creates an **interactive guitar effects control system** using deep learning that classifies the guitar playing style by genre.

System Overview



This system takes in the guitar audio input
extracts the **Mel-spectrogram** of the audio, predicts the preferred pedal layout using a convolutional neural network (**CNN**) and routes the interpolated prediction values to a **Max MSP guitar effects patch**.

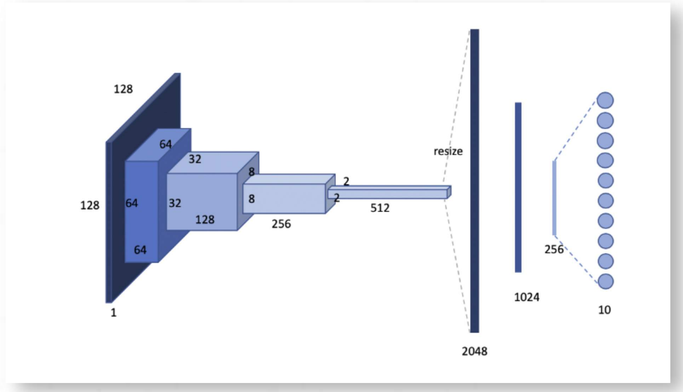
The audio is streamed to **Pytorch** and Max MSP for semi real-time interaction.

IDMT-SMT Dataset and Data Creation

Genres	# of IDMT-SMT Tracks	Added Tracks	# of Spectrograms
Rock/Pop	32	8	810
Jazz	32	8	807
Country/Folk	32	8	784
Reggae/Ska	32	8	776
Metal	32	8	795
Classical	32	8	815
Latin	32	8	803
Pop	32	8	787

The IDMT-SMT Dataset contains 8 guitar tracks for each genre with two different types of guitars at 2 different tempos
64 Guitar Tracks were created for this project to prevent overfitting and make the classifier more robust

CNN for Classification of Genre



Can a neural network classify unprocessed guitar playing styles by genre, without relying on the timbral cues of effects?

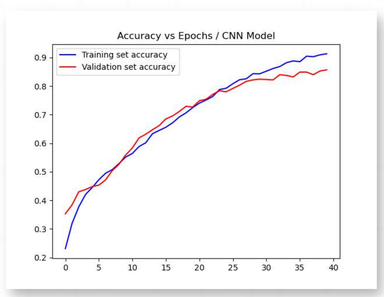
This project uses a **Convolutional Neural Network** that takes in the input guitar audio as a **Mel-spectrogram.**

The CNN **identifies patterns** in the spectrogram and **classifies** the real-time guitar audio **by the genre(s)** that it resembles.

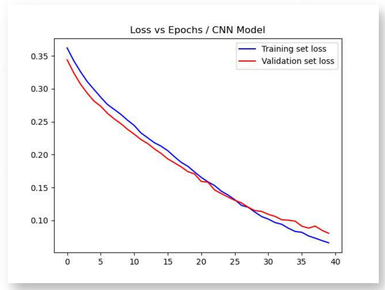
The CNN has **4 convolutional layers** with max pooling, RELU, dropout, and Batch-Normalization. It also includes **2 dense layers** and a Softmax layer with **8 class outputs**.

Classification Results

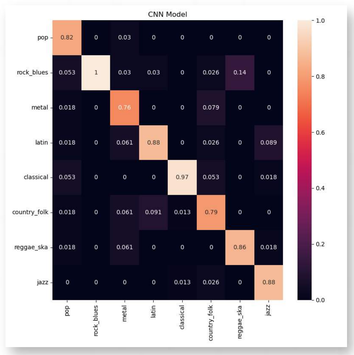
Precision: 0.87
Recall 0.88
F1 Score: 0.87



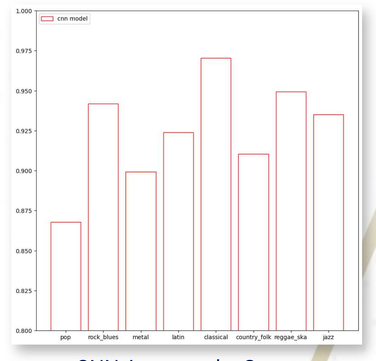
CNN Accuracy per Epoch



CNN BCE Loss per Epoch

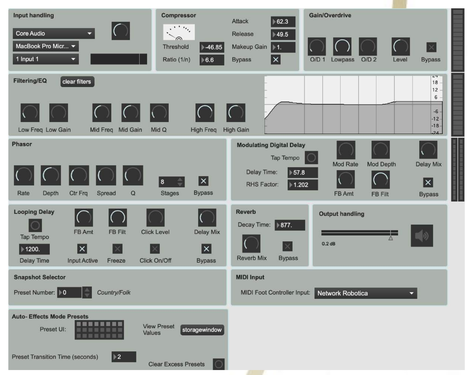


Confusion Matrix



CNN Accuracy by Genre

Overall System Results



The system was tested on its performance using three tests: **external data classification, external data interpolation,** and **audio to effect consistency**, to improve the human-computer interaction and determine if the system functions as hypothesized.
The **self-evaluation questionnaire** provided insights into the user experience with the system, which was **generally enjoyable but complicated**, with limited user control and unpredictable effects.

Conclusion

The system shows that **Convolutional Neural Networks can classify** guitar playing styles by genre or playing style without relying on effects.

The deep learning model **can even classify data outside the dataset with functional bias**.

The system creates a guitar-effects system that **meshes well with various playing styles** and enhances the playing experience, but there is **room for improvement in user control.**

Discussion and Future Work

- Contributes to future interactive **timbral control systems** for instrumentalists!
- Provides insights into the design and implementation of **neural networks for user interaction with music systems**.
- Test system **on beginners** and learn how this is most beneficial.
  - Improve UI – **Create a VST!**
- Allow classifications based on user chosen effect layouts.

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