

Playing Style-Based Guitar Effects Control with Deep Learning

Background

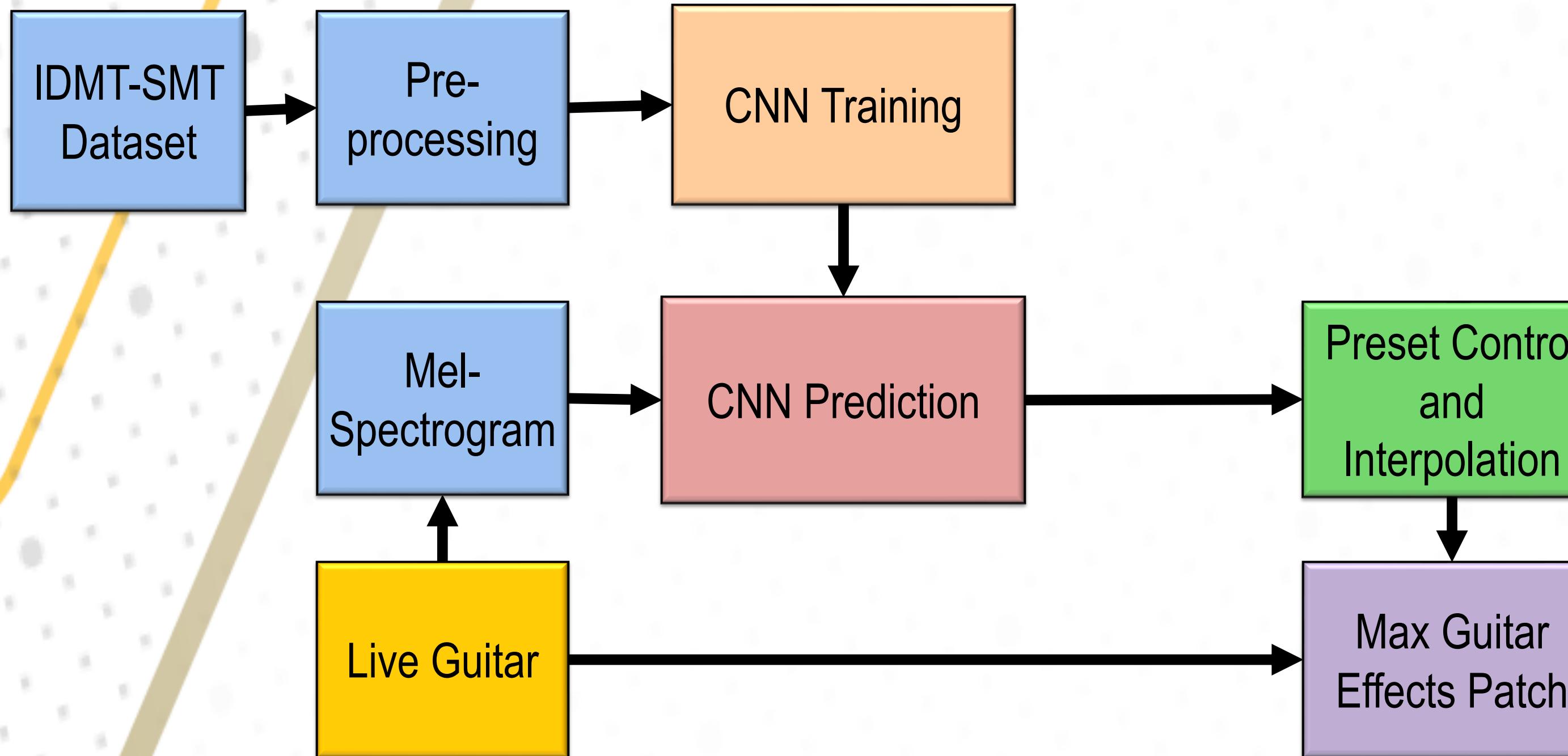


What if guitar effects changed based on how you played?

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.

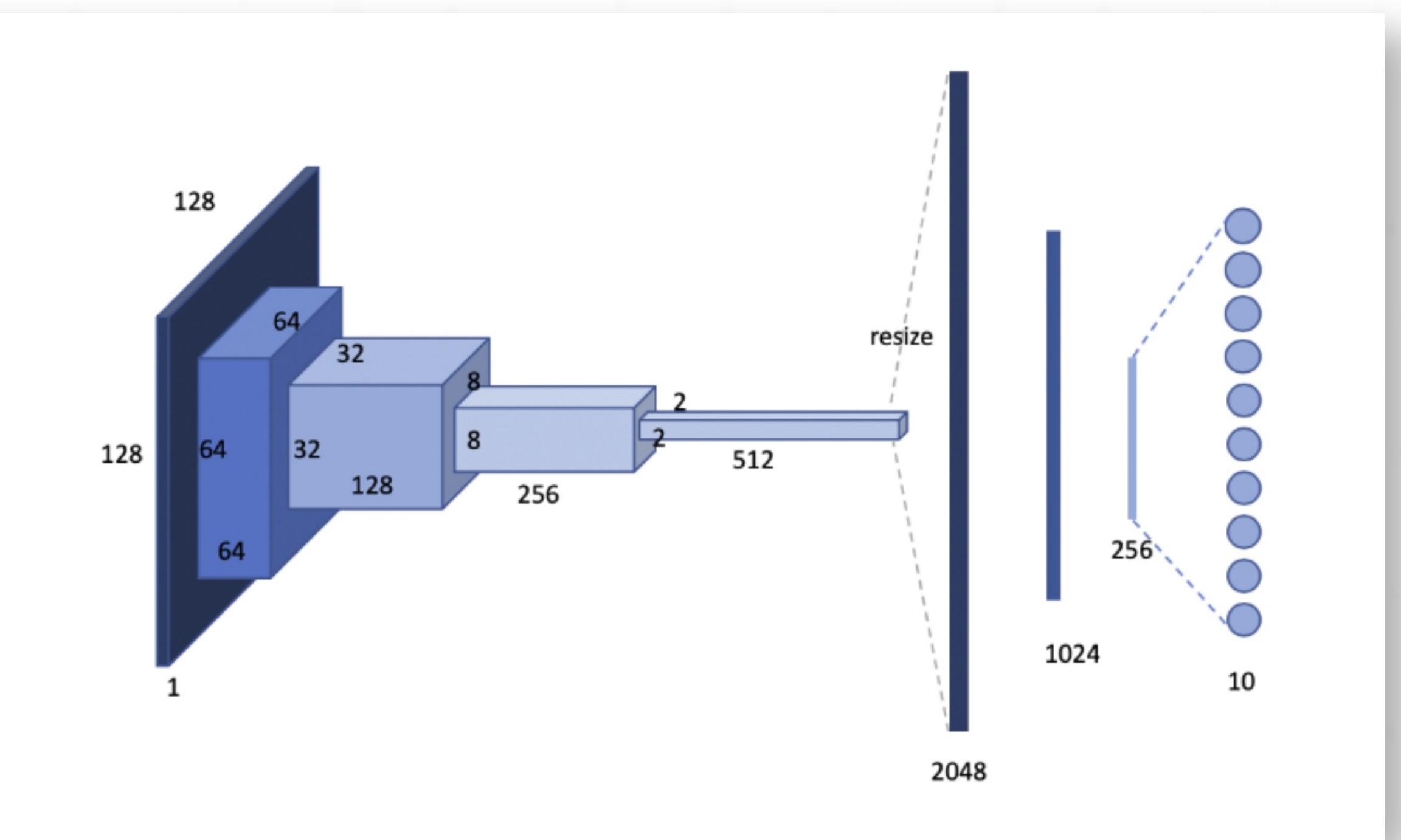
IDMT-SMT Dataset and Data Creation

| 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?

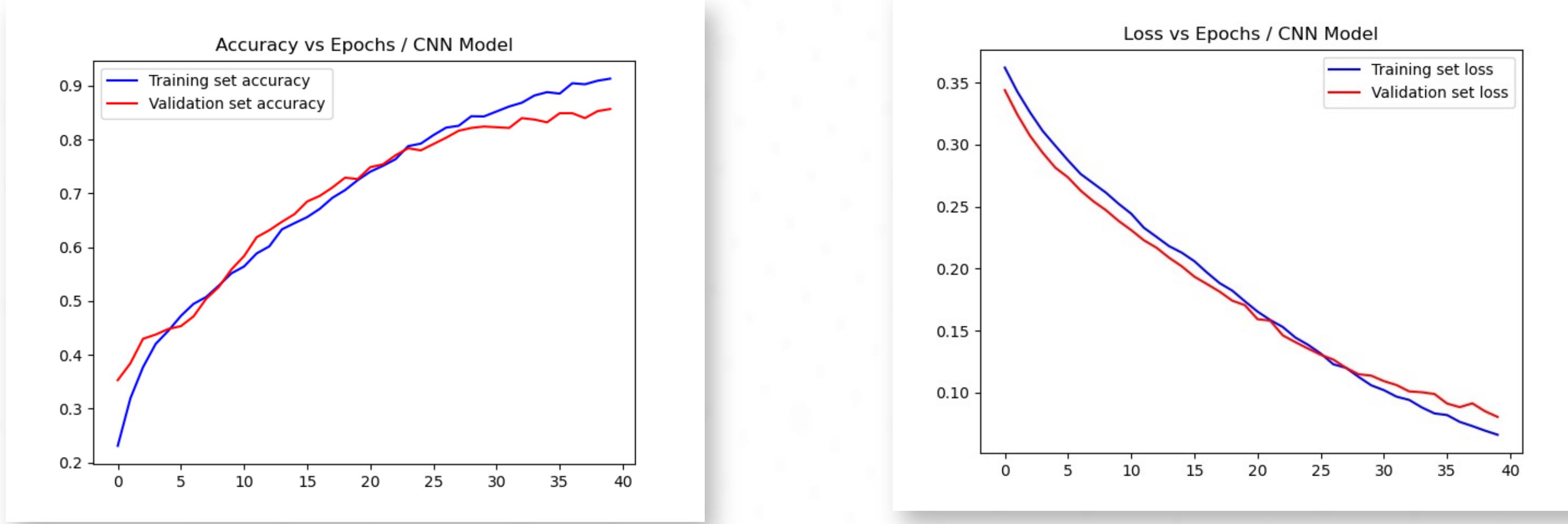
This project uses a **Convolutional Neural Network** that takes in the input guitar audio as a **Mel-spectrogram**.

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

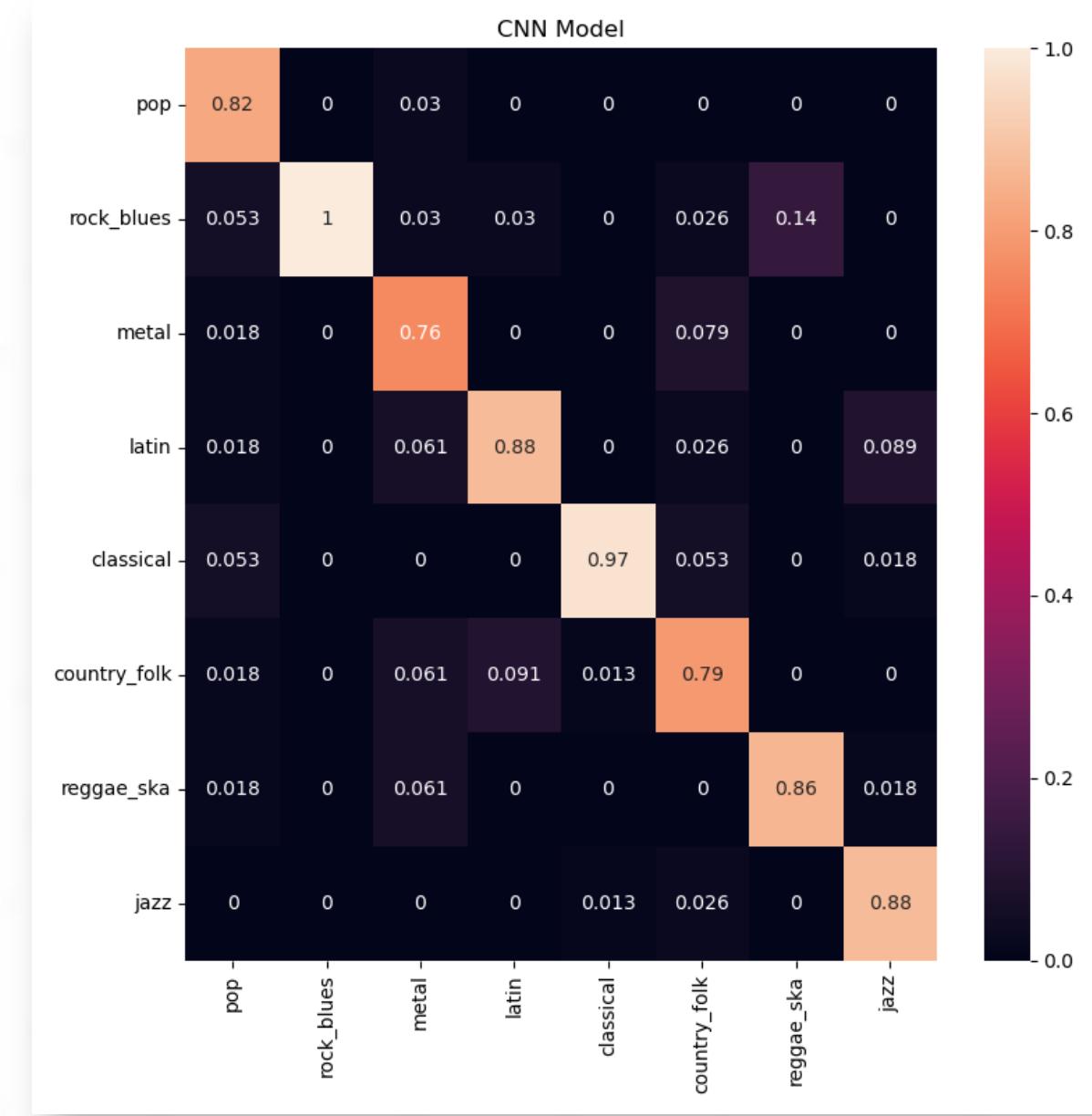
The CNN has **4 convolutional layers** with max pooling, RELU, dropout, and Batch-Normalization. It also includes **2 dense layers** and a Softmax layer with **8 class outputs**.

Classification Results

Precision: 0.87
Recall: 0.88
F1 Score: 0.87

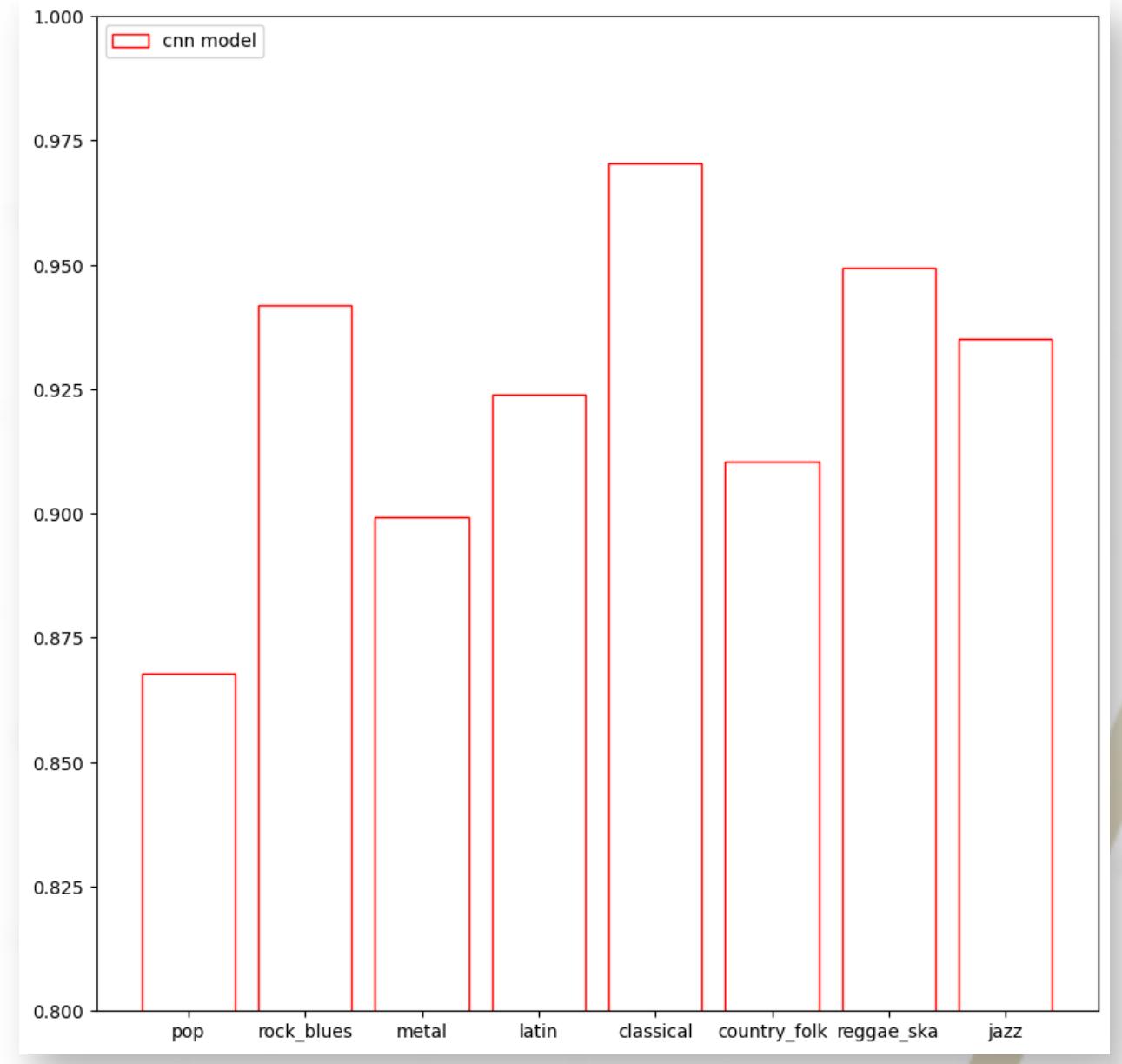


CNN Accuracy per Epoch



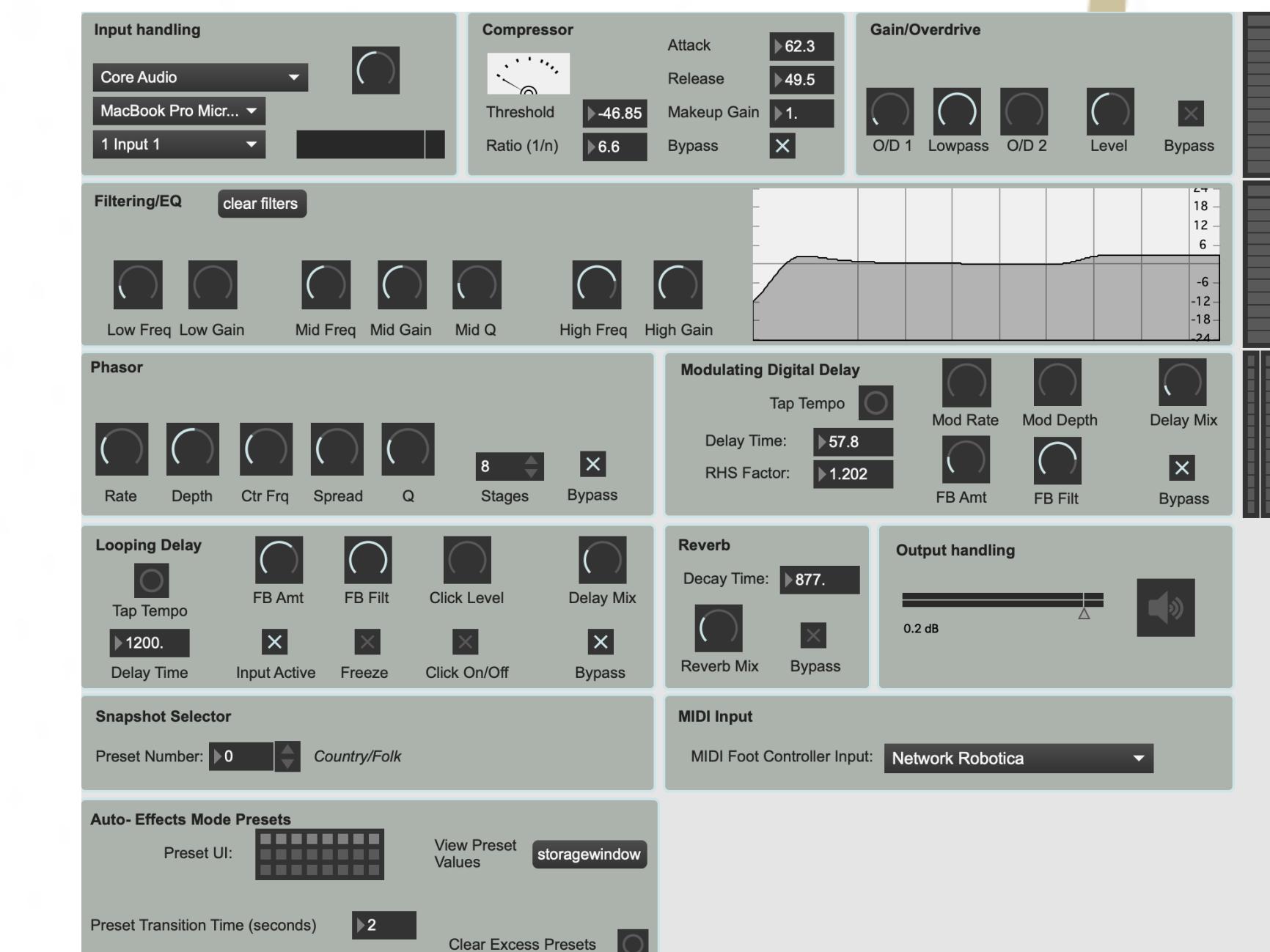
Confusion Matrix

CNN BCE Loss per Epoch



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.

