Stealing Guitar Tones

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Problem

- Identifying effect
- Figuring out parameters of effects without seeing them
- Replicating effects without owning plug-ins or physical gear

Goal

- Supply signal with effect on it (wet)
- Identify it
- Copy it and apply to signal with no effect (dry).
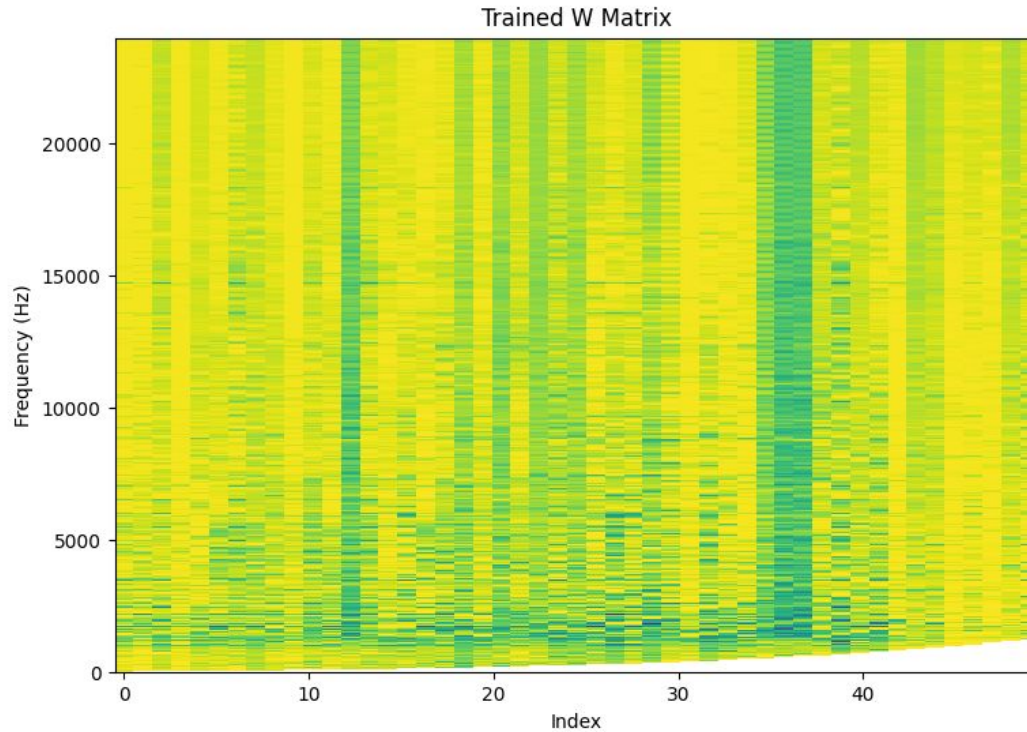
NMF and Datasets

- Baseline Dataset of:
  - Frequency Focused Audio
  - Time Focused Audio
- Effects Dataset
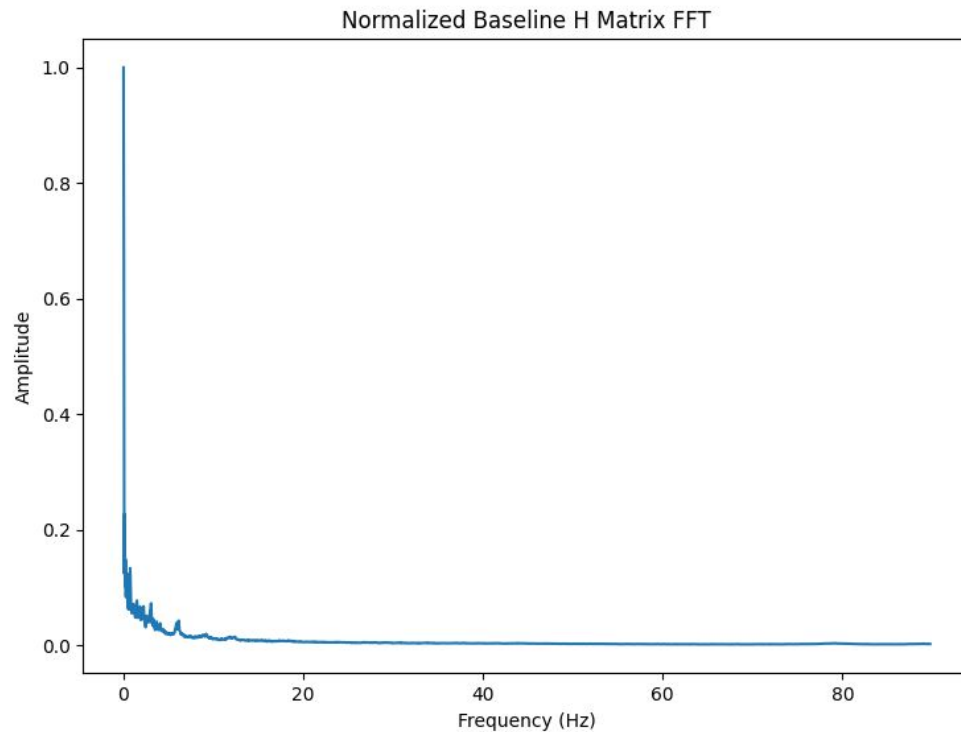- Obtain useful characteristics to compare and identify
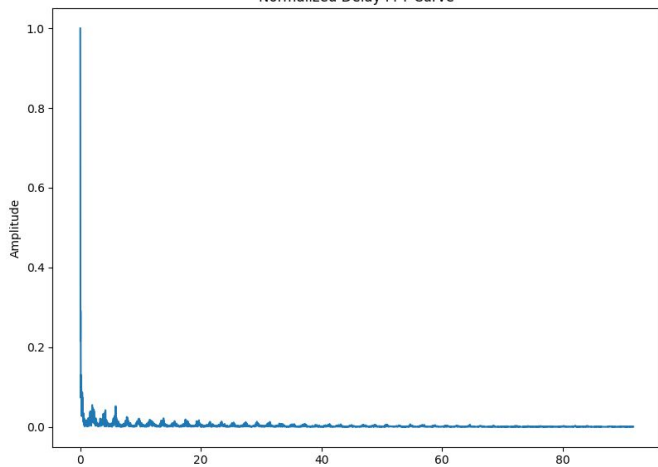
NMF and Datasets: Baseline Dataset

Intial W Matrix

NMF and Datasets: Baseline Dataset

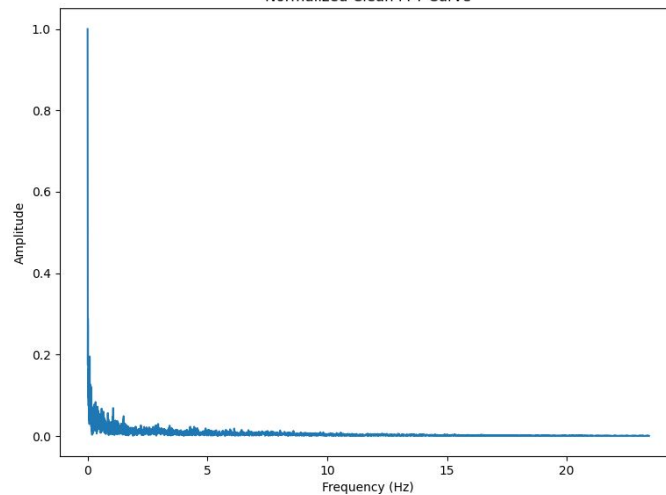Trained W Matrix
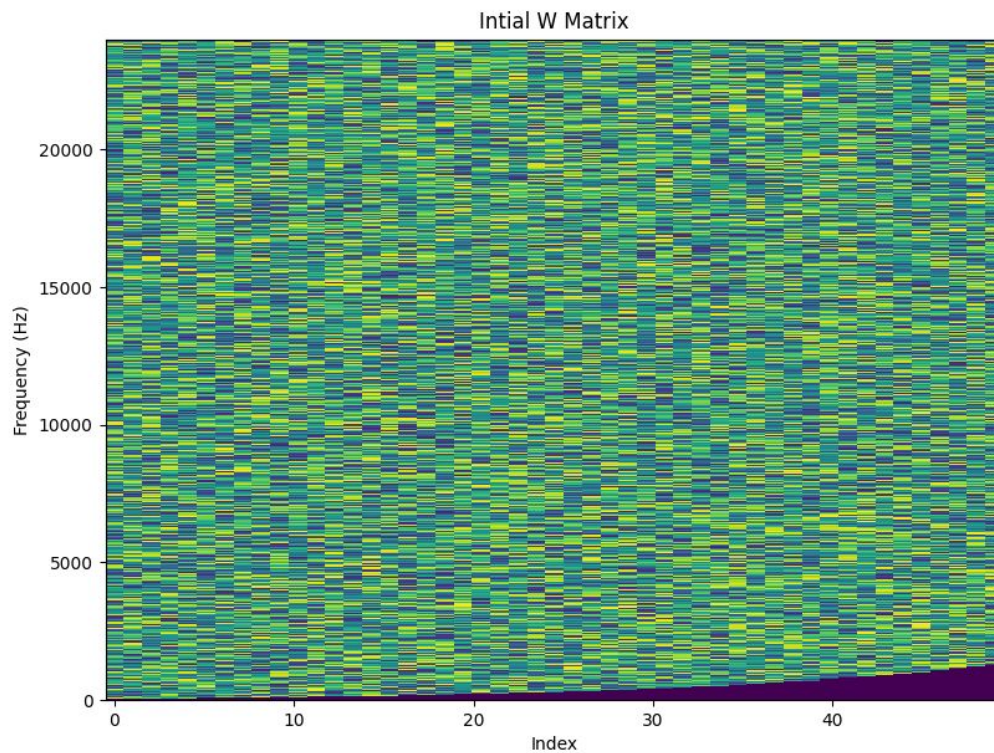
NMF and Datasets: Baseline Dataset

Normalized Baseline H Matrix FFT
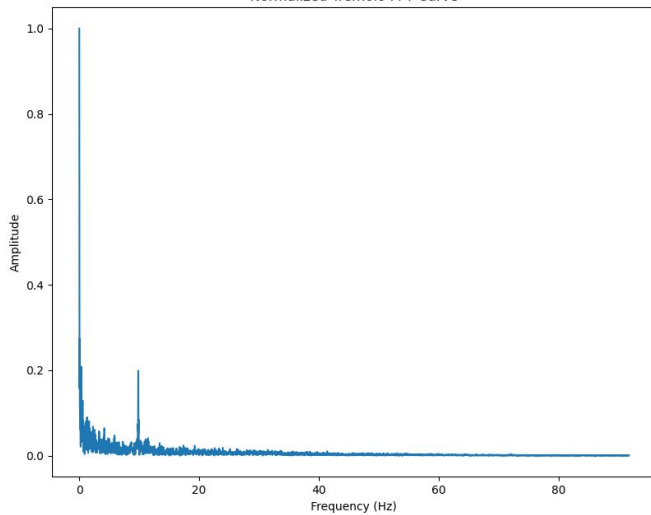
NMF and Datasets: Effect Dataset

NMF and Datasets: Effect Dataset

	Peaks	LPeaks
Clean	82.77	1.69
Tremolo	86.33	3.166
Delay	29.75	0
Reverb	13.5	1.5

Tremolo

Tremolo: Depth

Normalized Amplitude Peak Locations
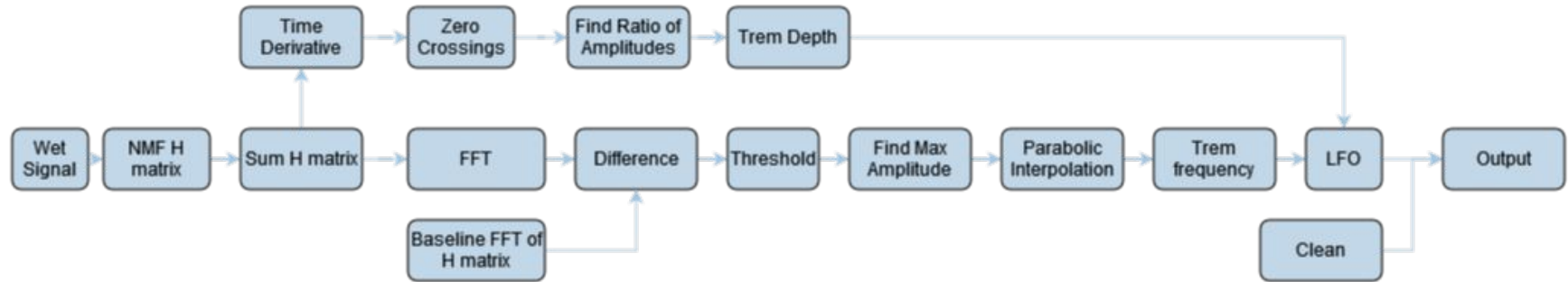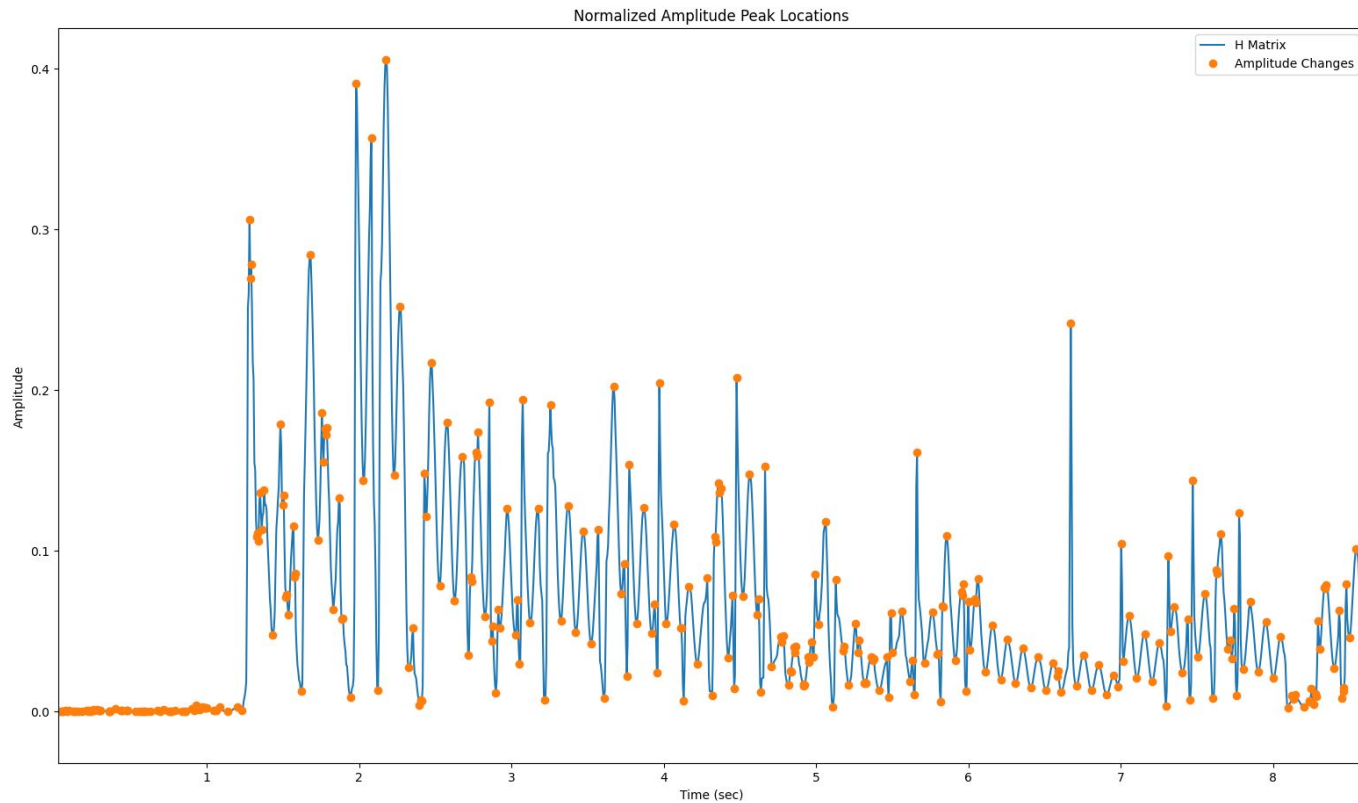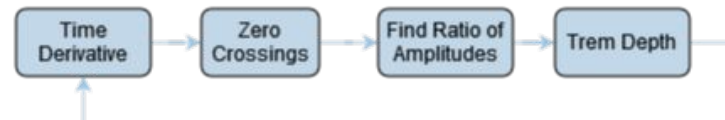
Tremolo: Frequency and Application

Normalized Tremolo Difference FFT Curve

Normalized and Filtered Tremolo Difference FFT Curve
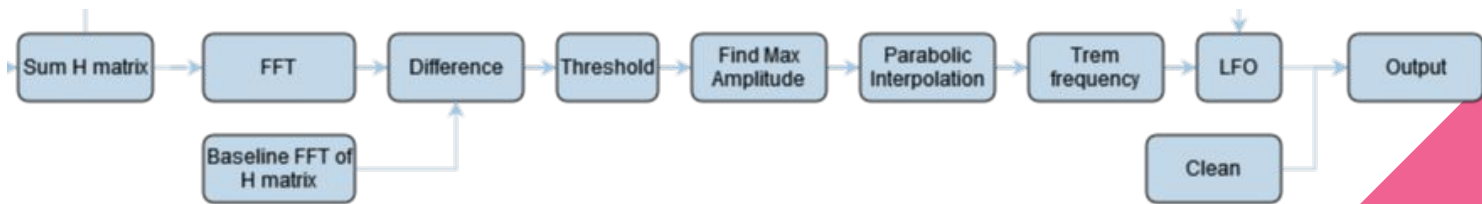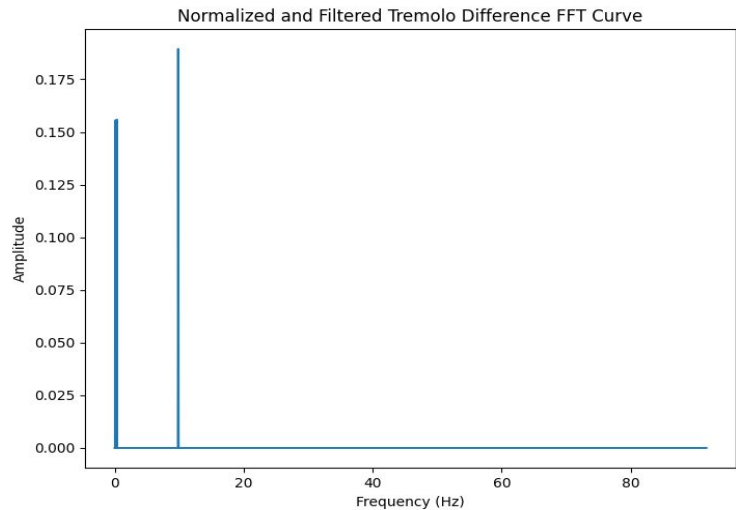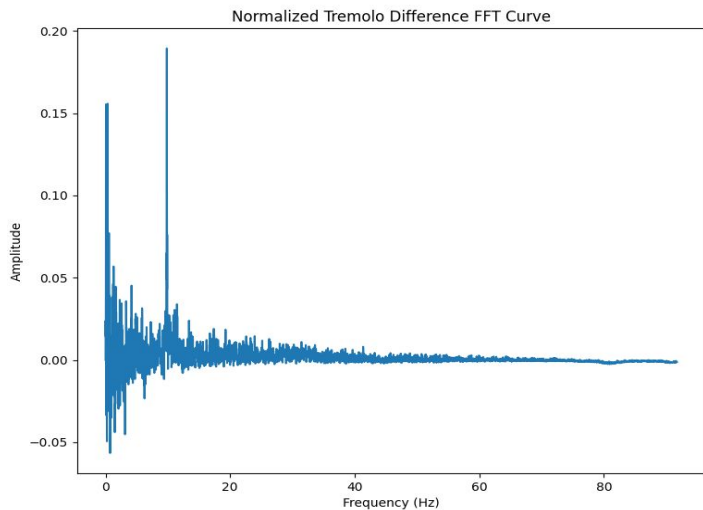
Tremolo: Results

	Run 1	Run 2	Run 3	Expected	Lowest Error	Average Error
Frequency	9.84 Hz	9.84 Hz	9.84 Hz	10.055Hz	2%	2%
Depth	41%	41%	42%	60%	30%	31%

Reverb

Reverb: Decay Time

Example Reverb H Matrix
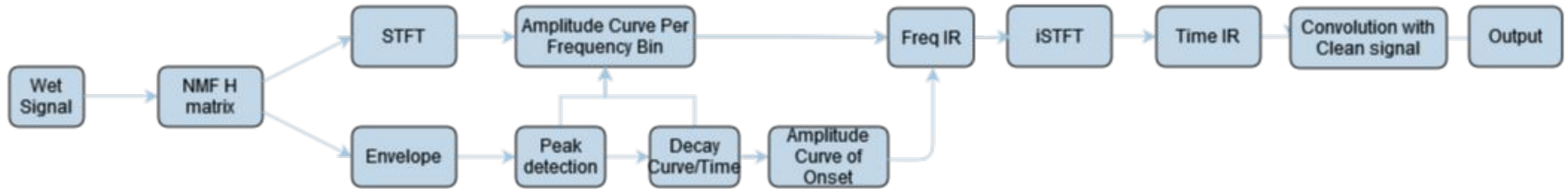
Reverb: Decay Curve
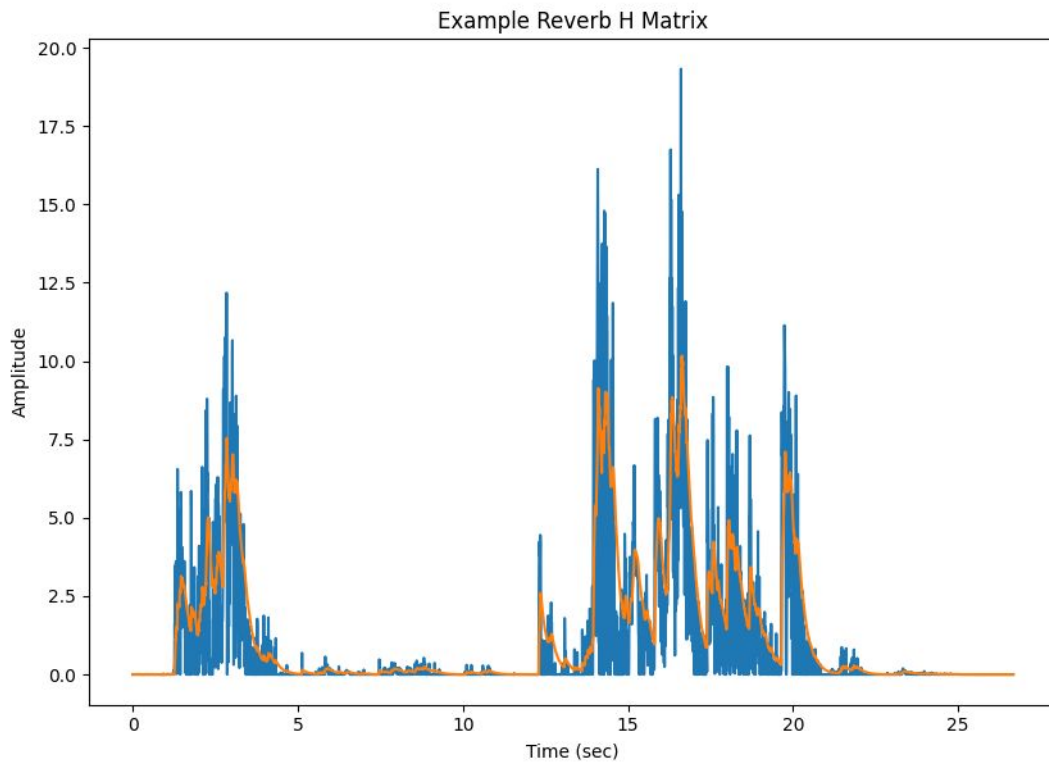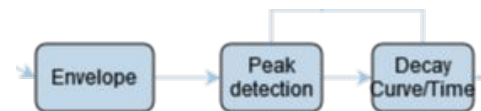
Normalized Reverb Decay Curve

Reverb: Impulse Response

STFT of Generated Impulse Response

STFT → Amplitude Curve Per Frequency Bin → Freq IR → iSTFT → Time IR → Convolution with Clean signal → Output
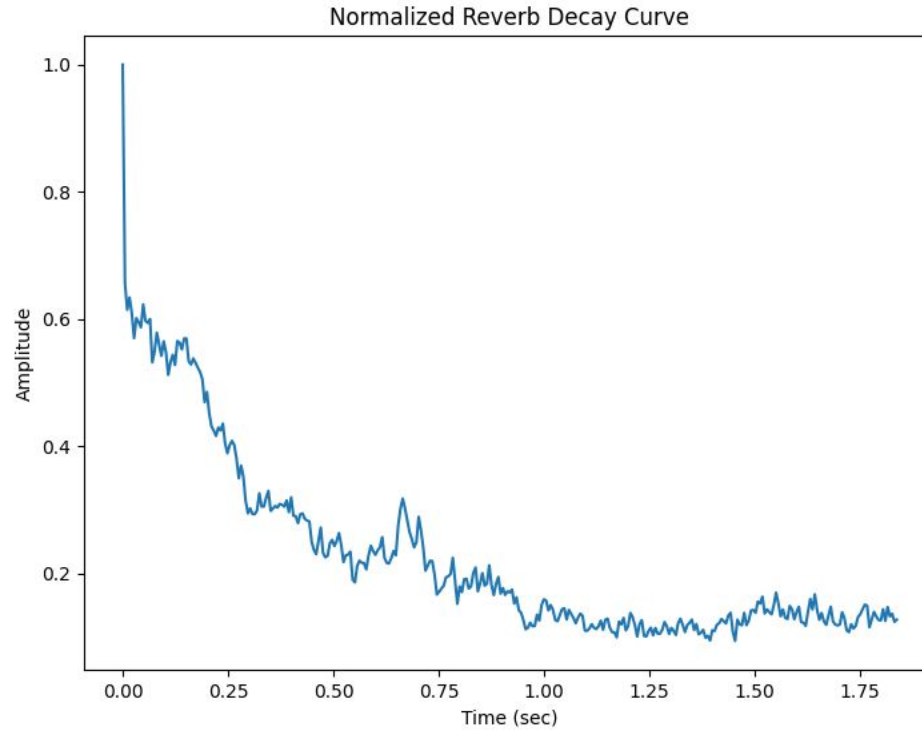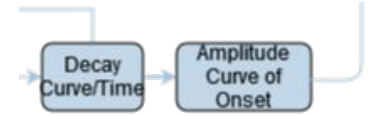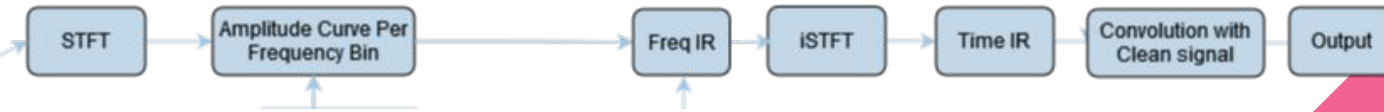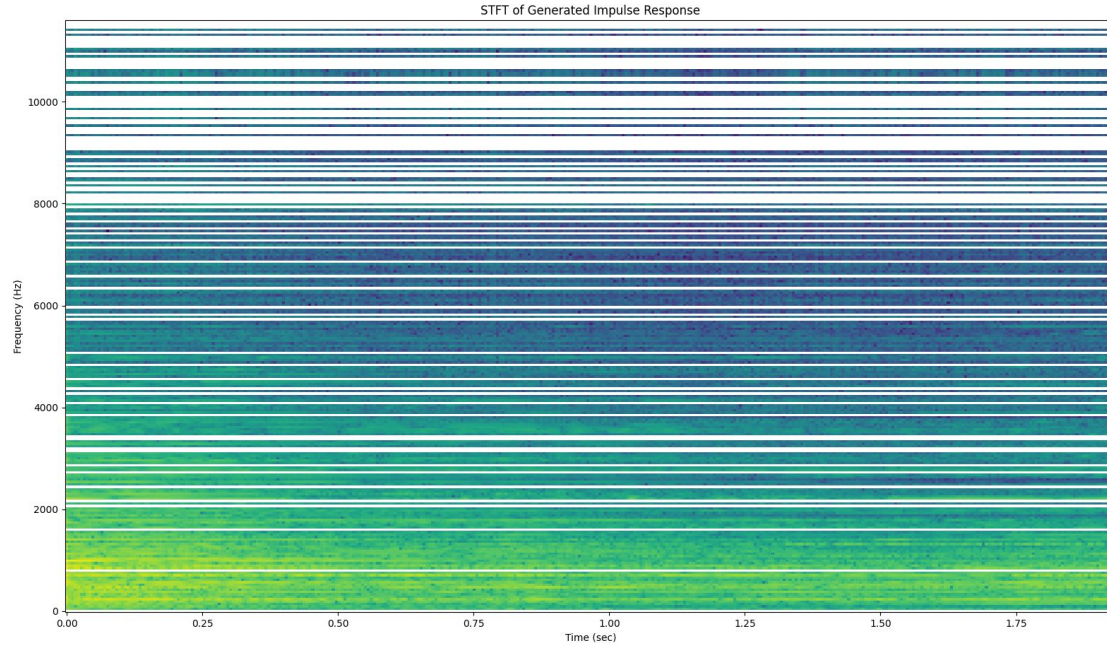
Reverb: Results

	Run 1	Run 2	Run 3	Expected	Lowest Error	Average Error
Decay Time	1.838 sec	1.835 sec	1.932 sec	2 sec	3%	7%

Delay

Delay: Delay Time


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H matrix sum → FFT of H matrix → Find Difference → Envelope Finder → Frequency of Delay via FFT peak detection → Decay Time

Baseline H FFT → Find Difference
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Normalized Delay Difference FFT Curve
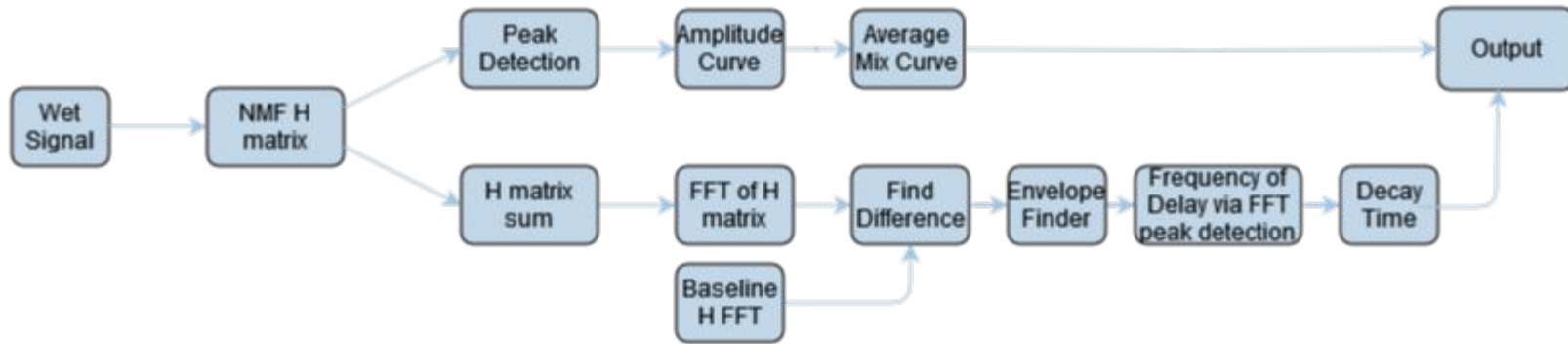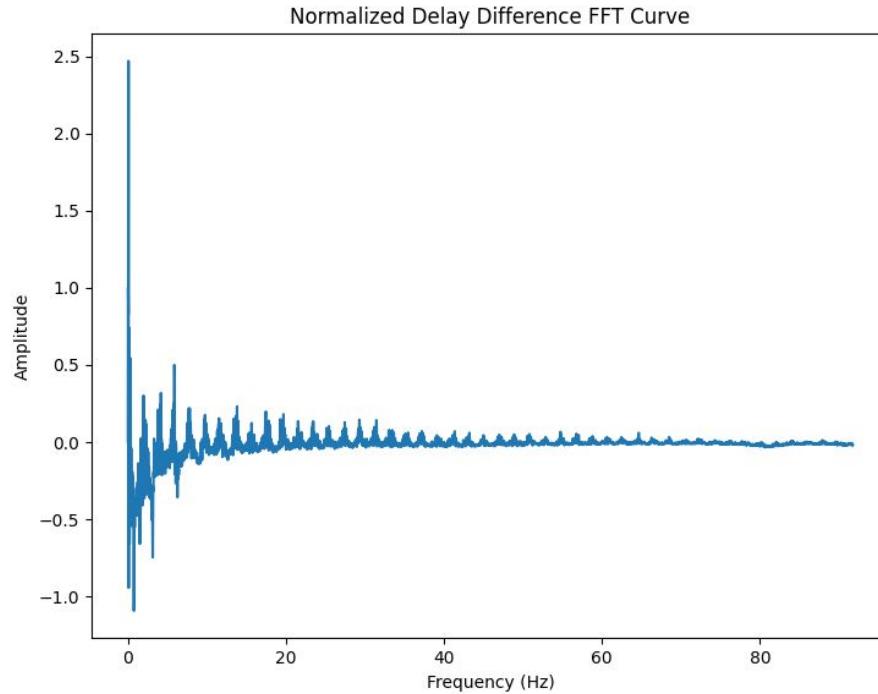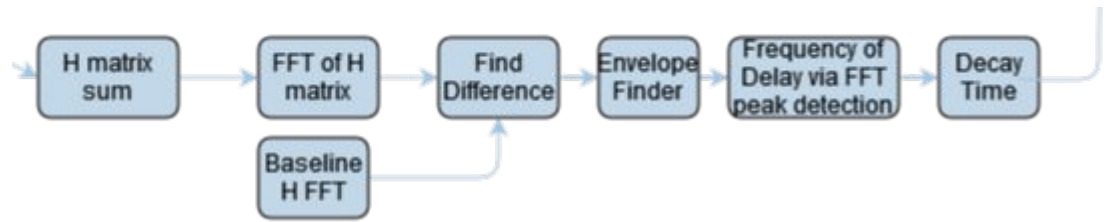
Delay: Echo Curve

Delay Echo Curve
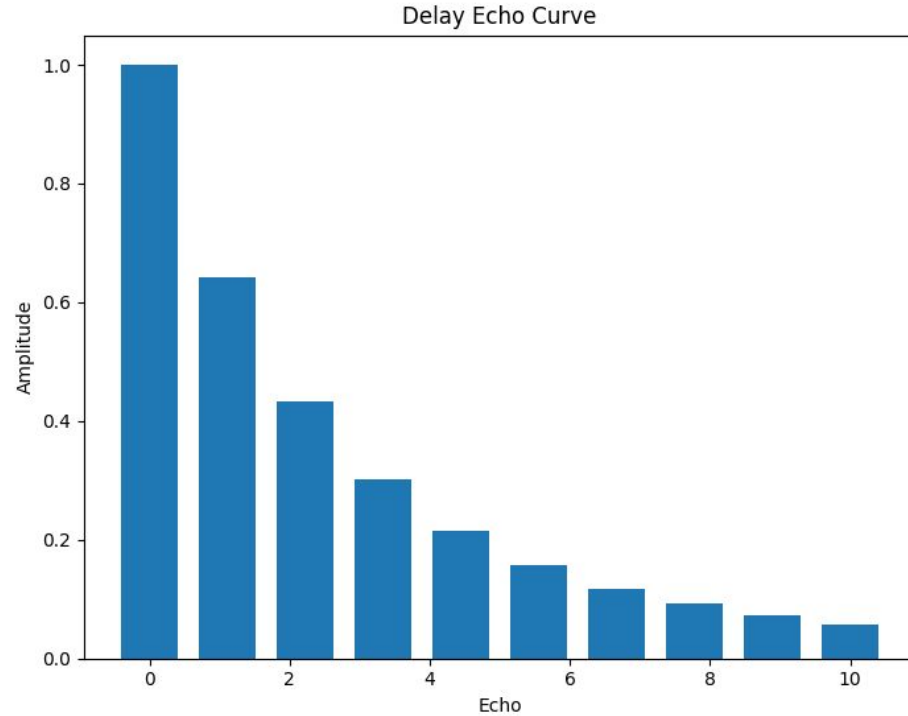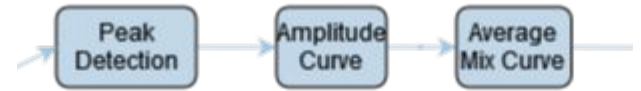
Delay: Results

	Run 1	Run 2	Run 3	Expected	Lowest Error	Average Error
Delay Time	585 ms	519 ms	611 ms	500 ms	4%	14%
Mix	71%	73%	72%	50%	42%	44%

Attempted Timbre Method

- Retrieve frequency characteristics from wet guitar, apply to dry guitar
- Attempt to use tanh distortion as a baseline
- Results were poor

Example Distorion W Matrix With Harmonic Series Identification
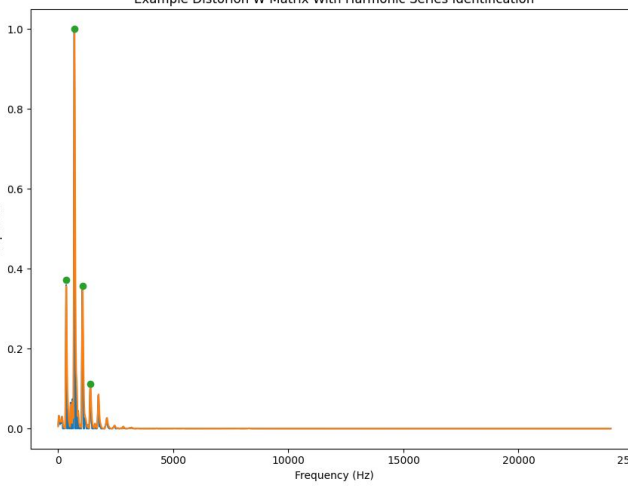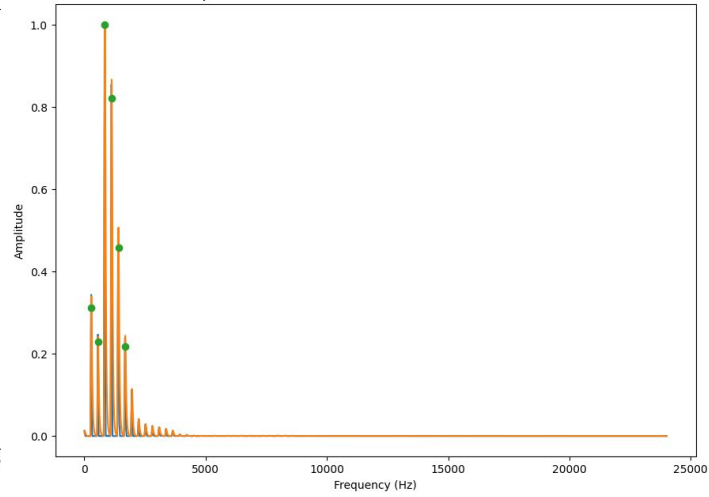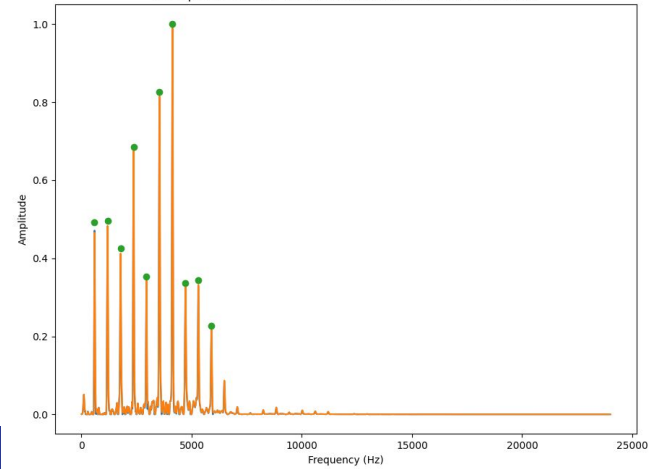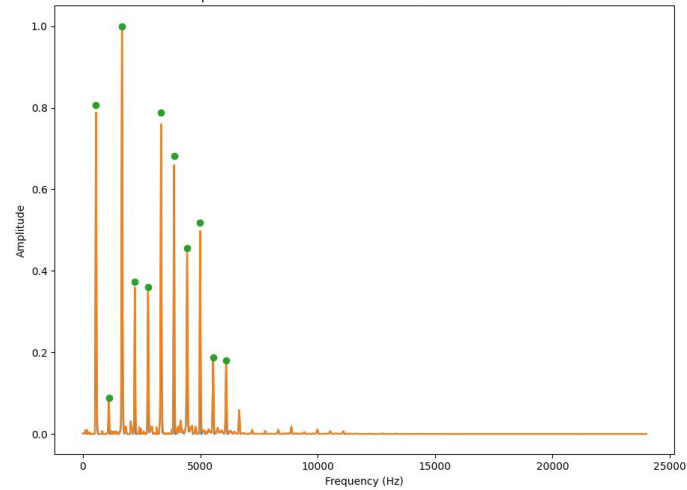

Example Distorion W Matrix With Harmonic Series Identification

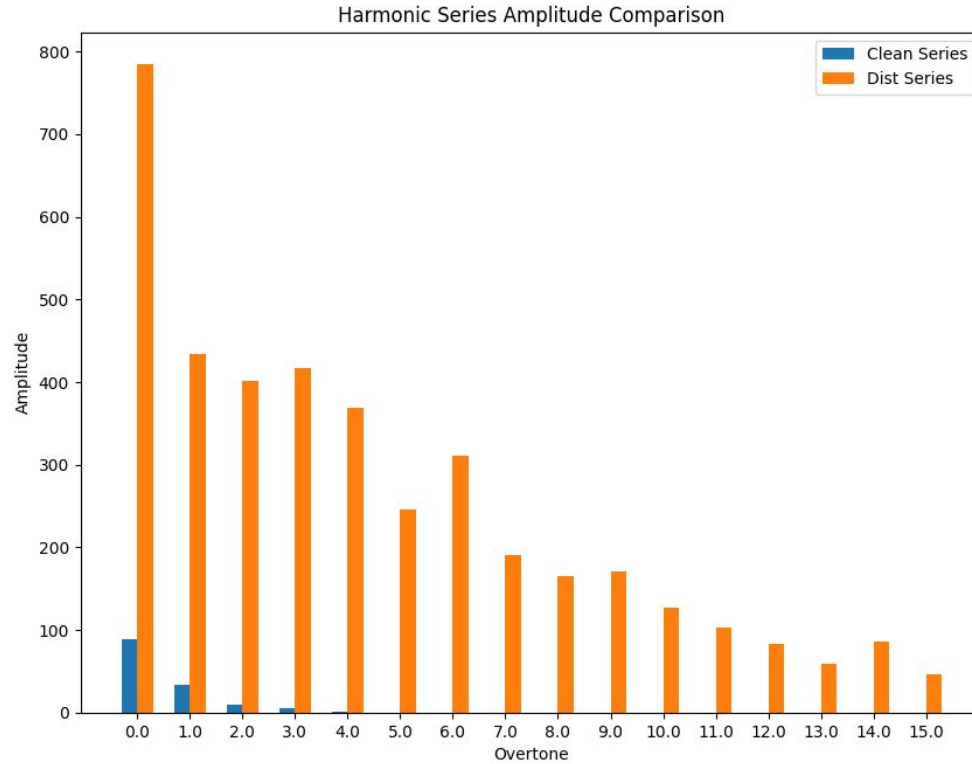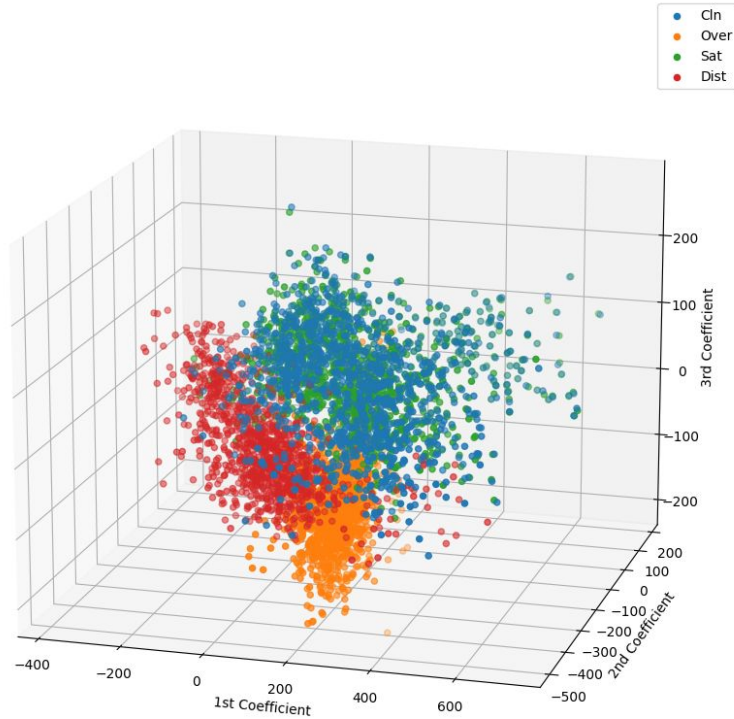Example Distorion W Matrix With Harmonic Series Identification

Example Distorion W Matrix With Harmonic Series Identification

Harmonic Series Identification

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Harmonic Series Amplitudes

Timbral Identification

MFCC of Different Types of Distortion

Identification Results

Guess	Inputted Signal			
	Clean	Tremolo	Delay	Reverb
Clean	69.83%	25.58%	50%	37.8%
Tremolo	65.82%	65.6%	35.37%	23.66%
Delay	25%	16.67%	92.86%	72.97%
Reverb	33.33%	0%	33.33%	81.48%

Replication Results

Clean
Audio

🔊

Tremolo
Audio

🔊

Delay
Audio

🔊

Reverb
Audio

🔊

Stolen
Tremolo
Audio

🔊

Stolen
Delay
Audio

🔊

Stolen
Reverb
Audio

🔊

Reverb
Impulse
Response

🔊

Future Work