



Music
Technology
Group

Groove Transfer VST for Latin American Rhythms

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Introduction



INSPIRATION

**Bridge the gap
between
algorithmic
rhythm creation
and the expressive
qualities of live
performance.**



OBJECTIVE

**VST Plugin to Apply
Authentic Latin
Grooves to quantized
MIDI**

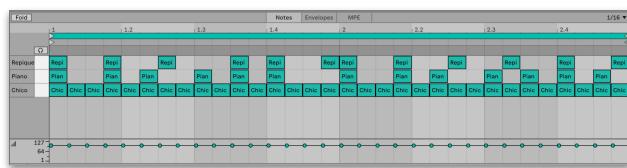


Overview

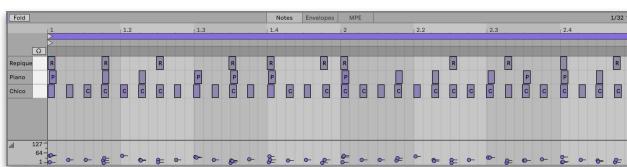
Candombe Drumming



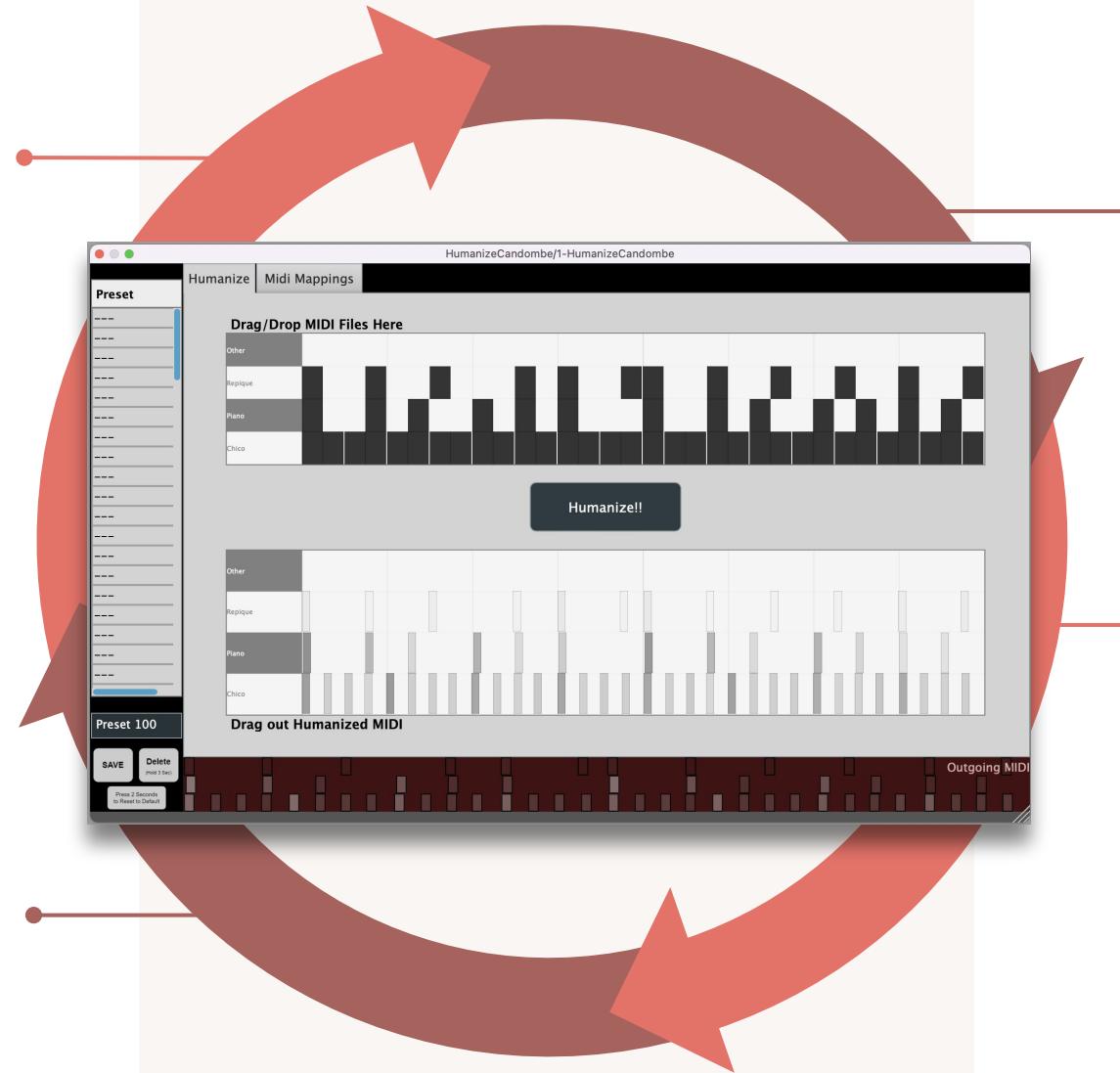
Groove Transfer



Quantized Midi



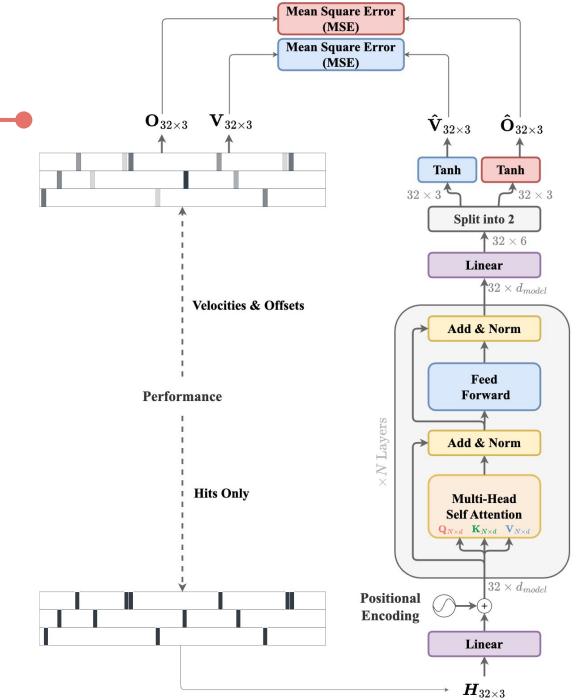
Humanized Midi



Data Representation

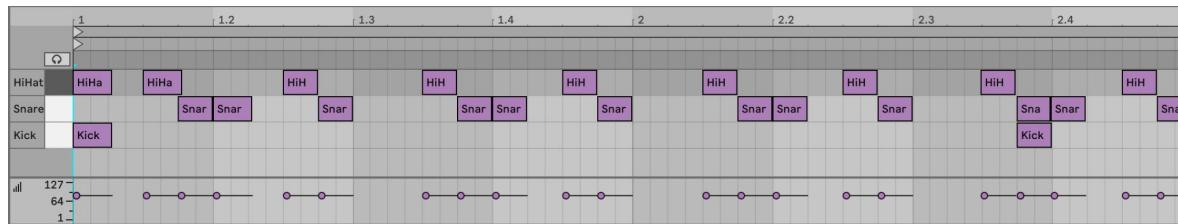
| Data | Matrix | Values |
|------------|-------------------|--------------------------|
| Hits | $H_{32 \times 3}$ | $h_{ij} \in \{0, 1\}$ |
| Velocities | $V_{32 \times 3}$ | $v_{ij} \in [0, 1]$ |
| Offsets | $O_{32 \times 3}$ | $v_{ij} \in [-0.5, 0.5]$ |

Model Architecture

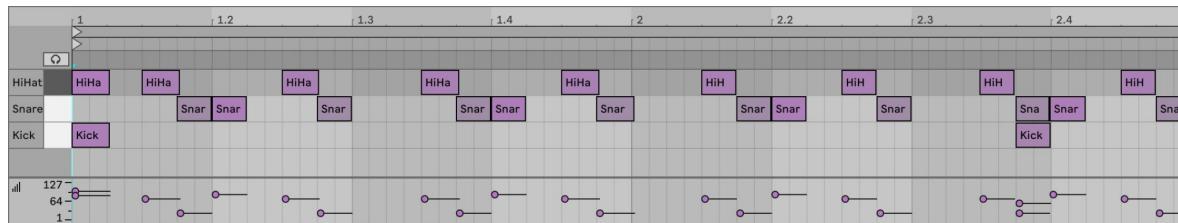




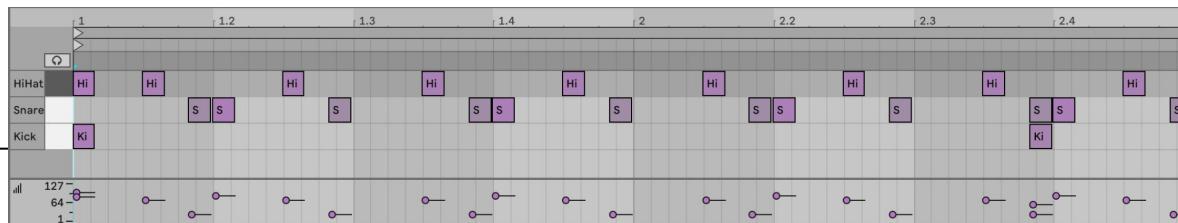
Quantized



Quantized with Dynamics



Unquantized (Humanized)



Microtiming

- Subtle deviations from strict grid timing
- Notes or Beats slightly ahead or behind expected position
- Used to express 'Feel' or 'Groove'
- Prevalent in Jazz, Funk, Hip-Hop, Waltz, Folk Traditions

Microrhythm

Broader term to include aspects that affect perception of groove ([Danielsen et al., 2024](#)).

- Microtiming
- Dynamic envelope
- Timbre
- Duration
- Central Frequency

Candombe Drumming



Microtiming plays a vital role in shaping the distinctive rhythmic feel in Afro-Latin American music.

Our focus in this work is Candombe drumming, a defining element of Uruguayan popular culture

Its metric structure follows a cycle of four beats with sixteen pulses—similar to other Afro-Atlantic music traditions.

It is performed using three drums of varying sizes and pitches—Chico, Piano and Repique—each playing a distinct rhythmic pattern.

Data Representation

| Data | Matrix | Values |
|------------|-------------------|--------------------------|
| Hits | $H_{32 \times 3}$ | $h_{ij} \in \{0, 1\}$ |
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Dataset

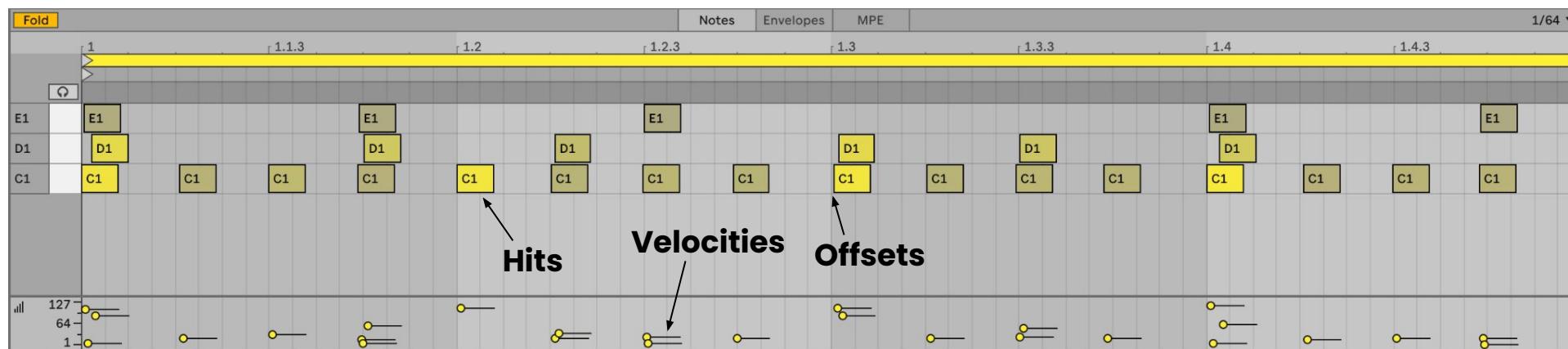
- IEMP Candombe Dataset
- 12 performances, total length of approximately 35 minutes
- Three stems corresponding to Chico, Piano and Repique drums

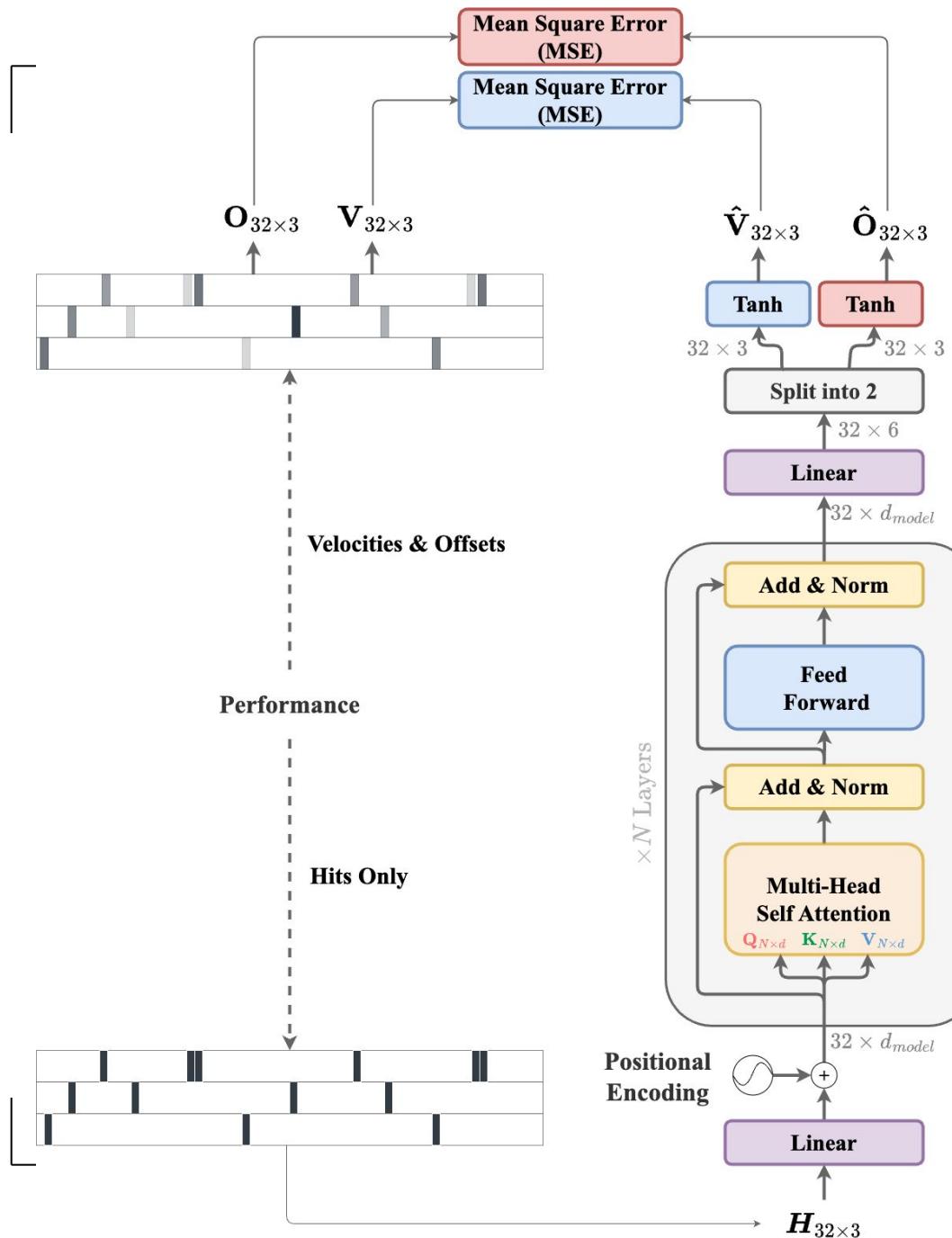
Annotations

- Provides beat, onset time & strength annotations for each drum
- Annotated at 16th note subdivisions

Processing

- Hits(H), Offsets(O) matrices from onset times, Velocity(V) from onset strength
- Matrices obtained over 2 bar sequences





Model Architecture



Model Details

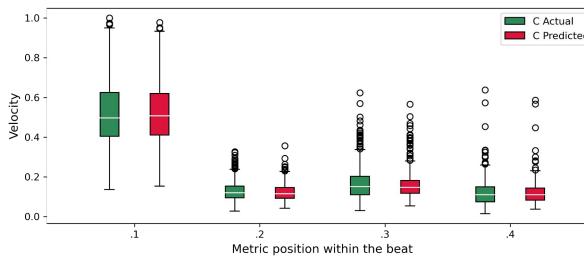
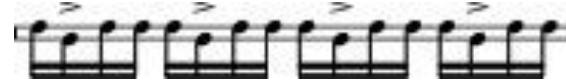
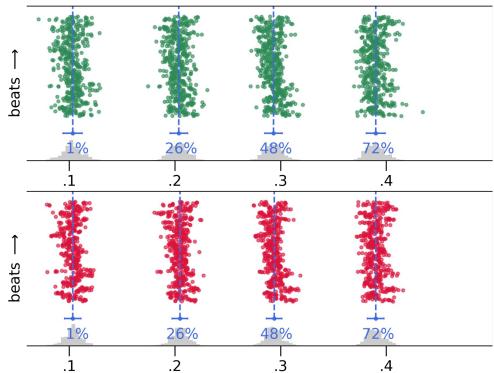
- Encoder only transformer
- Multi-head self-attention with 4 heads and a model dimension of 128
- Tanh activations both for velocities and offsets



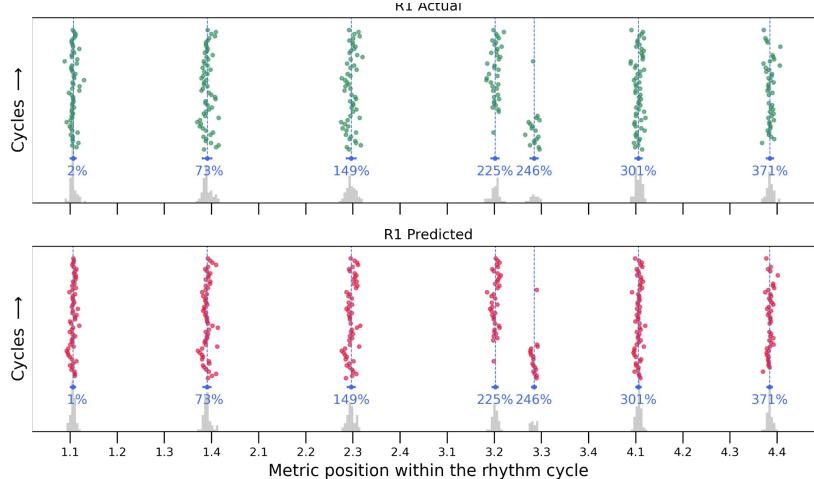
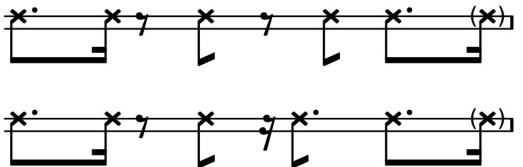
Input Output

- Input - Quantized Hits Matrix
- Output - Velocity and Offset Matrices
- Loss - Mean Square Error over outputs masked by input hits matrix

Beat - Level



Cycle - Level



Experiments

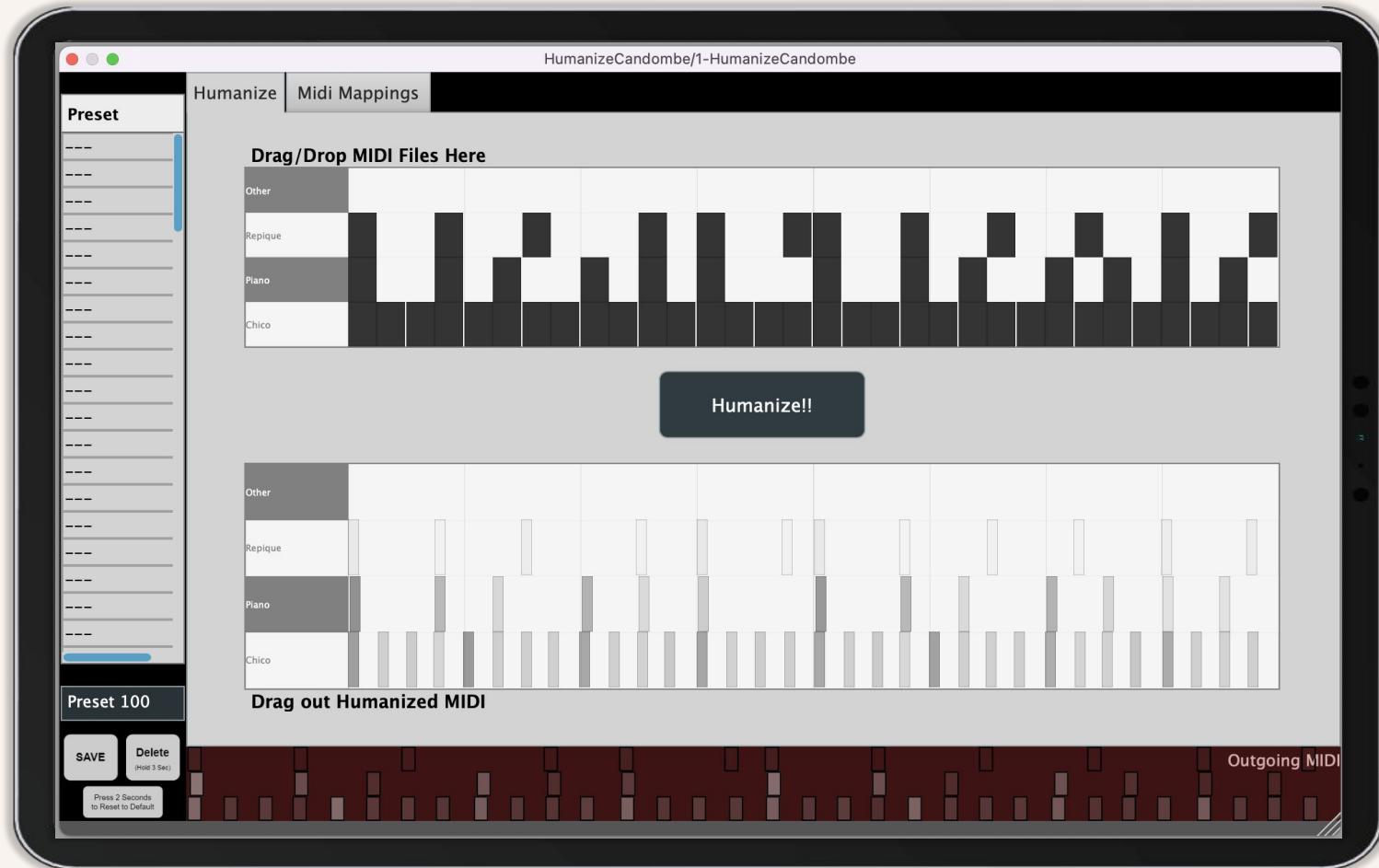
Leveraging musicological understanding of Candombe for analysis at two temporal scales

▀ Distribution of Onsets in Beat

- Chico assumes role of timekeeper
- Repeating pattern at beat level
- Comparison of actual vs predicted
 - onset distributions
 - velocity distributions

▀ Distribution of Onsets in Cycle

- Typical *Madera* pattern played by Repique
- Repeats over a metric cycle
- Inference on annotated sections in IEMP dataset



Groove Transfer VST for Inference

The plugin takes input drum hits pattern as MIDI and adds groove to it.

The humanized MIDI can be played within the plugin using default sounds, or dragged out to be used in DAWs.

Discussion & Future Work



01. Challenges

- Dependence on Data
- Ethical implications

02. Opportunities

- Study of various rhythmic cultures
- Richer algorithmic rhythm creation tools in music productions

Thank You

