Bistate Reduction & Comparison of Drum Patterns

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Computational models of **similarity** for drum patterns: important MIR applications (drum pattern recommendation, generation systems)

Challenge: Modelling complexity of polyphonic rhythm perception.
- How are multiple rhythmic streams integrated by listener?
- How do we perceive interaction between rhythmic streams?

Basic drum patterns usually defined by alternation of, typically,
- **bass drum** (or "kick drum") strokes &
- **snare drum** strokes

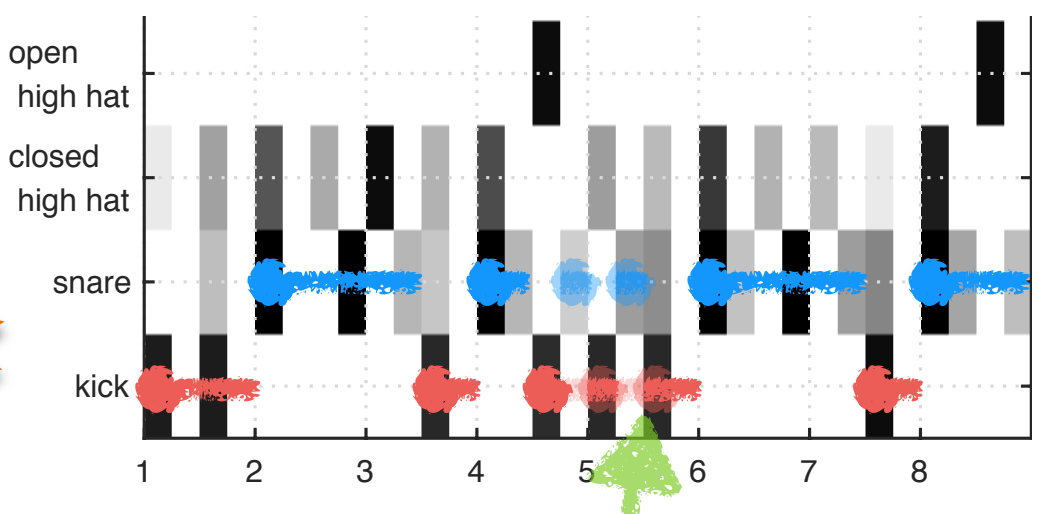
(further subdivision on ride cymbal or hi-hat)

Main hypotheses:

For **any** drum pattern, we tend to perceive **alternation** of **2** types of states: **Low** & **High states**

Soul Grooves 2

Listen here



When **comparing** drum patterns,
- we focus on **2 main drums** and ignore other drum channels.
- we focus on **alternation** between these 2 drums, **ignoring successive repetitions** of same drum.

Comparison based on simple **alignment**.

Soul Grooves 31

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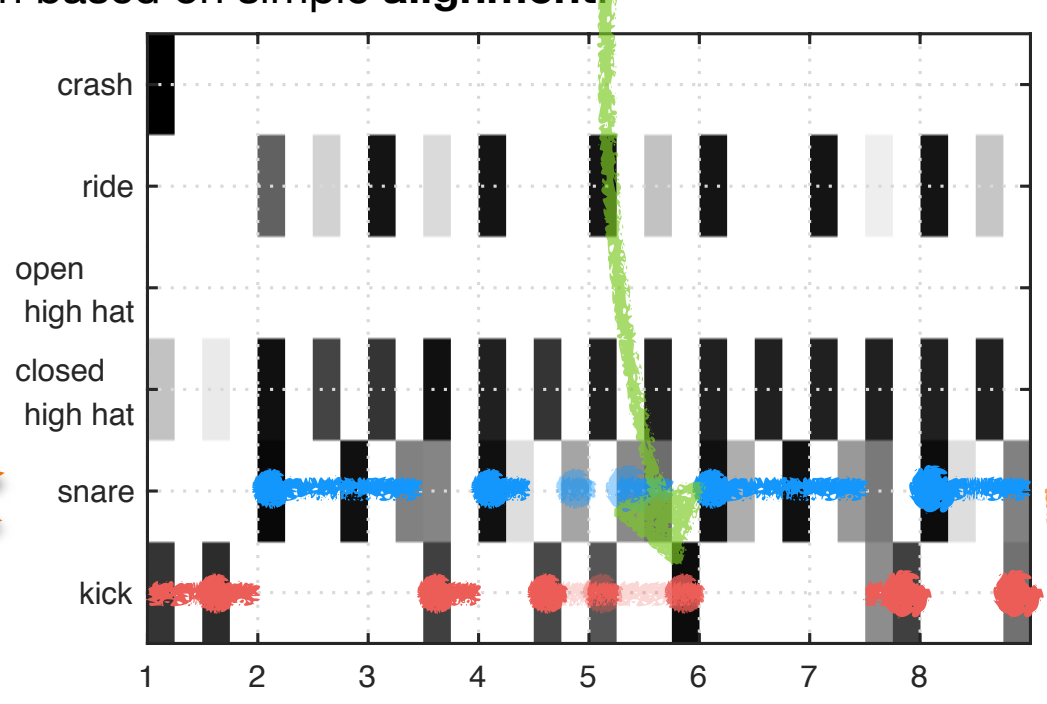
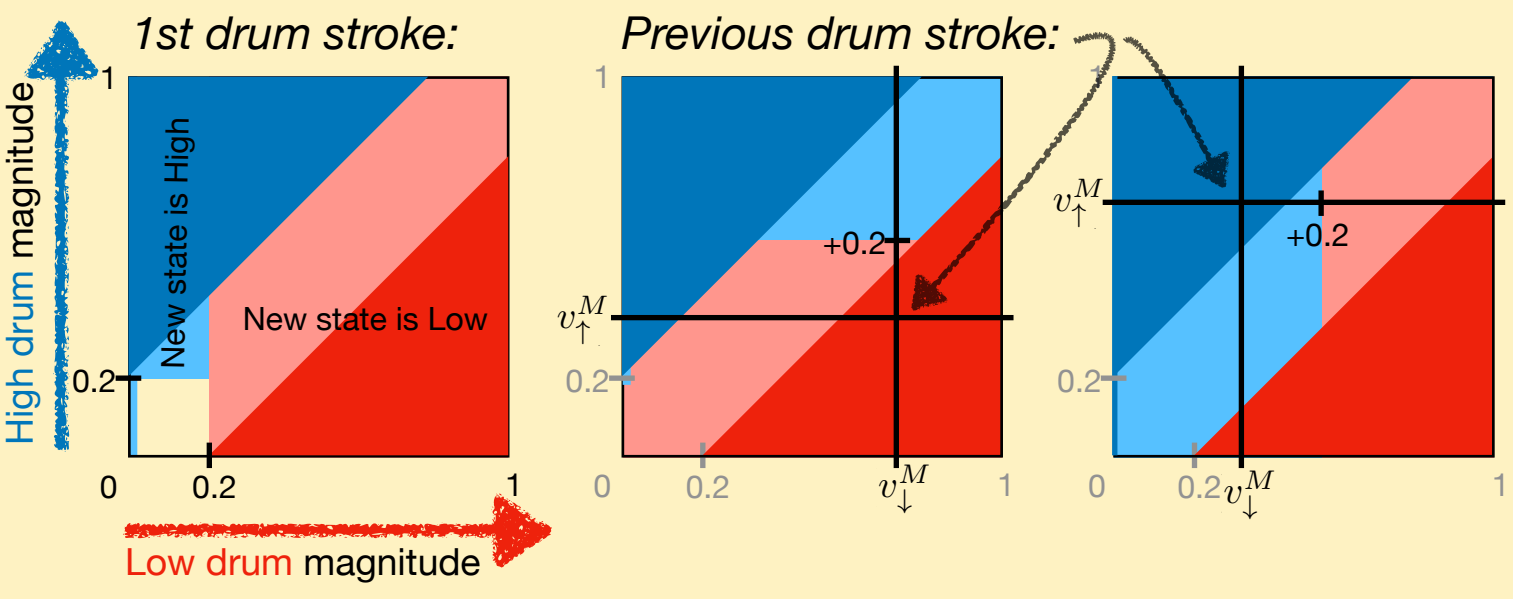
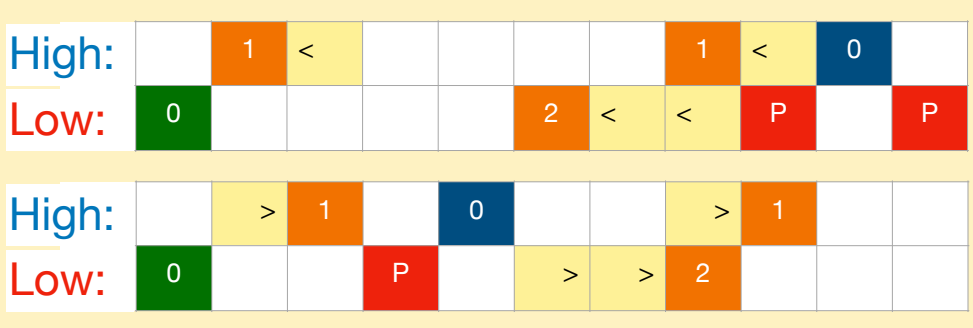


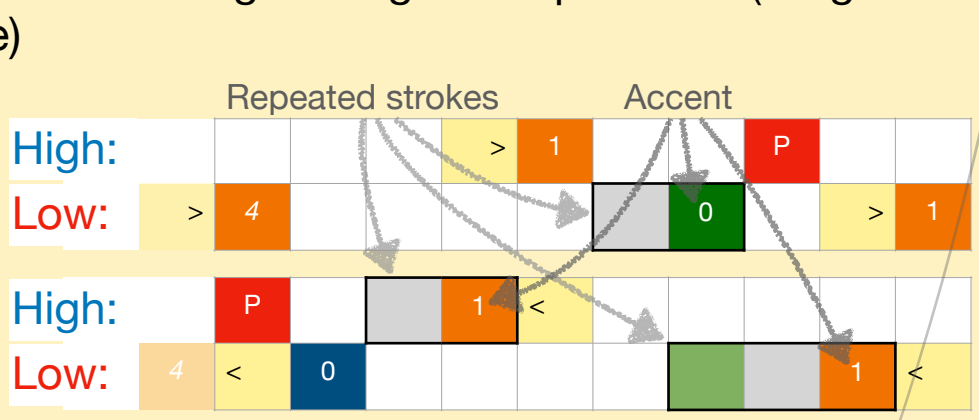
<u>More details:</u>
How to detect Low and High states when both drums are played?
☛ *State transition diagrams:*



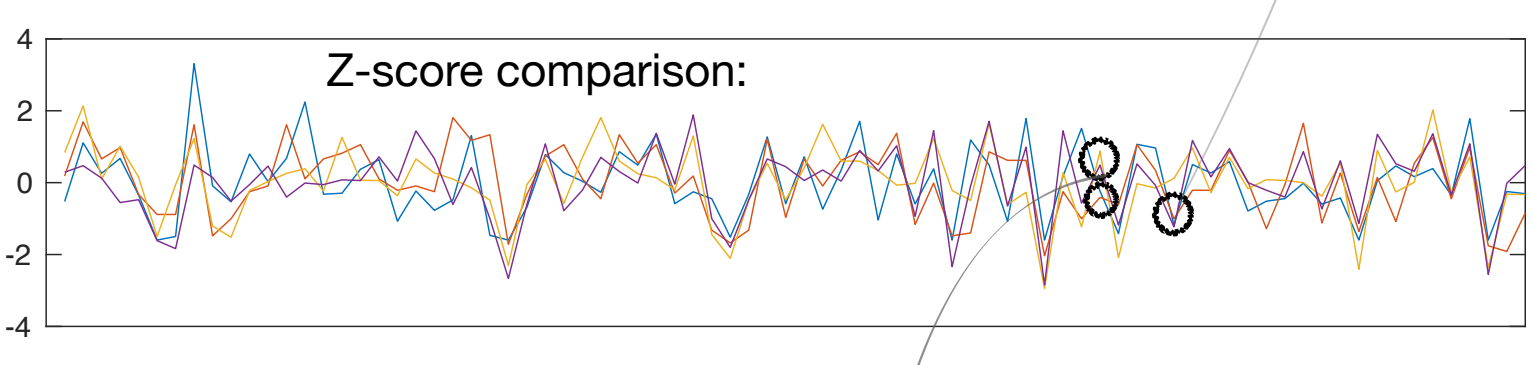
How to align two reduced drum patterns?
☛ *Misalignment penalties:*



Distance measure = summing misalignment penalties (weighted by stroke magnitude)



Evaluation: comparison with perceptual similarity ratings
Dataset: 160 drum patterns, various genres (rock, pop, jazz…)
Split into 80 pairs, with similarity ratings from 21 listeners



Listeners' ratings, New proposed distance, Hamming distance, Hamming distance on the 2 main channels

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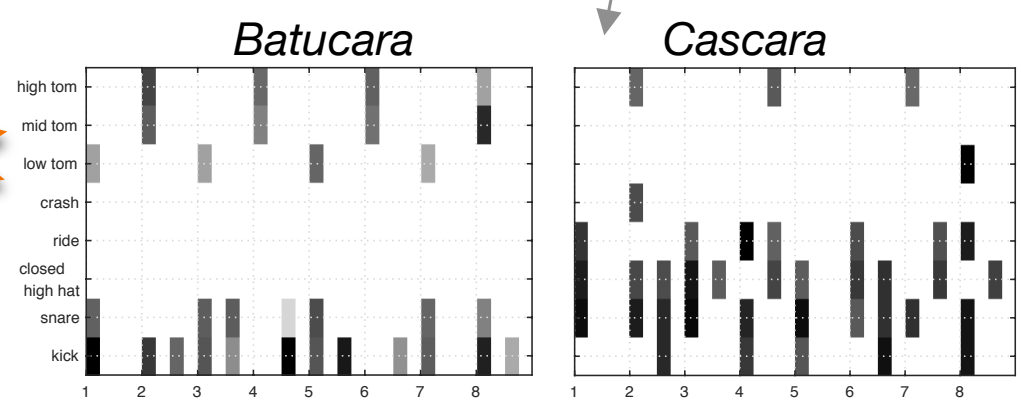

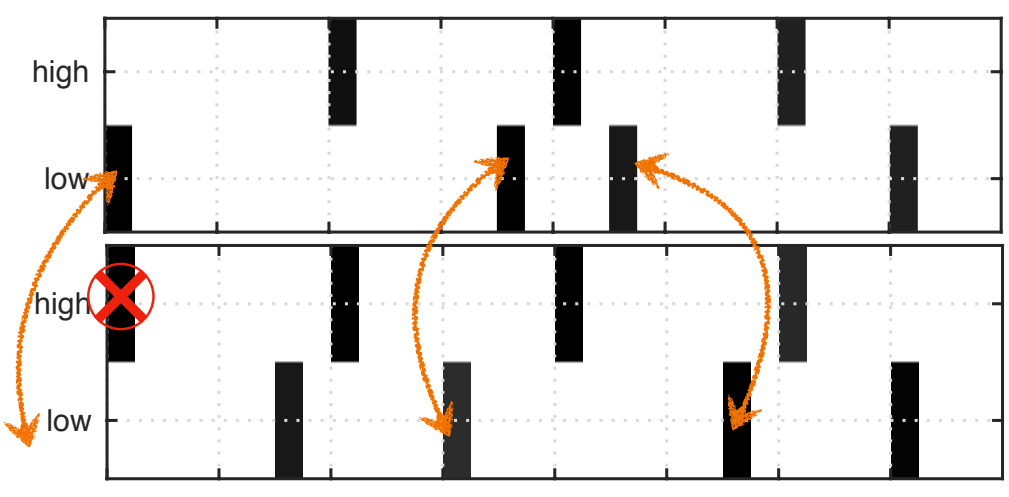

Similarity Model	*r*	*p*
Hamming Distance	0.604	2.97e-9
Hamming Distance (2 channels)	0.539	2.58e-7
Bistate Sequence Alignment	0.556	8.49e-8
min(Hamming (2 chan), Alignment)	0.606	2.65e-9
min(Hamming, Alignment)	0.692	1.21e-12

Table 2. Pearson correlation coefficient *r* and *p-value* between mean similarity ratings and distance models.

Results indicate that algorithms capture fundamentally **different aspects of similarity**:
- Hamming distance capturing **low-level** similarities between rhythms
- proposed **bistate sequence alignment** capturing qualities relating to **rhythmic interaction and structure**.

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