Development of Rhythm Game with Hand Tracker and Chart Editing Tools

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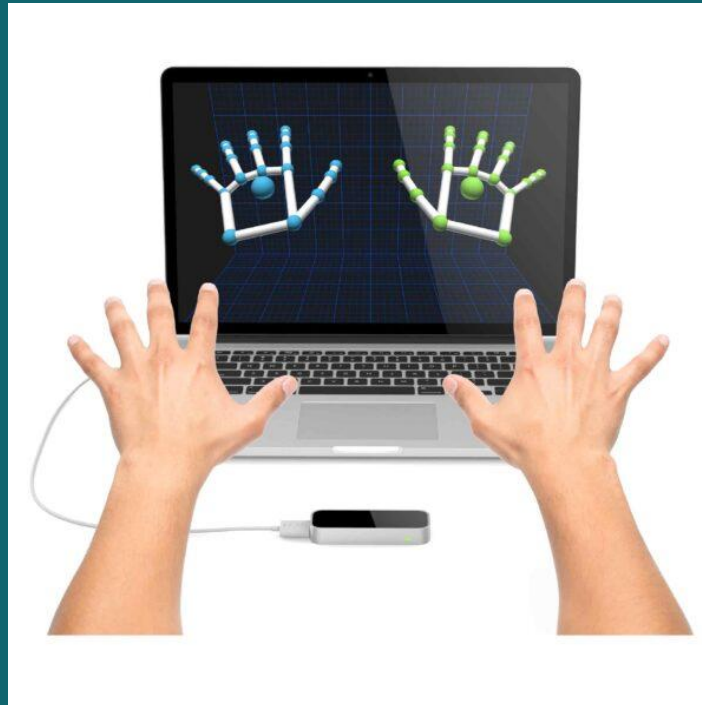
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Introduction

- **Rhythm game** is a music-based game that challenges the player's sense of rhythm

Taiko no Tatsujin (太鼓達人)
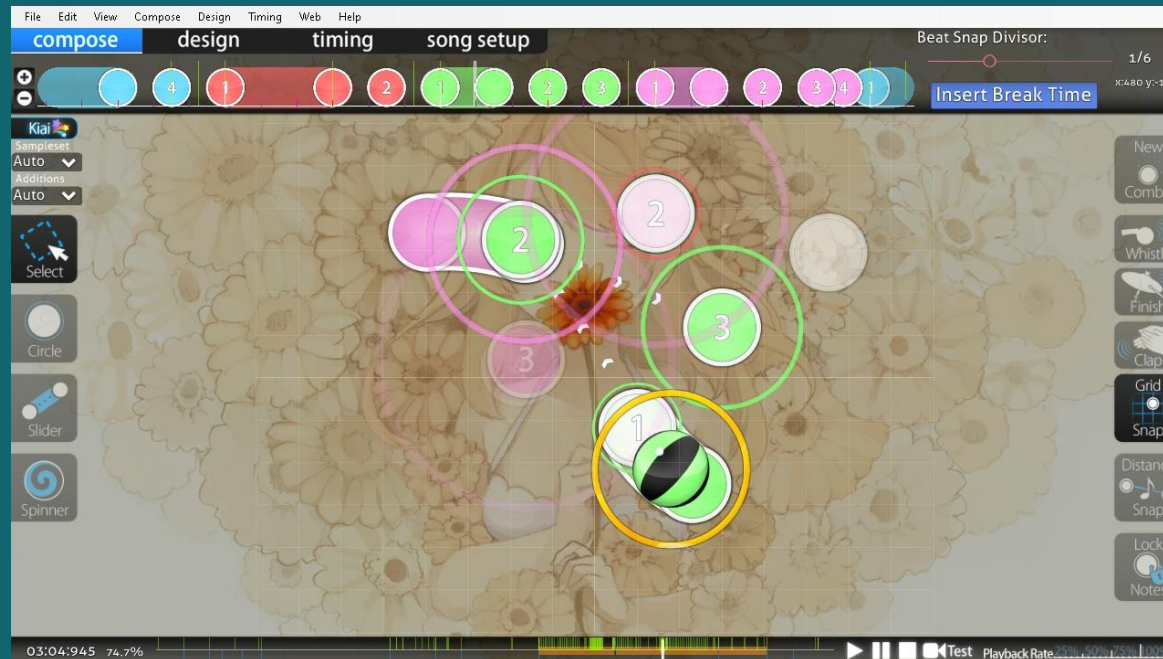
Introduction

- Goal: Develop a rhythm game with a **hand tracker** as the input
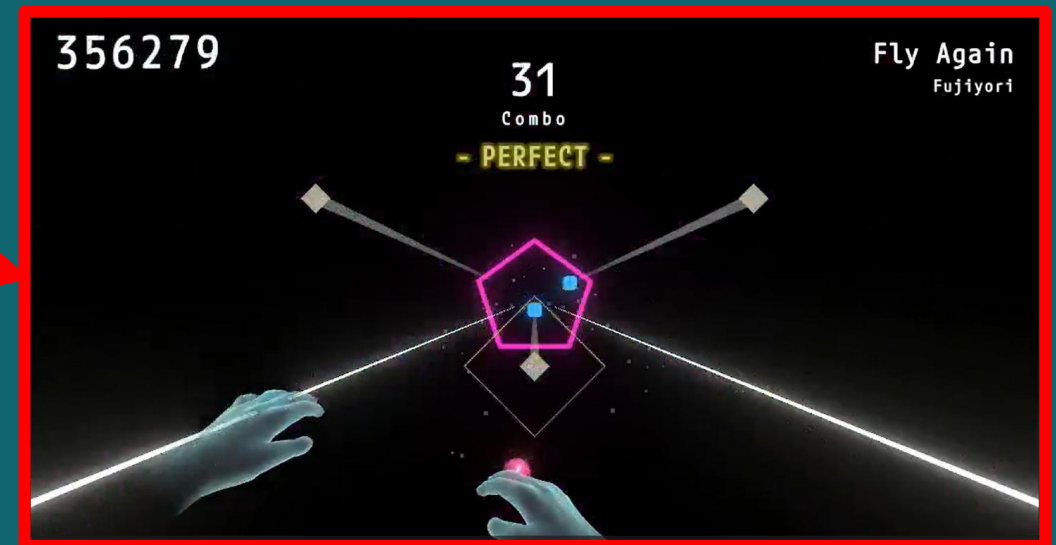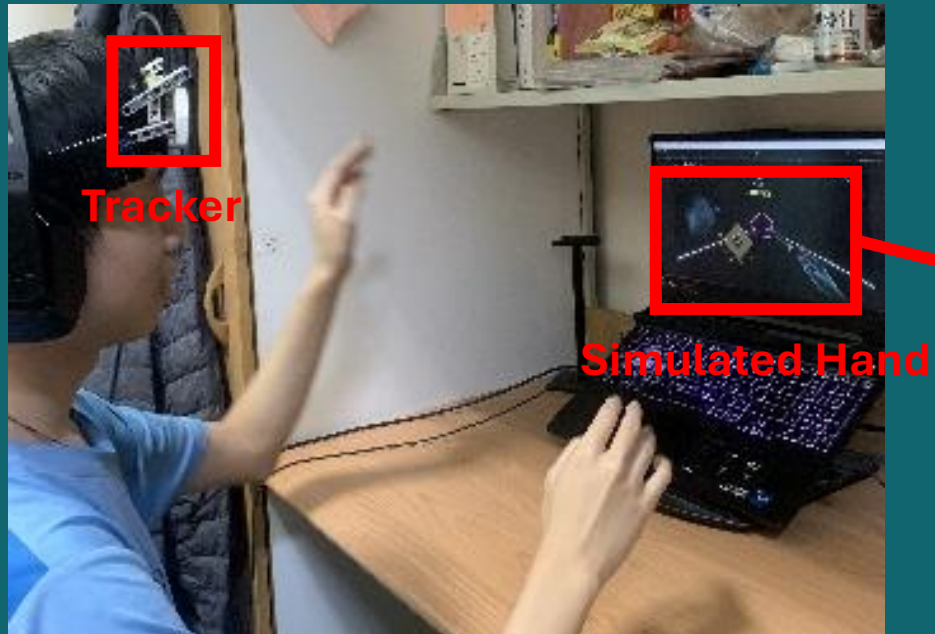

source: Leap Motion

Introduction

- Goal: Design a **chart editor** for the game and add **assist tools** inside
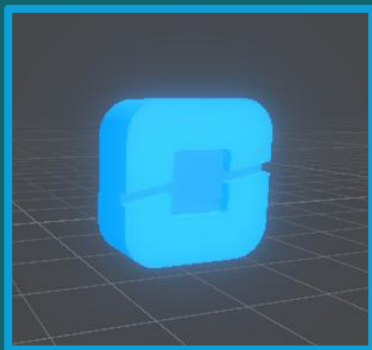

source: osu! Editor

Gameplay

- Controller: **Leap Motion 2**
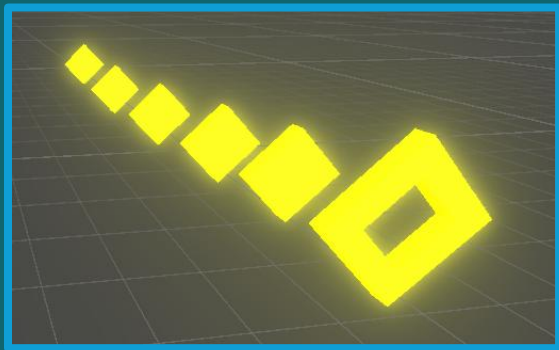- The tracker is mounted on a LEGO device to be wear **on the head**

Tracker

Simulated Hand

356279

31
Combo

- PERFECT -

Fly Again
Fujiyori

Gameplay

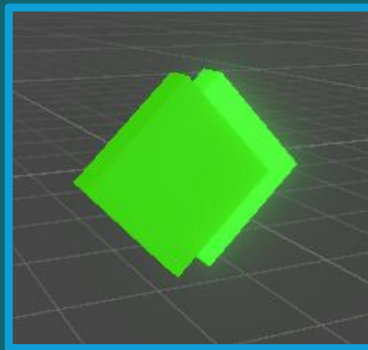- Consist of 5 kinds of notes
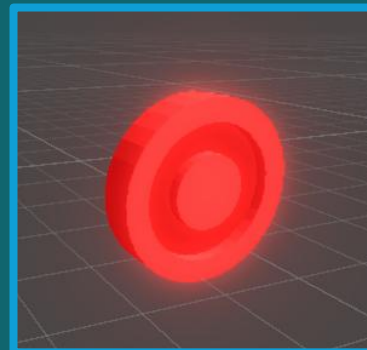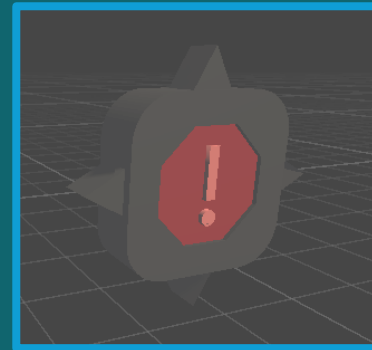

TAP   TRACK   CLAP   PUNCH   AVOID

Chart

- A .json file contains the **data of the level**

- **Problem:** It's difficult to <u>edit</u> and <u>preview</u>

```
{
  "Name": "No title",
  "Artist": "REOL",
  "Difficulty": 0.0,
  "Offset": 0.0,
  "BPMControl": [
    {
      "Beat": 0.0,
      "BPM": 128.0,
      "Easing": "hold"
    }
  ],
  "Lanes": [
    {
      "ID": 0,
      "Notes": [],
      "Nodes": {
        "PositionControl": [
          {
            "Beat": 0.0,
            "Position": {
              "X": 0.0,
              "Y": 0.0
            },
            "Easing": "easeInOut"
          }
        ],
```

Chart Editor

- Graphic interface
- Real-time preview
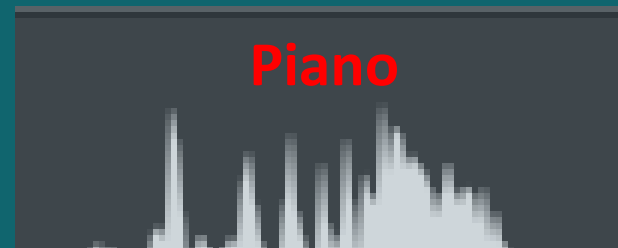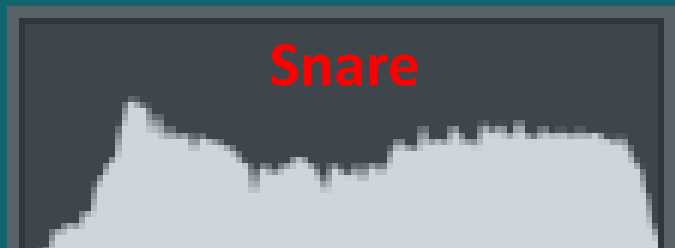- **Assist tools** (BPM estimation, Melody Onset Detection)
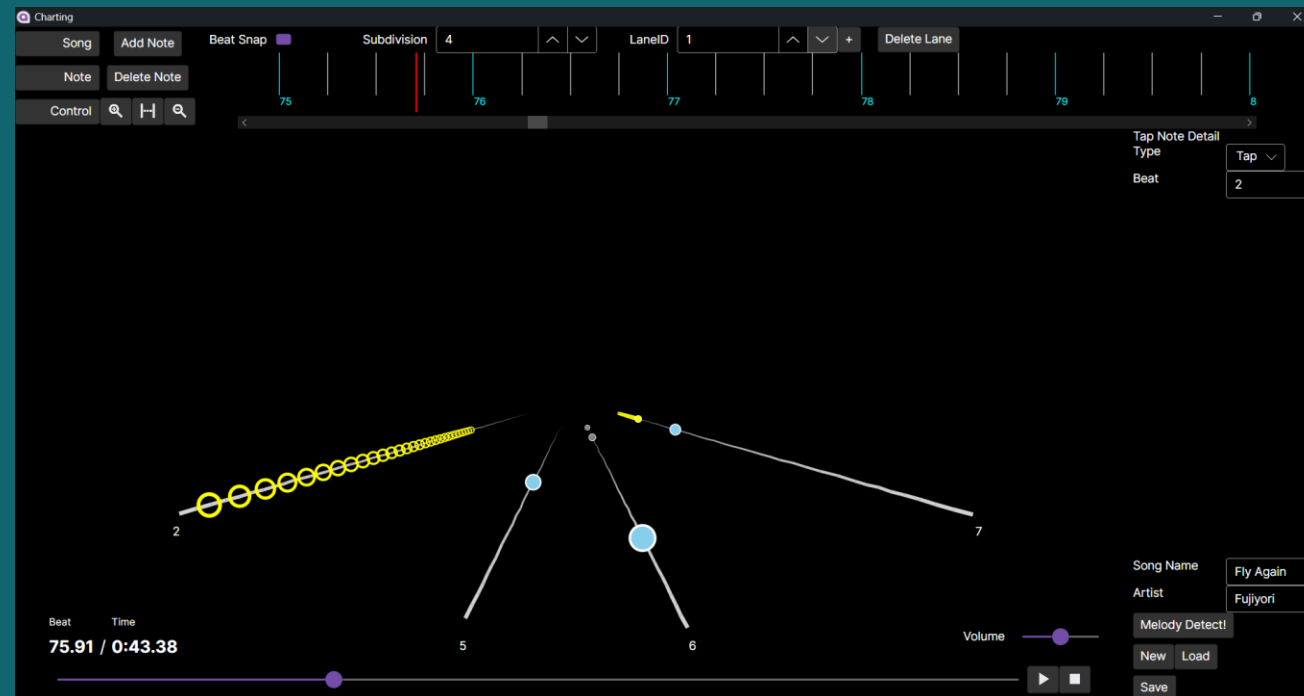
BPM Estimation

- **Goal:** Find the **drum onsets** (time when the drum hit begins) and calculate the most possible BPM
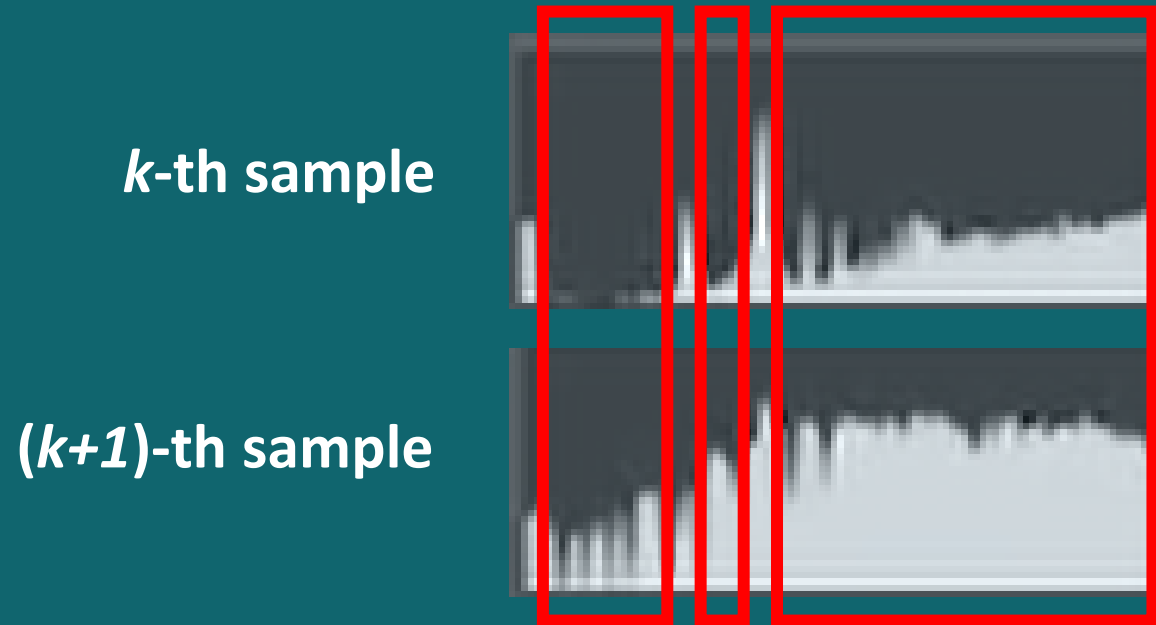
Audio Samples → *Preprocess* → *Onset Detect* → **Onsets** → *BPM Detect* → **BPM + Offset**

BPM Estimation - Method

- Percussion instruments have spectrum with rapid **broadband** onset

Snare

Piano

BPM Estimation - Method

- Count the frequencies with a significant rise in amplitude
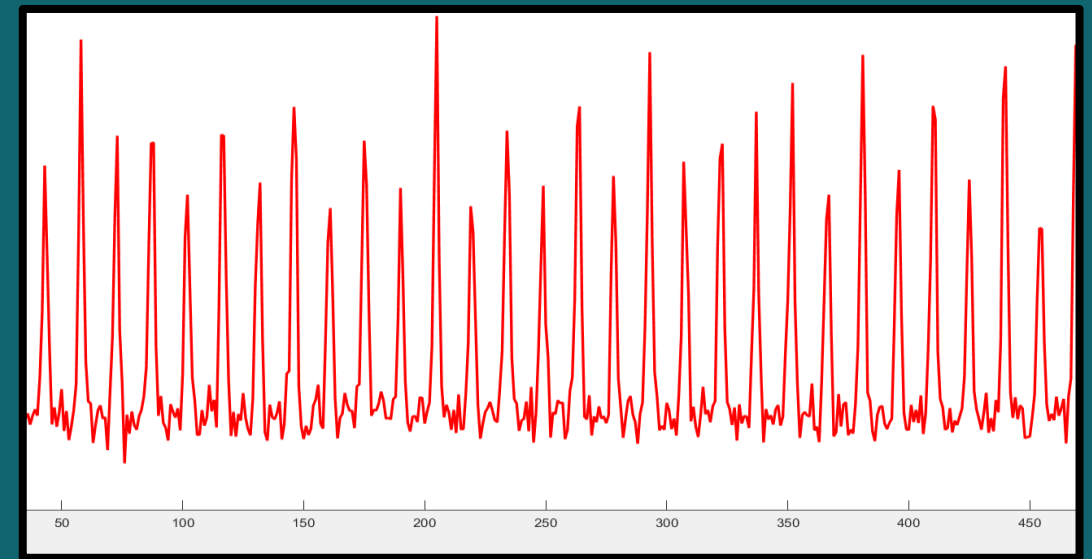

k-th sample

(k+1)-th sample

BPM Estimation - Method

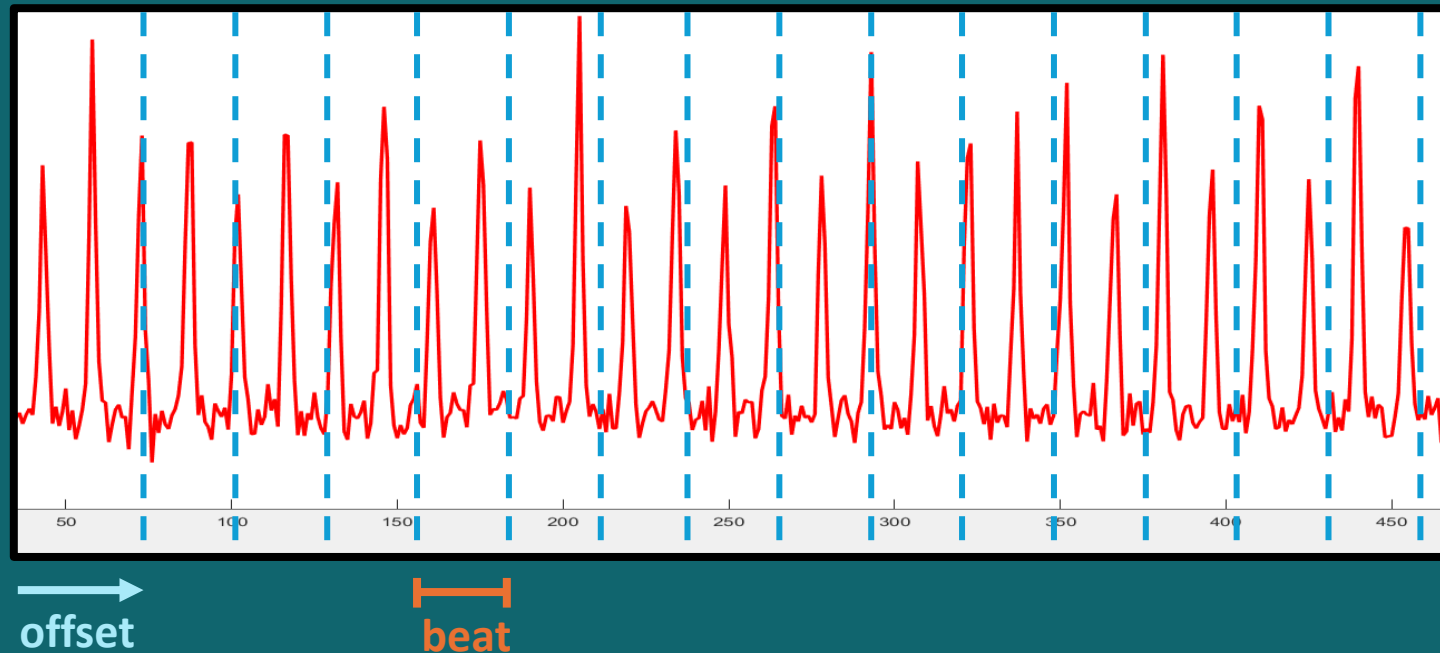- Apply **autocorrelation** to the obtained onsets
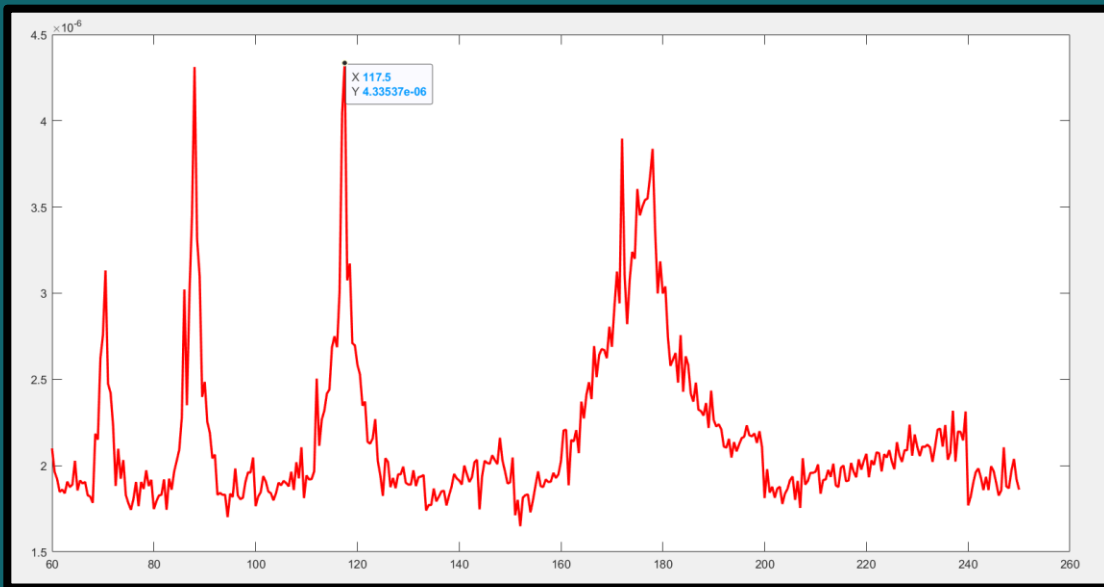
Detected Onsets
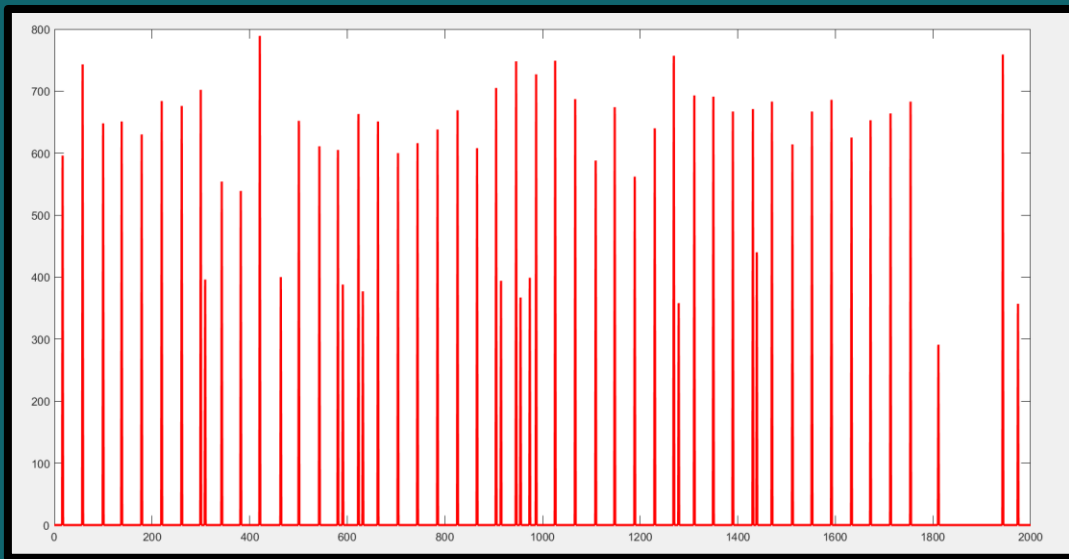
Autocorrelation

time

BPM Estimation - Method

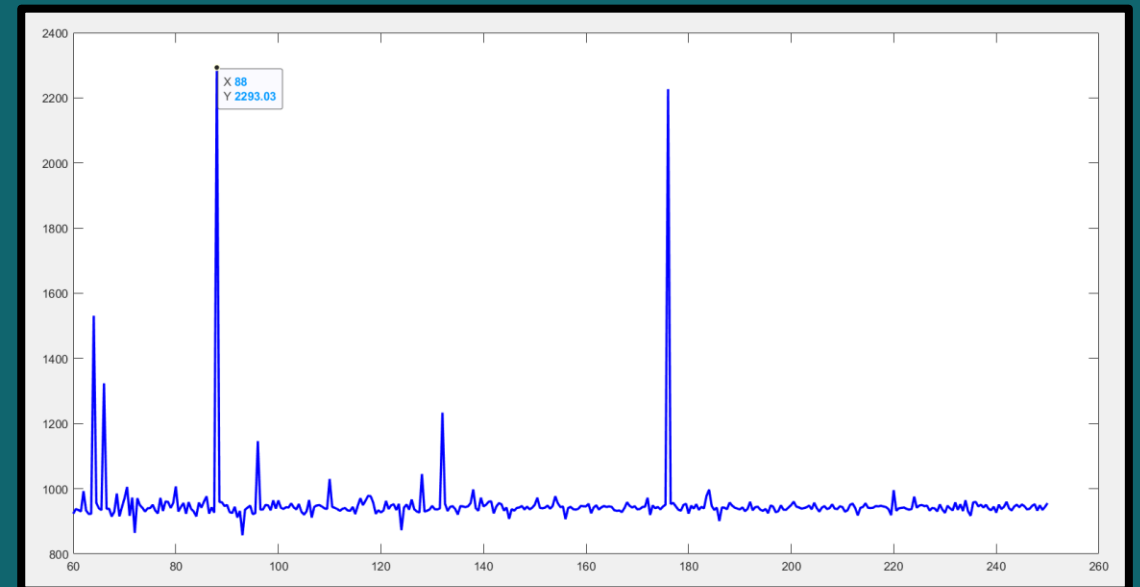- Sum up values with **offset** and **intervals** of given bpm

BPM Estimation - Result

Old Method
(117.5 bpm)

score

New Method
(88 bpm)

(PIKASONIC – heroine [176 bpm])

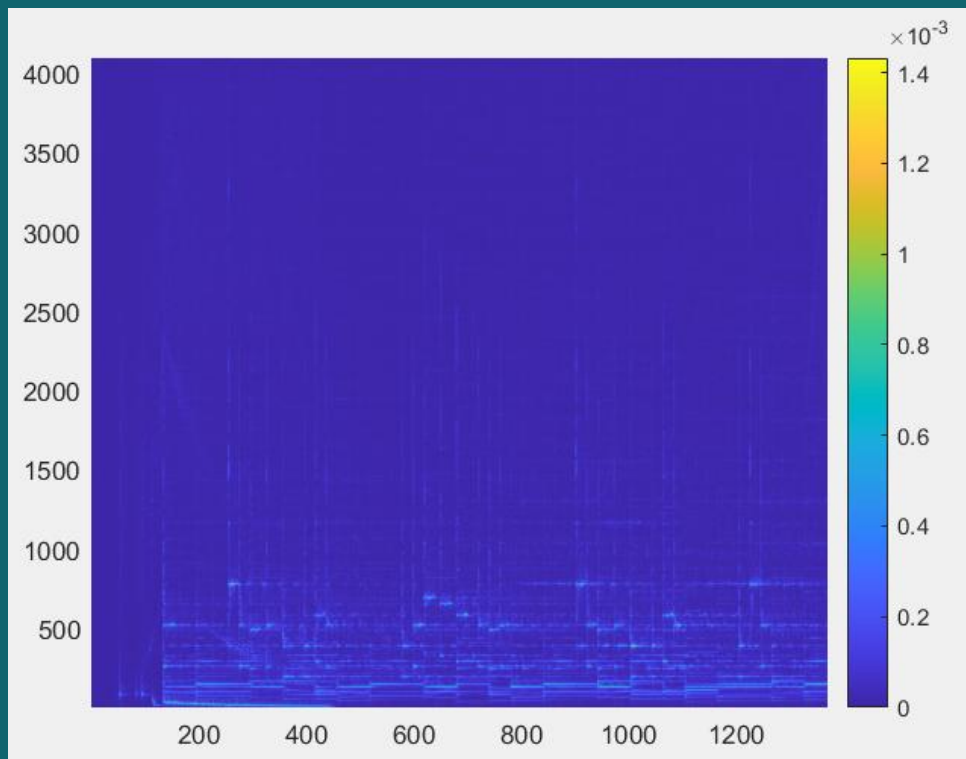**bpm**

Melody Onset Detection

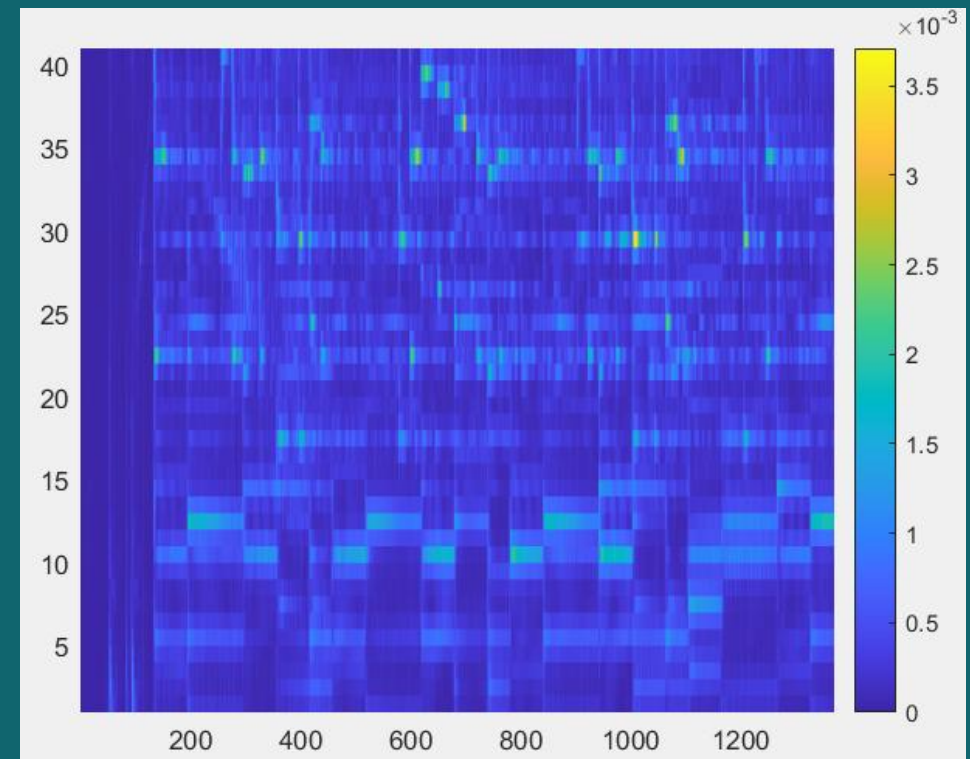- **Goal:** Find the **loudest melody** and detect its onset

Audio Samples → *Preprocess* → **Melody Blocks** → *Clustering* → *Onset Detect* → **Melody Onsets**

Melody Onset Detection - Method
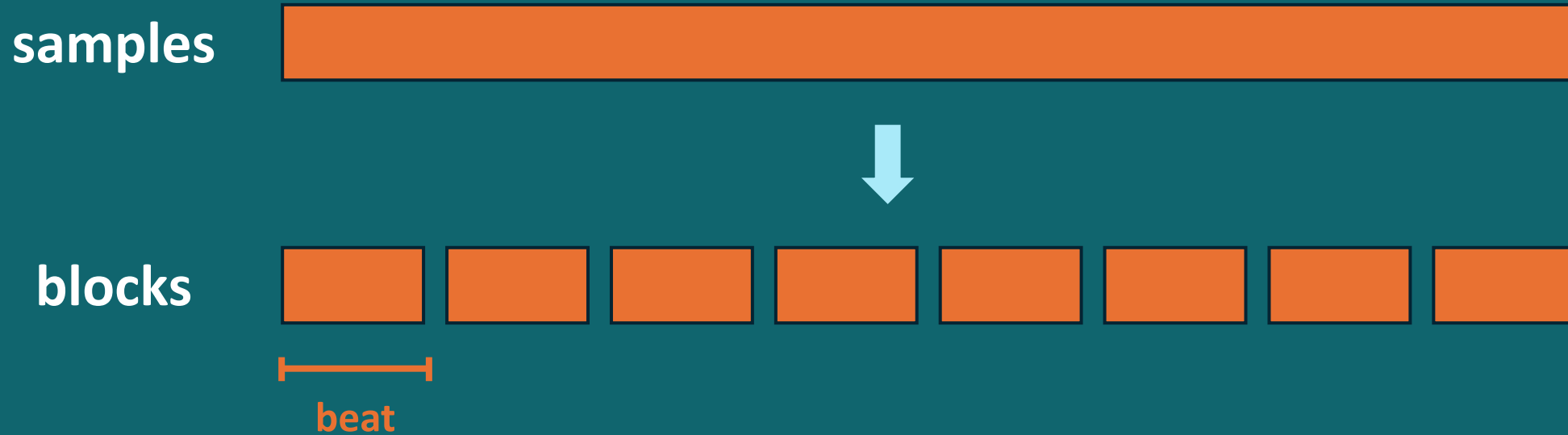
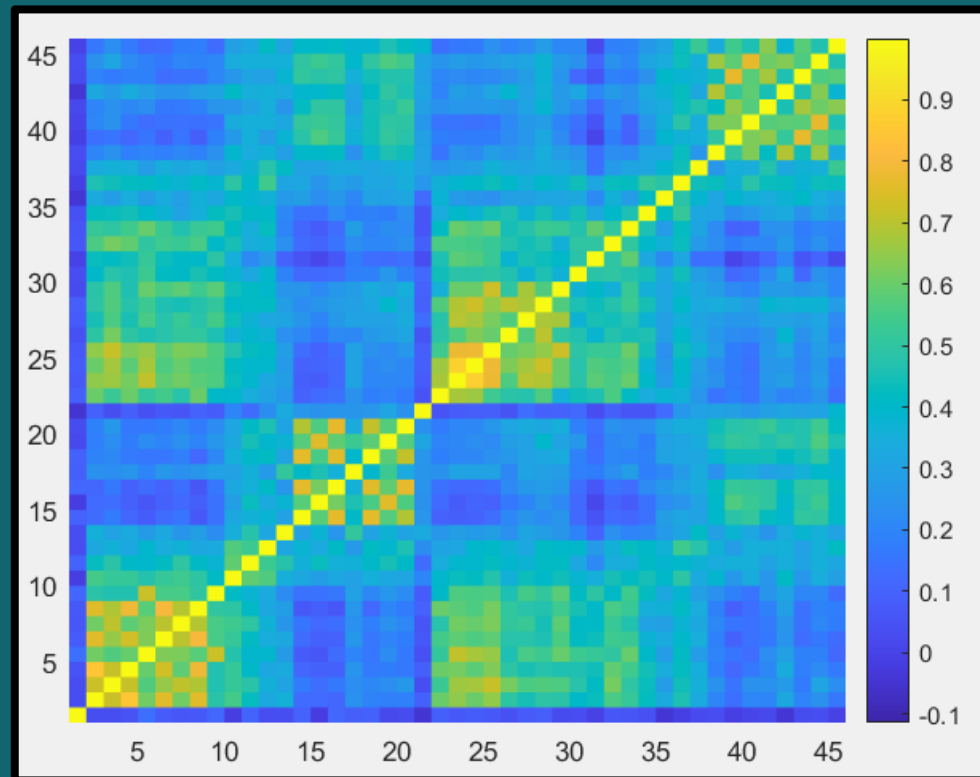- Transform the frequency axis to **semitone axis**

Melody Onset Detection - Method
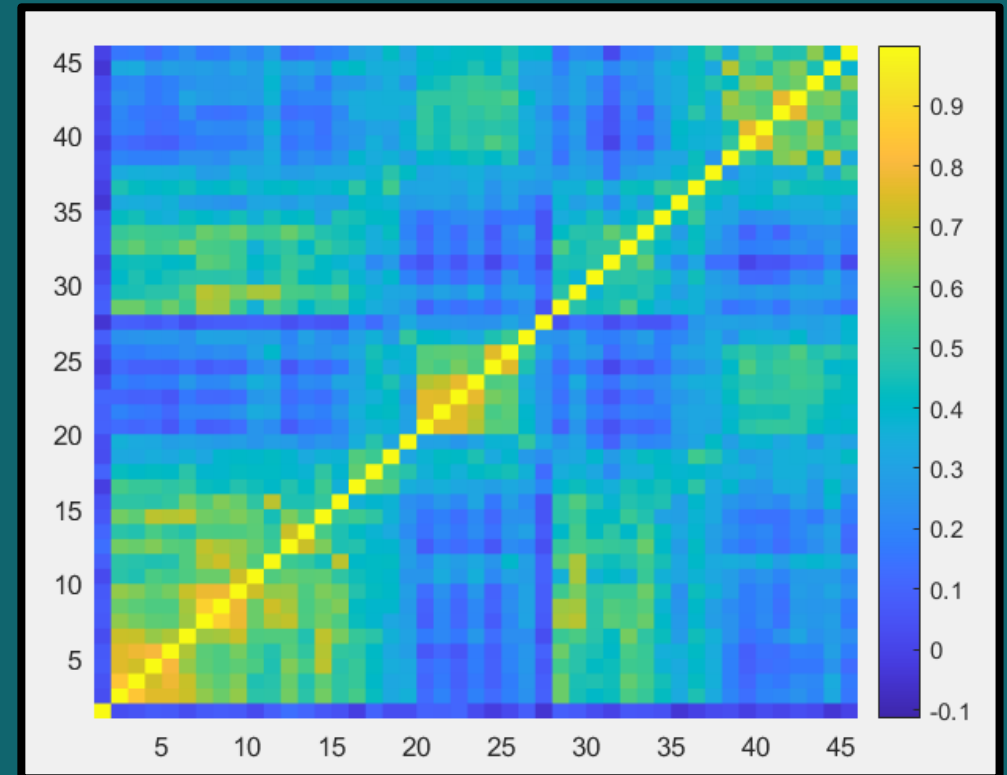
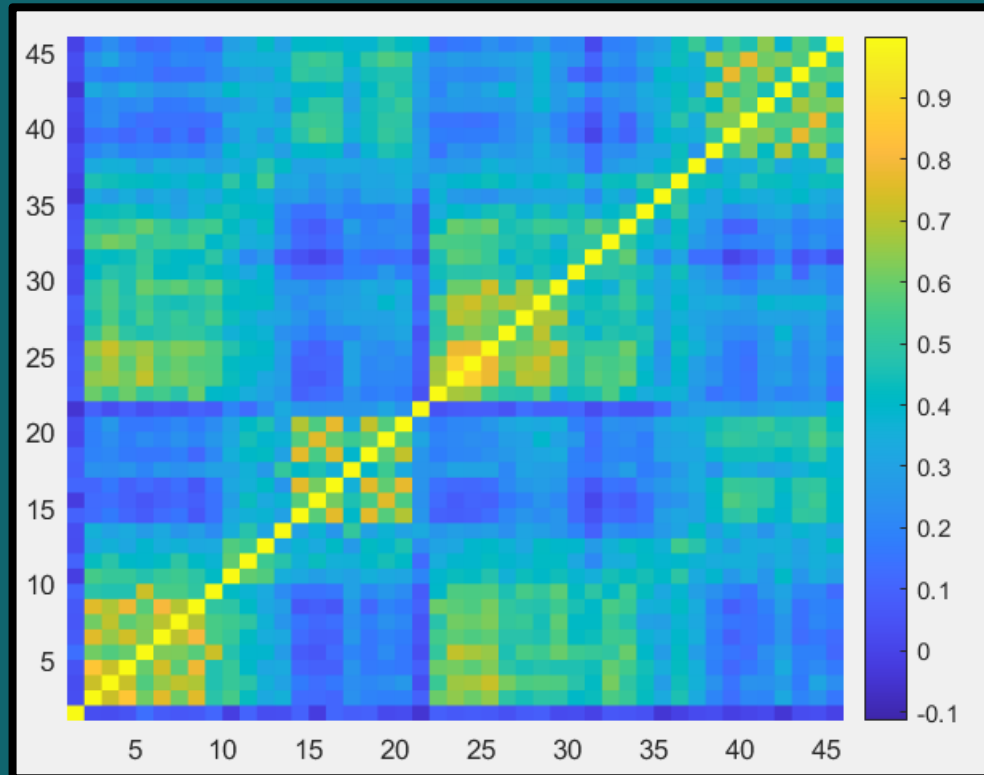- Split audio samples to blocks with the best bpm

Melody Onset Detection - Method
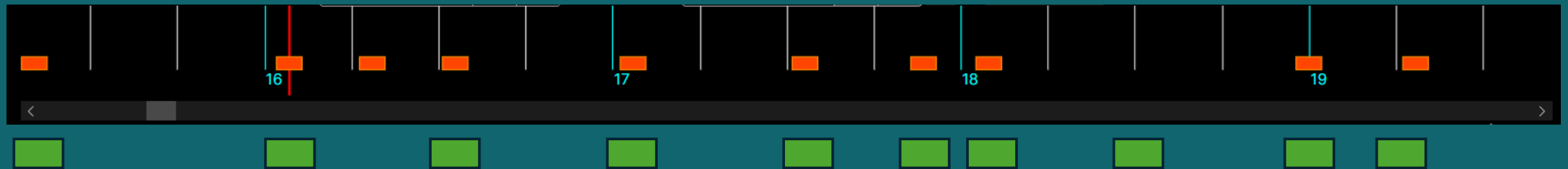
- Build correlation matrix
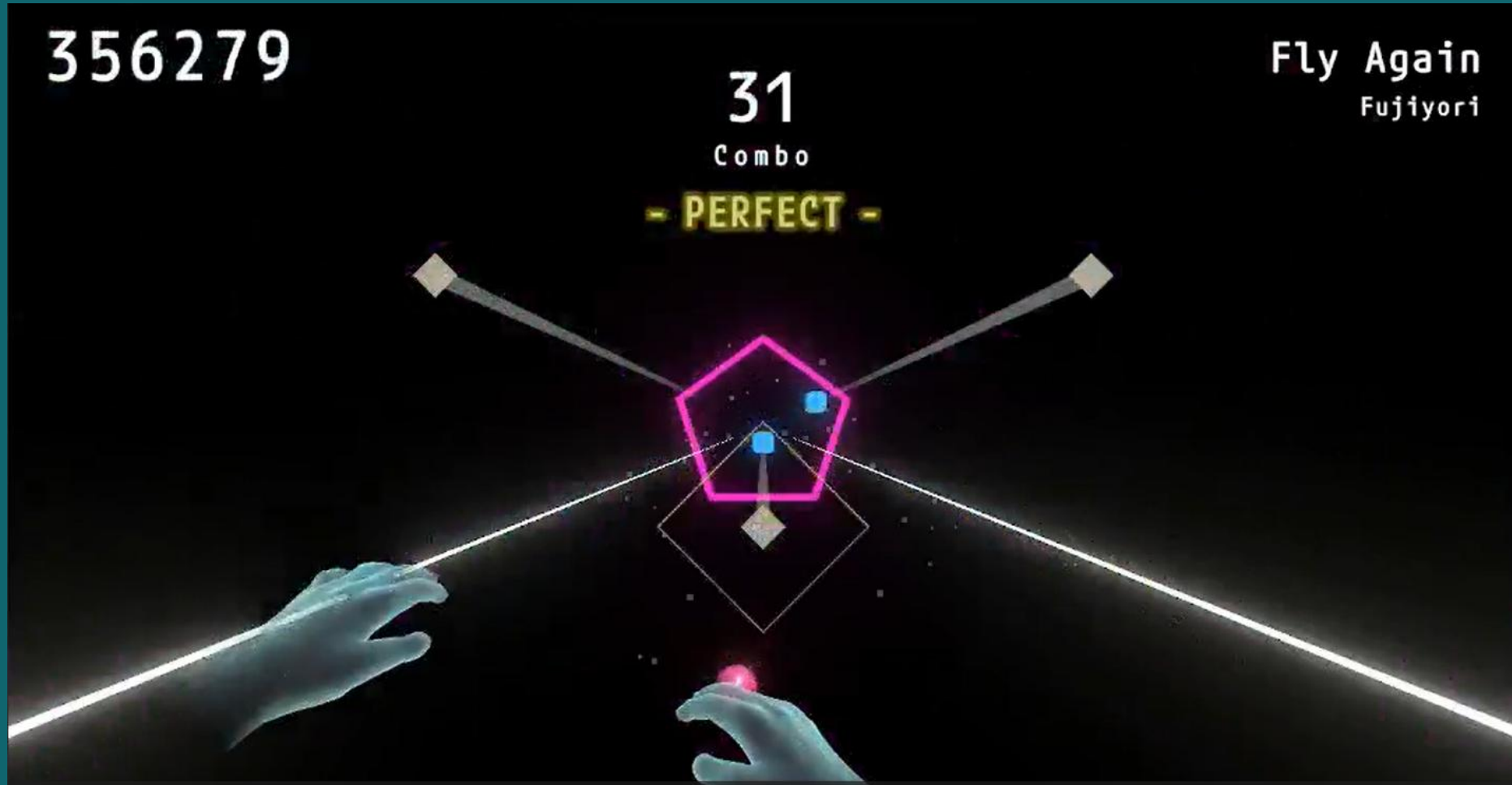
Melody Onset Detection - Method

- Apply hierarchical clustering

Melody Onset Detection - Result

Demonstration

Conclusion & Future Plan

- BPM estimation overall does well on **EDM songs**

- Melody onset detection method underperforms, could add **machine learning** to improve the results

- The game can be expanded to **VR**

- Alternatives to the expensive hand tracker

Reference

- Barry et al., *Drum Source Separation using Percussive Feature Detection and Spectral Modulation*, 2005

- Dik J. Hermes, *Measurement of pitch by subharmonic summation*, 1987

- Antonio Pertusa et al., *Recognition of Note Onsets in Digital Music Using Semitone Bands*, 2005

- Thank You for Listening -