Creating a Tool for Facilitating and Researching Human Annotation of Musical Patterns

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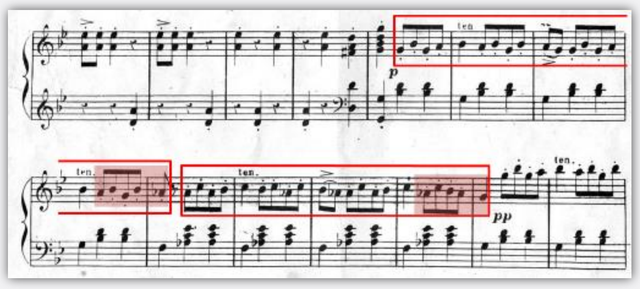
Abstract

Musical patterns (repeated segments of music) are highly widespread in all varieties of music, and annotations of such patterns are valuable in many areas of music information retrieval. Unfortunately, there is a lack of expert annotations of musical patterns, and most annotation is done by hand. In this project, we introduce a novel software, ANOMIC, designed for users to intuitively annotate repeated musical segments, and we perform a user study which yields a large database of annotations done using the tool. We find that the tool's reception was strongly positive and show that the annotations done with it reach high levels of inter-annotator agreement compared to traditional approaches.

1) Background

What is a musical pattern?

- A musical pattern is a repeated and noteworthy segment of music.
- Repetition can be exact or inexact.
- Discovery of patterns is subjective!



In the figure, we see two occurrences of a pattern encompassed by bounding boxes. Both occurrences have a small dissimilarity at the end of the phrase, shaded red.

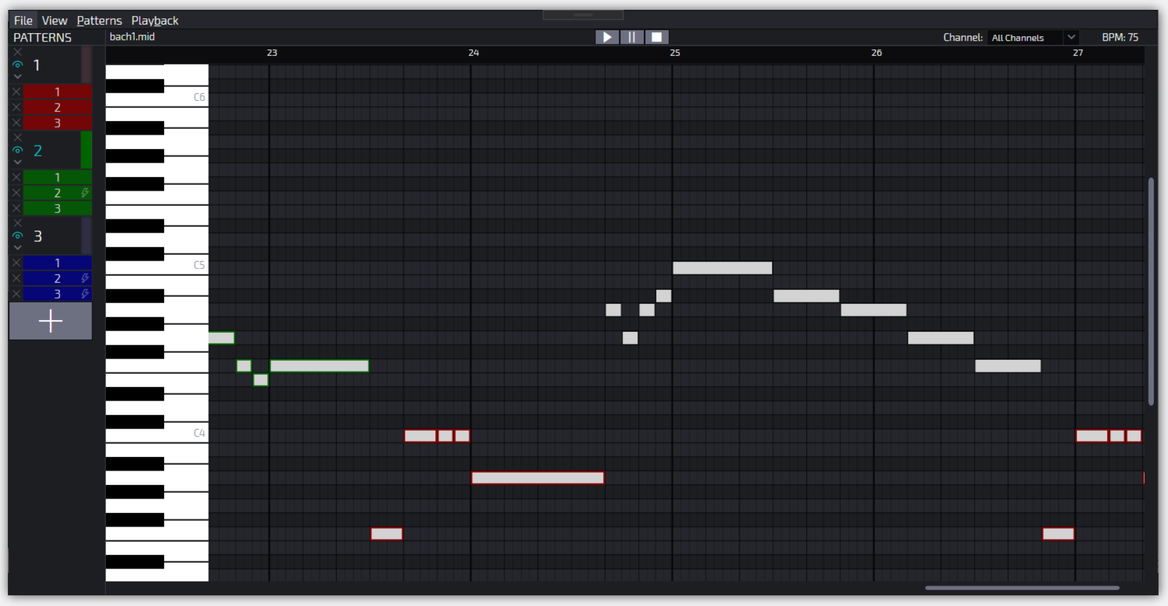
Human vs automatic pattern discovery:

- Humans have been shown to be much better at finding salient patterns.
- We need more data to train and design algorithms for pattern discovery.
- Methods to manufacture such data are outdated.

Challenges of pattern discovery:

- There are no clear rules on how long a pattern should be, when it should start or end, etc.
- "Salience" of patterns is an ambiguous term and the concept of ground truth is difficult to apply in the context of musical pattern data.
- Most methods of annotating music are done using sheet music and pen-and-paper approaches. This leads to long digitisation times and inaccuracies.

2) ANOMIC



ANOMIC is a novel software tool designed for musical pattern annotation. Features:

- Written in C++ and XAML using Visual Studio. Open-source[1].
- Compatible with Windows.
- User-friendly and customisable piano roll interface.
- Support for the widespread MIDI music format (including MIDI channel separation) and JAMS annotation files.
- Audio playback.
- Transposition-invariant, polyphony-robust automatic exact pattern occurrence matching.

[1] Repository: https://github.com/StephanWells/ANOMIC
Instructional video: https://tinyurl.com/annotationtoolvideo

SCAN ME GitHub

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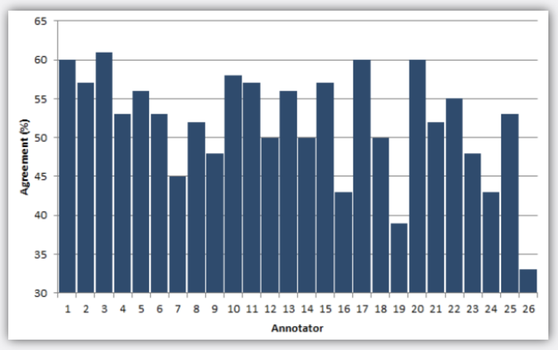
3) Evaluation

ANOMIC was evaluated by means of a user study, where participants were tasked to annotate repeated patterns in six MIDI files of excerpts of classical music and then take a survey querying them on their experience.

26 participants
2763 occurrences
788 patterns
6 MIDI files to annotate
38 average minutes spent
7.5 average notes / occurrence



This figure shows each annotator's average agreement across all six musical excerpts, using a novel inter-annotator agreement metric based on musical note comparisons.

> *I believe this tool was easier to pick up and use as a beginner than paper and pens would have been.*
>
> *It is easier to listen to the music and see the visualization at the same time.*
>
> *The tool clearly provides benefits where clarity and scale are concerned.*
>
> *It's much faster [than pen-and-paper methods], more flexible, and has more quality of life features that makes things easier.*

4) Findings

- Inter-annotator agreement was shown to be comparable or exceeding pen-and-paper annotation studies.
- User study participants with more musical experience tended to agree more with each other than those with less.
- Use of the automatic occurrence matching slightly improved agreement, but only if it is not relied on as the sole source of pattern discovery.
- From the user study, 65% of users stated that they would prefer to annotate music using ANOMIC than using traditional methods.