

## CREATING A TOOL FOR FACILITATING AND RESEARCHING HUMAN ANNOTATION OF MUSICAL PATTERNS

**Stephan Wells**

Utrecht University

s.b.wells@students.uu.nl

**Anja Volk**

Utrecht University

A.Volk@uu.nl

**Iris Yuping Ren**

Utrecht University

y.ren@uu.nl

### EXTENDED ABSTRACT

The use of musical patterns is highly widespread in all music, and we define them to be noteworthy sequences of notes that repeat in a given piece of music [1]. Annotations of such patterns are valuable in many problems tackled by the field of music information retrieval, such as music similarity, classification, prediction, and labelling, and these annotations can be procured from domain experts or algorithmically. Unfortunately, there is a distinct lack of domain expert annotations, in part due to the laborious process of the traditional "pen-and-paper" method of annotating music by hand and consequently digitising these annotations for use in music information retrieval systems. Any automatic musical pattern annotation method that is data-driven needs a large number of annotations to be trained on, but there is a lack of digital infrastructure in place for manually annotating music to produce these annotations.

This project aims to remedy the situation by introducing a novel software, hereafter referred to as ANOMIC, designed to intuitively annotate musical patterns through the use of a piano roll interface. ANOMIC is compatible with the widespread MIDI file format, and it features the ability to save and load pattern annotations using the JAMS [2] format, a popular JSON-based specification used in music information retrieval. Figure 1 shows a screenshot of the main interface of the annotation tool.

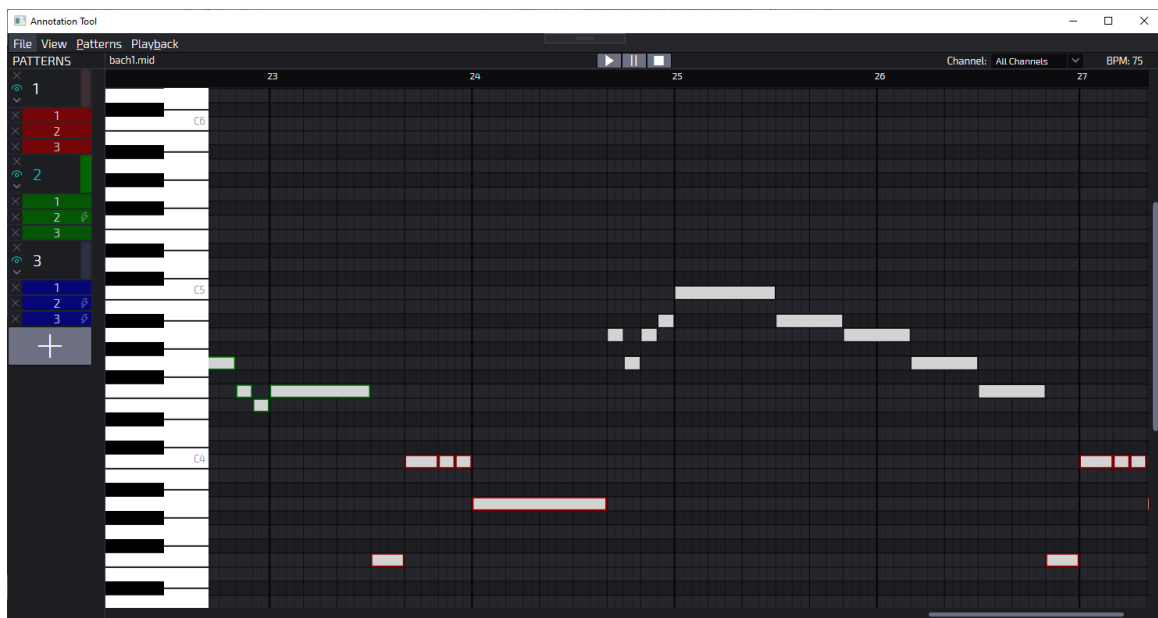


Figure 1. A screenshot of the developed annotation tool's main interface.



In this screenshot, the different features offered by the tool are immediately apparent. The software was loaded with a MIDI file entitled `bach1.mid`, which is an excerpt of a Bach cantata, and its notes were displayed in the piano roll interface as white bars. The horizontal position and length of these bars respectively determine the time in the music and the duration of each note, while the vertical position corresponds to the pitch of the note, as marked by the vertical piano keyboard on the left. The tool offers playback of the MIDI file with basic play/stop/pause buttons, MIDI channel selection to filter which notes appear on the screen, scrolling and zooming, an automatic, transposition-invariant occurrence finder, support for different annotation confidence levels, and various optional additional functionality through the available menu options.

Annotation through this tool is done by first adding a pattern through the interface and then establishing an occurrence for that pattern by selecting notes to include in that occurrence. The goal then is to find other segments in the music that repeat in a similar fashion to this new occurrence, building a set of occurrences associated with the pattern. The user can create as many different patterns as they desire, and each pattern also has no limit on the number of occurrences associated with it. This process can also be seen in Figure 1, where the panel on the left showcases three colour-coded patterns, each with three occurrences. Two occurrences of the first pattern and one occurrence of the second pattern are visible and highlighted in the piano roll interface with their corresponding colour.

ANOMIC was evaluated through a comprehensive user study, where 26 participants of varying demographics and musical experience were tasked to annotate repeated patterns in six classical music excerpts. 2763 occurrences were annotated in total across 788 different patterns. Their actions within the tool were logged and timed, and after the task was complete, their logs and pattern annotations were gathered and analysed. In addition to that, the users were given a brief survey after they were done with the tool where they were queried on their musical experience, their experience using the tool, and their opinion on the tool's usability and usefulness.

The user study gave a clear overview of users' opinions on the tool and the quality and quantity of annotations produced. 22 of the 26 participants expressed that they would not consider the pen-and-paper approach preferable for the task of pattern annotation, with 17 out of those 22 outright stating that they would prefer using ANOMIC for musical pattern annotation. The tool was praised for its accessibility among people who cannot read sheet music, its quality-of-life features such as audio playback and automatic occurrence finding, its intuitive and efficient nature, and its scalability. The participants took on average 38 minutes to annotate all six pieces, and each participant annotated 6 minutes and 18 seconds of music with an average of 106 occurrences. The quality of the annotations themselves was also explored, and through our metrics of pattern agreement it was found that people with a musical background had an inter-annotator agreement score that was higher than that of people without a musical background by a factor of 14%.

The software is freely available, open-source, runs on Windows, and requires no installation. The hope is that it provides a digital infrastructure for musical pattern annotation, a process that has traditionally involved pen-and-paper approaches with long and arduous manual digitisation times. With this infrastructure in place, pattern annotation can be done in a more intuitive and efficient manner, facilitating the research of human pattern annotations in music.

#### ACKNOWLEDGMENTS

This work was supported by the Tertiary Education Scholarship Scheme (Malta, 2019).

#### REFERENCES

- [1] T. Collins. 2019:discovery of repeated themes & sections. Accessed: 2019-06-06.
- [2] E.J. Humphrey, J. Salamon, O. Nieto, J. Forsyth, R.M. Bittner, and J.P. Bello. Jams: A json annotated music specification for reproducible mir research. In *ISMIR*, pages 591–596, 2014.