

VISUAL PATTERN ANALYSIS USING DIGITAL SHEET MUSIC

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EXTENDED ABSTRACT

The increasing amount of digital sheet music such as MusicXML [5] and through databases like MuseScore¹ enables the creation of innovative applications for visual analysis of harmonic patterns. Visual music inspection [2] allows for the investigation of harmonic progressions, the extraction of relevant themes or melody motifs [4], understanding tonal relationships [3,9] as well as the overall structure of sheet music [6]. This visual inspection, however, requires the ability to read the common music notation [10]. MusicXML preserves both layout information and musical content allowing for accurate digital representations of sheet music and additions of visualization annotation overlays to visually highlight pattern. Many existing approaches consider primarily audio data to extract melody [1] or chords, which requires different models for pattern recognition than digital sheet music.

To exploit the potential of MusicXML, we are developing an extensible prototype to support the music analysis. The prototype comprises an intuitive and interactive user interface that is accessible through the web². The visual music notation representation builds on OpenSheetMusicDisplay³. We use MusicXML files imported by the user to display the chords of specific music sections. Figure 1 presents the prototype's visual web interface that consists of three major components: *MusicXML Import*, *Highlights View*, and the *Sheet Music View*. The application supports an intuitive analysis workflow.

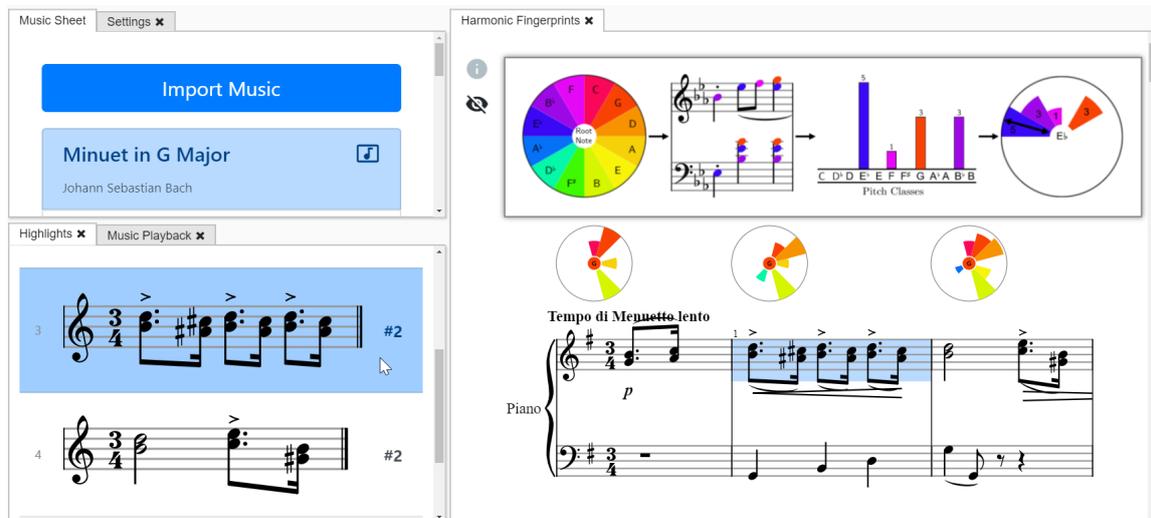


Figure 1. Our web-application enables user to import any sheet music in MusicXML format (*MusicXML Import*). Then, the prototype automatically extracts repeating patterns and lists them in the *Highlights View*. The user can interactively explore identified melodic patterns in the context of the digital sheet music that can be enriched by harmonic fingerprints (*Sheet Music View*).

¹<https://musescore.com/sheetmusic>

²<https://musicvis.dbvis.de/app/>

³<https://github.com/opensheetmusicdisplay/opensheetmusicdisplay>

As Figure 1 illustrates, we integrate the harmonic fingerprint visualization from Miller et al. [7] into our analysis prototype, which allows for close and distant reading of single bars of a musical piece. After importing a MusicXML, the system analyzes the given file for patterns that occur repeatedly. We then list these patterns in the *Highlights View* component displayed at the bottom left of the interface.

In parallel, we render the full music document in the *Sheet Music View*, which needs the most space of the interface. The interface enables users to interactively hide or show the harmonic fingerprints depending on the users' needs. We designed the interface to support the visual navigation and exploration of sheet music through the employment of simple visual elements. The system contains a number of preselected music pieces. We linked each of them with a performance videos that allow users to listen and watch the music simultaneously. Therefore, our work can be described by the branches *Analytic Tasks–Structural Analysis* and *Visualization Tasks–Navigation/Exploration* within the *Theory & Analysis* domain of the Visual Musicology graph, which was recently published by Miller et al. [8]. The data attributes that our prototype uses are primarily structural features such as *rhythm* and *pitch*.

Until now, our prototype is subject to limitations such as only patterns that cover full bars are extracted. In the future, we will add further sophisticated functionality to the system to improve the user experience. Moreover, we will execute thorough user studies to investigate the suitability of our system for different use cases such as melody detection and understanding of harmony progressions.

ACKNOWLEDGMENTS

We greatly acknowledge the German Research Foundation (Deutsche Forschungsgemeinschaft) for financial support within the project Knowledge Generation in Visual Analytics with the Project-ID: 350399414.

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