Hierarchical Annotation of MEI-encoded Sheet Music

Petter Ericson
Digital and Cognitive Musicology Lab,
École Polytechnique Fédérale de Lausanne (EPFL)

Martin Rohrmeier
Digital and Cognitive Musicology Lab,
École Polytechnique Fédérale de Lausanne (EPFL)

ABSTRACT

Hierarchical and reductive analyses are central methods for music modeling and anaysis. However, to this day, no dedicated software exists to support analysts with this task. Here, we present a prototype of a generic tool for hierarchical analysis of scores in the Music Encoding Initiative (MEI) [1] format. We use the rendering engine Verovio [2] to render an MEI XML structure to a Scalable Vector Graphics (SVG) which is presented to the user. By selecting and manipulating the SVG elements using the tool, we add hierarchical analysis metadata to the MEI following the scheme proposed by Rizo and Marsden in [3]. We hope this tool will support professionals in performing hierarchical music annotations as well as find use in educational contexts.

1. HIERARCHICAL SCORE ANALYSES

Hierarchical and reductive analyses are central methods for music analysis, theory [4–6] and its computational modeling. [7–9] At a first approximation, two common tasks in reductive analysis of symbolic music is the grouping of certain notes together, and the selection of one or more of the notes from such a group as more stable, salient or prominent. In particular, in various types of hierarchical analysis, less-salient notes are successively removed from the surface to show underlying structures and core relations between pitches, e.g. as in [10].

In [3], Rizo and Marsden propose to import definitions of tree and graph analysis annotations from the Text Encoding Initiative standard (on which MEI is based). For both of these cases, the analysis is included in the XML as a separate section, with elements of the score being referenced using XML ID. That is, the MEI remains intact, and continues to be rendered exactly the same way by default. The analysis is encoded strictly as meta-data, rather than as graphical elements such as ties and slurs, which has the advantage of both separating the score being analysed from the analysis, and limiting the ambiguity of the annotations.

Many existing hierarchical analyses [5, 11–13] are composed of *trees*, which organise the elements of some *string* (of notes, chord symbols, harmonies) into a hierarchical structure. Trees tend to be easier to analyse, process and encode than graphs, but are unsuitable for a general tool for analysing full scores, as full polyphonic textures cannot be simply projected into a single sequence or a set of sequences without dropping important note relations. Also,the Maximal Outerplanar Graphs (MOP) of Yust [4], despite the name, are fundamentally trees, though Yust describes procedures for integrating MOPs for several concurrent sequences.

In our tool, the notes of the score are considered as *vertices* in a *graph*. When adding a relationship between notes $n_1 \dots n_k$, we introduce a new vertex c to the graph, and use edges $(c, n_1) \dots (c, n_k)$ to show their association. These edges are labelled *primary* or *secondary* to show the relative importance of the note in the relation. For example, in a neighbour-note relation, the neighboured note is primary, while the neighbouring note is secondary. This general approach enables annotation of various common classes of relations between notes.

2. CREATING GRAPH ANALYSES

The prototype webapp [1] that is the main focus of this abstract is shown in Figure 1. Based on the Verovio [2] MEI rendering engine, the user can load an MEI or MusicXML [2] score which will be shown in the main view. The most basic workflow entails selecting a number of notes as either primary or secondary and pushing a button or key to annotate a relation between the selected notes. The type of the relation can either be left unspecified, chosen from a list of common types such as "neighbour" or "passing", or be set by the user. After having created a number of relationships, the user can save the MEI, including the annotations, for further processing.

There is currently no further restriction on the relations that can be annotated, and thus almost any analysis that relates exclusively to notes visible in the score can in principle be annotated using this tool.

3. REDUCING AND RERENDERING HIERARCHICAL GRAPH ANALYSES

As the secondary notes of relations are assumed to be less salient than the primary notes, we include functionality to hide secondary notes. This is done in steps where, in each

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[1] Available for use at `https://go.epfl.ch/dcmlredapp`, source code at `https://go.epfl.ch/dcmlredappsrc`

[2] Loading zipped MXL is a planned feature.

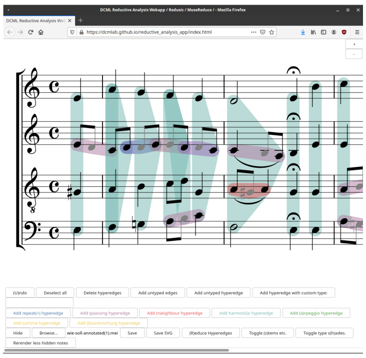

Figure 1. The main view of the app, with some relations highlighted. The teal areas denote harmonic relations, red neighbour relations, blue repeated notes, and purple passing motions. Greyed-out notes are secondary.

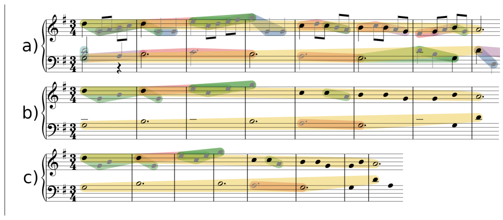

Figure 2. Analysis from Kirlin [9] in (a) full, (b) reduced and (c) rerendered versions. Green areas denote arpeggiations, while the large yellow relations denote the annotated *Urlinie* and *Bassbrechung*.

step, only those secondary notes that are not primary notes of some other remaining relation are removed. For example, in Figure 2a we show an example rendering of a Schenkerian analysis of Minuet in G major, BWV Anh. 114, mm. 1-16, taken from the corpus presented in [9]. In 2b we hide everything but the noteheads, and have run a single reduction step. This removed the notes A and C in bar 1 of the upper voice. A second reduction step would remove the notes G and B as well, as they were only primary to the previously removed A and C. Note that reduction steps are run purely on the structure of the graph of relations, and does not correspond to the Schenkerian notion of structural layers.

After having run a number of reduction steps, simply hiding notes results in an extremely sparse graphical texture. Thus a provisional rerendering feature removes some of the unused horizontal space (see Figure 2c).

4. FUTURE DEVELOPMENTS

Much of the forthcoming work will lay in UI improvements and quality-of-life fixes for the user, such as configurable edge colours, the ability to show and interact with multiple layers of the reduction at once in different renderings, and alternate modes of hierarchical analyses, such as visualising and interacting with tree analyses in a GTTM or MOP style. Another aim is to allow for merging of staves to facilitate analysing full scores in a fashion closer to current hand-analyses.

It is our hope that this tool will facilitate the creation of datasets of hierarchical and reductive analyses, help researchers clarify and define the status and relative importance of various relations among notes in scores, and help students and educators visualise the process of successive reductive analysis of musical scores.

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