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Early music and the Music Encoding Initiative

Music notation encoding is the process of creating a structured representation of the original notation so that software applications can read and manipulate it. When you share a file containing music notation with a colleague, you are interacting with this process of encoding, by which the software stores the musical notation symbols and their relationships such that they may be understood by another piece of software—perhaps your colleague's preferred notation editing software.

Since the start of the modern computing age in the early 1960s there has been an interest in applying the power of the computer to symbolic representations of music. These early representation formats used punch-card technology to record notational symbols—staves, clefs, notes and so on—and to make them available for processing and reuse. Subsequently, many music encoding systems were introduced to fit the specific needs of a project or software application.[1] Often, a new format was accompanied by the encoding of an extensive corpus of music, but quickly abandoned when the research project finished or the person leading the effort lost interest. This pattern of use has been repeated throughout the history of music notation encoding for computers, which is a story about many projects begun with great public appeal and promise, but abandoned after a relatively short time.

The problem of representation

We believe that this cycle of intense work, followed by poor uptake by others and eventual abandonment, points to a fundamental truth in music notation encoding: it is a very difficult problem. Music notation itself is an organic and primarily visual system for representing instructions from which a performer can create a sonic effect, or for recording the result of a performance. It changes when a composer or editor decides that, to evoke a certain effect, new symbols must be introduced or existing symbols redefined. If we consider the set of all symbolic music documents, we find that there are as many exceptions as there are rules, and designing an encoding scheme that can represent, in a structured way, the full breadth of expression possible in music notation is a challenging task, to say the least.

It is no surprise, then, that most formats restrict their encoding to common practice notation, which we will refer to as conventional Western music notation (CWMN). This system of representation is ubiquitous, and software is usually designed to work with representations that conform to expected norms of this notation. Encoding systems developed for CWMN elevate the conventions of this notational repertory to the level of fundamental structural requirements; that is, a staff must have bars, bars must conform to the number of beats defined by a metre signature, and so on.

For early music practitioners, this presents a significant problem. How should unmeasured notation (for example, the plainchant and mensural notation in illus.1) be represented in an encoding that assumes, as a structural requirement, regularized bars and beats? There are two commonly accepted answers to this problem.

The first way of addressing this treats music notation as a primarily visual medium, designed for human consumption. Accordingly, bar lines can be made invisible, note stems can be shortened to zero, and note-head shapes can be changed from ovals to squares or diamonds. Yet these visual changes only mask the fact that the underlying encoding is still fundamentally CWMN. While the visual rendition mimics the original, its structure and meaning

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1 Francesco de Layolle, 'Donec veniam' (excerpt) from *Contrapunctus seu figurata musica super plano cantu missarum solennium totius anni* (Lyon, Etienne Gueynard: 1528), p.15*v* (London, British Library K.9.a.23, f.15*v*). For a complete online facsimile, see http://gallica.bnf.fr/ark:/12148/btv1b8538821j

are not accurately captured. The second method is to devise an entirely new system of encoding that represents the intent of a specific type of notation as faithfully as possible. In many cases, dedicated software is written that can interpret this encoding. A great many hours of effort are dedicated to transcribing source material into the structured format.

To date, however, as mentioned earlier, these systems have usually been pioneered by a single individual or research project, and buy-in from outside users has been low. As a result, further development of the format, and the growth of the encoded corpus, stops when the funding runs out or the person responsible for it moves on. This has had the very real and unfortunate effect of creating data 'silos' in the early music world. Bodies of thousands of documents have been created, but captured in encoding formats for which software—or hardware in the case of punch cards—is no longer available. Sometimes the effort required to translate an existing corpus into a different encoding system exceeds the amount of work simply to reinput the notation in the format *du jour*.

So, early music encoding exists in a state of unease. On the one hand, performers and editors frequently turn to purely visual modes of operation, suitable for humans but not useful for computational analysis or interactivity. On the other hand, academics often create large corpora of faithfully encoded music notation, but store them in formats that are so customized to the needs of a single corpus that they are fundamentally incompatible with other music encoding systems. If history is any guide, both paths can end at the digital dustbin.

The digital edition

Driving the need for encoded music notation is the promise of the digital edition. Digital environments offer new ways of publishing scholarly editions, and digital music editions are beginning to show great potential.[2] A key feature of a digital edition is the potential to link data not only within its own digital environment, but also to external resources. For example, a digital edition can embed facsimile images and make critical apparatus entries directly accessible from the musical text. These capabilities provide convenience as well as new possibilities for user interaction with the underlying encoding.

Digital editions also make it possible to change dynamically the presentation of the music notation. This is of particular interest for early music since there is often the need to display both the original notation and a modernized or standardized form. For example, standardizing clefs according to modern practice is often desirable. This has traditionally been accomplished in printed editions by providing incipits in the original clefs, but in digital editions, display of original or modern clefs can be performed interactively at the discretion of the user—and not just for incipits, but for the entire work. Providing these features and functionalities is possible, however, only if the logical structure of the edition is explicitly encoded.

The scholar-encoder

Editors of digital editions will still be concerned with creating a thoroughly researched result, taking an exhaustive approach to consulting the available sources to produce an edition that represents the latest research concerning the chosen material. Of course, those responsible for creating a digital edition can continue to employ the traditional modes of working used for printed editions.

Unlike a print edition editor, however, who is concerned with communicating the notation visually in a printed medium, the creator of a digital edition must be primarily concerned with encoding the structural features of the notation. The 'scholar-encoder' will focus primarily on the 'logical' content of the musical notation, and will be responsible for encoding editorial practices in a structured way that enables the user of the digital edition to interact with multiple views of the encoding. This editor must not only enforce rigorous scholarly practice, but must also be knowledgeable in the ways of creating digital structural representations.

To support the role of the scholar-encoder, an encoding format is required that permits them to capture the symbolic notation, as well as editorial information, source analysis and bibliographic data to support the digital critical edition. With the challenges of notation representation, and the seemingly inevitable problems of tools and encodings becoming obsolete, how will the scholar-encoder work in this new editorial milieu?

```
<mei xmlns="http://www.music-encoding.org/ns/mei" meiversion="2013">
  <music>
    <body>
      <mdiv>
        <parts>
          <part label="Superius">
            <section>
              <staff n="1">
                <layer n="1">
                  <clef line="1" shape="C"/>
                  <mensur sign="C" slash="1"/>
                  <accid accid="f" ploc="b" oloc="4"/>
                  <rest dur="brevis" ploc="g" oloc="4"/>
                  <note pname="f" oct="4" dur="brevis"/>
                  <note pname="f" oct="4" dur="semibrevis"/>
                  <note pname="g" oct="4" dur="brevis"/>
                  <note pname="a" oct="4" dur="semibrevis"/>
                  <note pname="b" oct="4" dur="semibrevis"/>
                  <dot ploc="a" oloc="4"/>
                  <note pname="a" oct="4" dur="minima"/>
                  <note pname="a" oct="4" dur="minima"/>
                  <note pname="c" oct="5" dur="minima"/>
                  <dot ploc="c" oloc="5"/>
                  <note pname="b" oct="4" dur="semiminima"/>
                  <note pname="a" oct="4" dur="semiminima"/>
                  <note pname="g" oct="4" dur="semiminima"/>
                  <note pname="f" oct="4" dur="semibrevis"/>
                  <dot ploc="f" oloc="4"/>
                  <note pname="g" oct="4" dur="minima"/>
                  <note pname="a" oct="4" dur="minima"/>
                  <dot ploc="a" oloc="4"/>
                  <note pname="g" oct="4" dur="semiminima"/>
                  <note pname="f" oct="4" dur="semiminima"/>
                  <note pname="e" oct="4" dur="semiminima"/>
                  <note pname="f" oct="4" dur="semibrevis"/>
                  <note pname="e" oct="4" dur="minima"/>
                  <note pname="f" oct="4" dur="semibrevis"/>
                  <note pname="e" oct="4" dur="minima"/>
                  <note pname="d" oct="4" dur="semiminima"/>
                  <note pname="c" oct="4" dur="semiminima"/>
                  <custos pname="d" oct="4"/>
                </layer>
              </staff>
            </section>
          </part>
          <part label="Tenor">
            <section>
              <staff n="1">
                <layer n="1">
                  <clef line="4" shape="C"/>
                  <mensur sign="C" slash="1"/>
                  <note pname="c" oct="4" dur="semibrevis"/>
                  <note pname="b" oct="3" dur="semibrevis"/>
                  <note pname="c" oct="4" dur="semibrevis"/>
```

2 MEI markup for the Lyon *Contrapunctus* (illus.1)

```
                  <note pname="d" oct="4" dur="minima"/>
                  <note pname="e" oct="4" dur="semiminima"/>
                  <dot ploc="d" oloc="4"/>
                  <note pname="d" oct="4" dur="semiminima"/>
                  <note pname="c" oct="4" dur="semiminima"/>
                  <note pname="b" oct="3" dur="semiminima"/>
                  <note pname="a" oct="3" dur="semiminima" stem.dir="up"/>
                  <note pname="g" oct="3" dur="semiminima"/>
                  <note pname="f" oct="3" dur="semiminima"/>
                  <note pname="e" oct="3" dur="semiminima"/>
                  <note pname="d" oct="3" dur="minima"/>
                  <note pname="a" oct="3" dur="minima"/>
                  <dot ploc="g" oloc="3"/>
                  <note pname="f" oct="3" dur="semiminima"/>
                  <note pname="b" oct="3" dur="minima"/>
                  <dot ploc="b" oloc="3"/>
                  <note pname="a" oct="3" dur="semiminima"/>
                  <note pname="a" oct="3" dur="semibrevis"/>
                  <note pname="g" oct="3" dur="minima"/>
                  <note pname="a" oct="3" dur="minima"/>
                  <note pname="f" oct="3" dur="minima"/>
                  <custos pname="f" oct="3"/>
                </layer>
              </staff>
            </section>
          </part>
        </parts>
       </mdiv>
    </body>
  </music>
</mei>
```

2 *continued*

The Music Encoding Initiative

The Music Encoding Initiative (MEI), http://music-encoding.org, begun in 1999 at the University of Virginia, represents a new approach to creating a symbolic encoding system, placing development and maintenance of the encoding system in the hands of a distributed community of music technologists, librarians, historians and theorists. The MEI closely mirrors work done by text scholars in the Text Encoding Initiative (TEI) and, while the two encoding initiatives are not formally related, they share many common characteristics and development practices.[3]

The work of the MEI focuses on creating a core set of rules for recording physical and intellectual characteristics of music notation documents. This schema is developed much like open-source software, where its source code is made freely available for downloading, modification and customization. The schema can be used to automatically validate an MEI-encoded document, ensuring that the encoding follows its rules for how to encode notation.

The intellectual model governing the design of the MEI schema divides notation functions into four information-carrying domains: logical, visual, gestural and analytical. These distinctions were first introduced by an earlier encoding system, the Standard Music Description Language.[4] 'Logical' refers to the structural aspects of a notation system: notes, clefs, staves, neumes, mensuration and so on. 'Visual' records information pertaining to a specific layout of the signs in a printed or displayed representation. 'Gestural' captures performance-related information, or how a musical symbol is realized aurally. Finally, the 'analytical' domain records any theoretical analyses or commentaries on any of the previous three domains. MEI adds a fifth domain, the bibliographic, which captures extensive information about sources, authors, provenance and many other bibliographic details.

The intersection and interplay of these five domains is where the true digital edition emerges from an encoding. Using MEI, the scholar-encoder can provide a full structural representation of the contents of a musical work. This representation can show, in situ, areas where multiple readings or realizations of the musical content—drawn from different sources—are possible, or encode information indicating that a different hand was used to write a section, or even a particular symbol, of a manuscript. Multiple media may also be related to the encoding, providing methods of associating audio recordings or scanned images with the musical content.

Of course, coordinating and reconciling the vast range of possible musical expressions into a single, monolithic encoding scheme is an impossible task. Different types of music notation are sometimes fundamentally incompatible with each other. For example, mensural notation and CWMN employ completely different ways of expressing rhythmic information. It is for this reason that MEI is partitioned into modules, each of which contains the rules for encoding a particular type of source. These modules may be activated or deactivated according to the needs of the encoder, making it possible to create an MEI schema that contains, and validates, only the rules of mensural notation, only the rules for square-neume notation, or the combination of both styles found in sources from periods of notational transition, as in the page from the 1528 Lyon *Contrapunctus* shown at illus.1. Furthermore, should an MEI module not exist to meet specific needs, the scholar-encoder can create a new module that contains the customizations required to meet those needs but that also conforms with the general principles defined for MEI as a whole. This custom module can be combined with the remainder of the MEI schema, creating a powerful, flexible and, most importantly, verifiable means of producing a source encoding.

This modular approach is a third path through the two historical methods of encoding notation, and represents a new approach. The scholar-encoder does not have to settle for an unnecessary translation into a foreign notation scheme, nor do they have to create their own encoding island—and be responsible for maintaining yet another notation scheme. This new method allows the scholar-encoder to leverage a community-developed scheme for encoding sources, without sacrificing their own specific source or project needs. This approach can form a new foundation for digital editions.

As a demonstration of basic MEI encoding, illus.2 shows the mark-up for the Lyon *Contrapunctus* excerpt in illus.1.[5] Several elements in the mark-up are specific to mensural notation, <mensur>, <dot> and <custos> elements, for example. Note also the absence of bars. Emphasizing the visual domain of the source material, each part is encoded in a separate <part> element, as in the original choirbook. Also, the duration of the notes, represented in the @dur attributes ('longa', 'brevis' etc.), capture the graphical symbol present in the source without providing information regarding the expected performance duration of the event.

Conclusion

The Music Encoding Initiative is a community-developed approach to encoding music notation capable of supporting a wide variety of notation systems. Moreover, it can be extended to provide customized functionality for a particular set of documents without requiring a complete reinvention of the entire encoding scheme. As a notation encoding technology, it offers a novel approach to representing notation in a computer.

Beyond the technology, however, we view the community-orientated focus of MEI as its primary distinguishing point. It is the cooperatively developed nature of MEI which we believe demonstrates a new approach to music encoding, leaving behind the data silos of the past, not by imposing yet another soon-to-be-obsolete technological standard, but by creating a community that fosters discussion and develops collaborative solutions to the challenges of working with symbolic notation in a digital context.

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1 For an introduction to many of these formats, see E. Selfridge-Field (ed.), *Beyond MIDI: the handbook of musical codes* (Cambridge, MA, 1997).

2 Digitally published documents, pdf files made available online for example, should not be confused with true digital editions. The main difference is that, since they are simply visual representations of the notation, pdf files and other images do not contain any information about its logical structure and, therefore, do not support manipulation of the musical data.

3 For example, MEI employs the TEI One Document Does-it-all (ODD) meta-schema language to create a model of notation. For an introduction to ODD, see the TEI Consortium, 'Getting started with P5 ODDs' at *Guidelines for electronic text encoding and interchange* <www.tei-c.org/Guidelines/Customization/odds.xml>

4 S. R. Newcomb, 'Standard Music Description Language', *Computer*, xxii/7 (July 1991), pp.76–9.

5 An extended version of this example is available at http://music-encoding.org/downloads/BL-K9a23-excerpt-parts.xml. The notation itself is encoded within the <music> element, while metadata is recorded within the <meiHead> element. The metadata demonstrates the interoperability of MEI, as it was automatically converted from an existing library resource; that is, a RISM-UK catalogue record available at www.rism.org.uk/manuscripts/165632. Information about the provenance of each metadata component is given by its @analog attribute, which refers to the corresponding MarcXML field from which the data were extracted.