Crafting TabMEI, a Module for Encoding Instrumental Tablatures

Reinier de Valk
Goldsmiths, University of London
r.f.de.valk@gold.ac.uk

David Lewis
Goldsmiths, University of London
d.lewis@gold.ac.uk

Tim Crawford
Goldsmiths, University of London
t.crawford@gold.ac.uk

Ryaan Ahmed
Digital Humanities, MIT
rahmed@mit.edu

Laurent Pugin
RISM CH, Switzerland
laurent.pugin@rism-ch.org

Johannes Kepper
University of Paderborn
kepper@edirom.de

Abstract

In this progress report, we describe the issues encountered during the design and implementation of TabMEI, a new MEI module for encoding instrumental tablatures. We discuss the main challenges faced and lay out our workflow for implementing the TabMEI module. In addition, we present a number of example encodings, and we describe anticipated applications of the module.

Introduction

A substantial part of Western art music for plucked, bowed, and keyboard instruments from roughly the early 16th to the late 18th century is notated in *tablature*, a prescriptive notation system that provides the actions a player must take rather than a description of the sounds these actions produce [1]. The mid-20th century saw a revival of tablature for plucked instruments — principally the same as the earlier system, but now for modern (electric) guitar and bass guitar — with the rise of popular music, enabling a large audience to reproduce its favourite music. With the emergence of the personal computer and, especially, the internet in the late 20th century, enormous amounts of user-created tablature — now in various *digital* formats, and increasingly linked to performance material (audio, video) — have become available. Music in tablature, in short, is a force to be reckoned with.

Yet, with the exception of a handful of recent attempts [2, 3, 4, 5, 6, 7, 8], large-scale computational research into music in tablature is lagging behind. We hypothesise that this is to a large extent due to the lack of a suitable digital format capable of encoding not only the explicit, but also the implicit and the contextual information conveyed by a piece in tablature. We think that MEI, which "brings together specialists from various music research communities [...] in a common effort to define best practices for representing a broad range of musical documents and structures" is such a format.[1] In this paper, we describe TabMEI, a module modelling the various tablature variants, to be included into MEI.

At this early stage, TabMEI focuses on tablature for plucked instruments, and includes historical lute tablature in three different types (Italian, French, and German) and tablature for the modern (electric) guitar. We do not yet attempt to model historical guitar or keyboard tablatures, which bring their own challenges. We aim to implement a basic set of elements and attributes — reusing, in the spirit of MEI, existing ones as much as possible — that cover most of the repertories and their performance techniques to a usable level.

In what follows, we discuss the main challenges faced, illustrated where appropriate with real-life examples (Section 2); our workflow for designing and implementing the TabMEI module (Section 3); three example encodings addressing some of the aforementioned challenges (Section 4); anticipated applications of the module (Section 5); and, finally, several of the many avenues of future work (Section 6).

1 https://music-encoding.org/

Challenges

Designing and implementing a new MEI module involves considerable challenges. Below, we describe five such challenges.

First, there is the issue of reconciling proposed new MEI elements and attributes with existing ones: are they really needed if MEI already contains mechanisms that model highly similar concepts? This applies at the most basic level: as Figure 1 illustrates, like mensural forms of music, music in tablature consists of a staff-like object containing symbols (notes) possibly arranged in vertical events (chords). Despite the fact that the 'staff' is now a visual representation of the courses (i.e., strings or string pairs) on the instrument, most of the elemental building blocks of MEI — `<staff>`, `<layer>`, `<note>`, and `<chord>`, as well as many of their attributes — can either be reused or be repurposed.

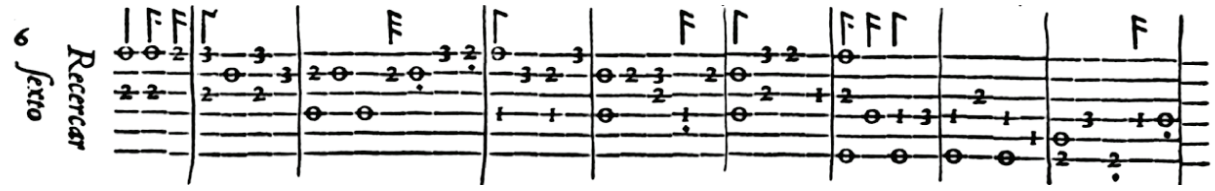

Figure 1: Giovanni Maria da Crema, *Intabolatura de lauto, Libro primo* (Venice, 1546). *Recercar sexto*, first system. Italian lute tablature with numbers indicating the frets and lines indicating the courses to be played.

Second, modern guitar tablature contains a substantial range of indications of very common performance techniques particular to the instrument (e.g., various legato techniques such as *hammer-on*, *pull-off*, and *slide*; string bending techniques; or articulation techniques such as *palm muting* or vibrato). Often, these require the introduction of new, idiomatic concepts; an example is a 'virtual' note reflecting the current 'state' of a note whose pitch is being inflected (bent) while retaining properties of that initial note. Figures 2 and 3 show examples of such techniques and concepts.

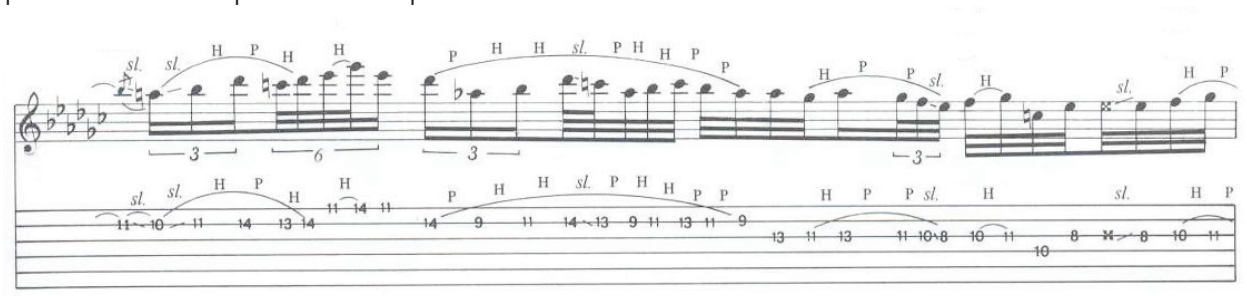

Figure 2: Joe Satriani, *Surfing with the Alien* (Relativity Records, 1987). *Ice 9*, fragment. Modern guitar tablature with a transcription in CMN superimposed. The fragment displays examples of (combinations of) the legato techniques hammer-on (*H*), pull-off (*P*), and slide (*sl.*).

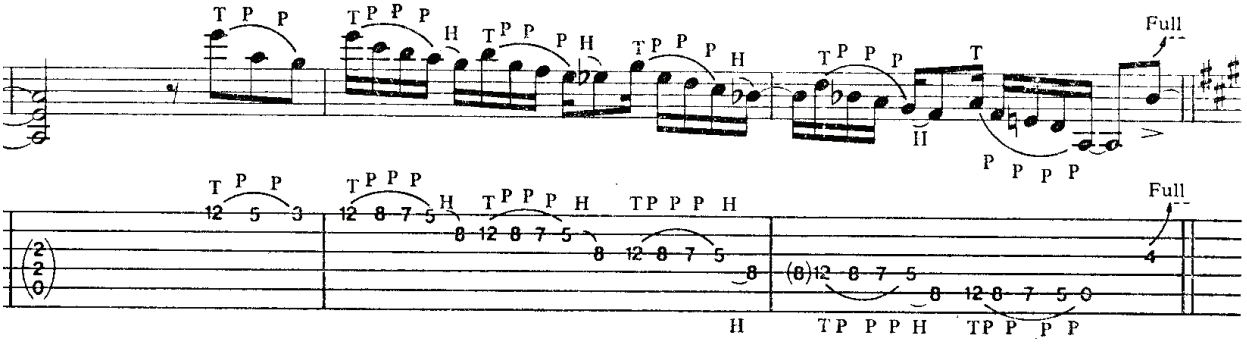

Figure 3: Van Halen, *1984* (Warner Records Inc., 1984). *Hot for Teacher*, fragment. Modern guitar tablature with a transcription in CMN superimposed. In addition to examples of (combinations of) the legato techniques hammer-on (*H*) and pull-off (*P*), the fragment displays examples of the right-hand finger tapping technique (*T*) and of the string bending technique (arrow with *Full*). The note following the last note in the example (not shown) is a 'virtual' note reflecting the current 'state' of that last, bent note.

Third, as Figures 2 and 3 show, modern guitar tablature is often accompanied by a transcription into CMN, which may contain relevant information, added by the transcriber, that is only implicitly or ambiguously present in the tablature (e.g., the exact duration of a note). How should such different levels of objectivity be modelled?

Fourth, when dealing with online tablatures in ASCII (plain text) format, one sees a high variance in quality and, since there is no notational standard and anyone can make their own encoding with just a text editor, in representation. Both complicate, among other things, any necessary data preprocessing.

Fifth, German lute tablature, which, as Figure 4 shows, contains no staff but represents each fret-course coordinate by a unique symbol, requires a different rendering paradigm. Although this presents a challenge now, the experience gained modelling this type of tablature will be useful when dealing with keyboard tablatures later.

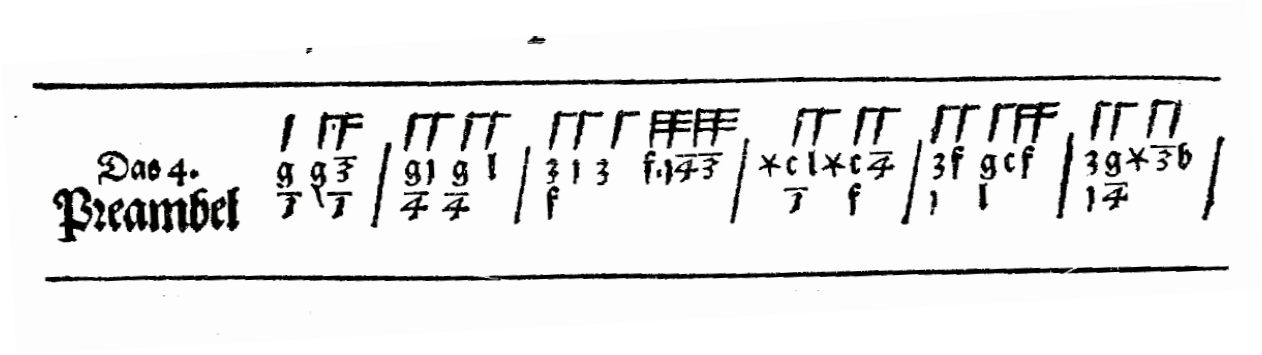

Figure 4: Hans Gerle, *Eyn newes sehr künstlichs Lautenbuch* (Nuremberg, 1552). *Das 4. Preambel*, first system. German lute tablature with unique symbols indicating the fret-course coordinates to be played. This is the same piece as the one shown in Figure 1.

Workflow

We adopt the following workflow for designing and implementing the new MEI module:

- Identify notational features specific to tablatures, always taking into account the domain — visual, gestural, or analytical — to which they belong. A feature frequently belongs to more than one domain.
- List requirements based on a set of examples. Complex and rare examples (such as, for instance, those in Figure 2 and 3) should be considered in order to validate an approach.
- Ensure that the proposed model fits the MEI approach.
- Ensure that existing MEI elements and attributes are reused when appropriate.
- Ensure that the module's granularity is in line with that of existing MEI modules (i.e., avoid a surplus of new elements and attributes).
- Prepare a customisation and the accompanying documentation, both of which are required to make a proposal (in the form of a pull request) to MEI.
- Incorporate feedback from the larger MEI community.

Example encodings

Figure 5 presents the TabMEI encoding of the antepenultimate bar of the fragment shown in Figure 1. `<measure>`, `<staff>`, and `<layer>` elements can be reused from the CMN MEI module, but `<chord>` elements have been replaced with the idiomatic `<tabGrp>` elements, which themselves contain the idiomatic `<tabRhythm>` elements (whose presence indicates that the tablature chord is provided with a rhythm symbol) and `<note>` elements. Because the duration of the rhythm symbols in lute tablature is often open to interpretation, on the `<tabGrp>` element the `@dur.ges` (and not `@dur`) attribute is used, and on the `<note>` element the `@pname` and `@oct` attributes, which depend on the tuning used, are replaced by the idiomatic `@tab.course`

and `@tab.fret` attributes. (The tuning itself, along with the tablature type, is specified in the `<staffDef>`; see the TabMEI GitHub repository for full examples.)[2]

```
<measure n='7'>
  <staff n='1'>
    <layer n='1'>
      <tabGrp dur.ges='4' dots='1'>
        <tabRhythm/>
        <note tab.course='6' tab.fret='0' xml:id='m7.n1'/>
        <note tab.course='4' tab.fret='2' xml:id='m7.n2'/>
        <note tab.course='1' tab.fret='0' xml:id='m7.n3'/>
      </tabGrp>
      <tabGrp dur.ges='8'>
        <tabRhythm/>
        <note tab.course='3' tab.fret='0' xml:id='m7.n4'/>
      </tabGrp>
      <tabGrp dur.ges='4'>
        <tabRhythm/>
        <note tab.course='3' tab.fret='1' xml:id='m7.n5'/>
        <note tab.course='1' tab.fret='0' xml:id='m7.n6'/>
      </tabGrp>
      <tabGrp dur.ges='4'>
        <note tab.course='3' tab.fret='3' xml:id='m7.n7'/>
      </tabGrp>
    </layer>
  </staff>
</measure>
```

Figure 5: TabMEI encoding of Figure 1, antepenultimate bar.

Figure 6 presents the TabMEI encoding of the second half of the last bar of the fragment shown in Figure 3. It shows the reuse of the `<dir>` control event, now with the value `'tap-fing'` for the idiomatic `@technique` attribute, to encode the right-hand finger tapping technique; the reuse of the `<slur>` control event to encode the legato techniques hammer-on and pull-off, and the use of the idiomatic `<pitchInflection>` control event to encode the string bending technique.

```
<measure n='3' right='dbl'>
  <staff n='1'>
    <layer n='1'>
      <beam>
        ...
        <tabGrp dur='16'>
          <note tab.course='5' tab.fret='12' xml:id='m3.n7'/>
        </tabGrp>
      </beam>
      <beam>
        <tabGrp dur='16'>
          <note tab.course='5' tab.fret='8' xml:id='m3.n8'/>
        </tabGrp>
        <tabGrp dur='16'>
          <note tab.course='5' tab.fret='7' xml:id='m3.n9'/>
        </tabGrp>
        <tabGrp dur='16'>
```

2 https://www.github.com/music-encoding/tablature-ig/

```
          <note tab.course='5' tab.fret='5' xml:id='m3.n10'/>
        </tabGrp>
        <tabGrp dur='16'>
          <note tab.course='5' tab.fret='0' tie='i' xml:id='m3.n11'/>
        </tabGrp>
      </beam>
      <beam>
        <tabGrp dur='8'>
          <note tab.course='5' tab.fret='0' tie='t' xml:id='m3.n12'/>
        </tabGrp>
        <tabGrp dur='8'>
          <note tab.course='3' tab.fret='4' tie='i' xml:id='m3.n13'/>
        </tabGrp>
      </beam>
    </layer>
  </staff>
  ...
  <dir technique='tap-fing' startid='m3.n7'>T</dir>
  <slur startid='m3.n7' endid='m3.n11' show.dirmark='true'/>
  <pitchInflection startid='m3.n13' endid='m4.n1' dis='2'>
  Full</pitchInflection>
</measure>
```

Figure 6: TabMEI encoding of Figure 3, second half of last bar.

Figure 7, finally, presents the TabMEI encoding of the first bar of the fragment shown in Figure 4. Apart from the correction, the only difference in material usage with the encoding shown in Figure 5 is the additional use of the idiomatic `<fretGlyph>` element on the `<note>` element, which facilitates the encoding of unique symbols for fret-course coordinates using the `@symbol` and `@symbol.mod` attributes. (For the sake of brevity of the example, the scribal error — the note with `@xml:id='m1.n4'` should move one `<tabGrp>` to the left — has not been corrected. For the full, corrected, example see the TabMEI GitHub repository.)

```
<measure n='1'>
  <staff n='1'>
    <layer n='1'>
      <tabGrp dur.ges='2'>
        <tabRhythm/>
        <note tab.course='6' tab.fret='0' xml:id='m1.n1'>
          <fretGlyph symbol='1' symbol.mod='strikethrough'/>
        </note>
        <note tab.course='4' tab.fret='2' xml:id='m1.n2'>
          <fretGlyph symbol='g'/>
        </note>
      </tabGrp>
      <tabGrp dur.ges='4' dots='1'>
        <tabRhythm/>
        <note tab.course='4' tab.fret='2' xml:id='m1.n3'>
          <fretGlyph symbol='g'/>
        </note>
      </tabGrp>
      <tabGrp dur.ges='8'>
        <tabRhythm/>
        <note tab.course='6' tab.fret='0' xml:id='m1.n4'>
          <fretGlyph symbol='1' symbol.mod='strikethrough'/>
        </note>
        <note tab.course='6' tab.fret='2' xml:id='m1.n5'>
          <fretGlyph symbol='3' symbol.mod='strikethrough'/>
```

```
        </note>
      </tabGrp>
    </layer>
  </staff>
</measure>
```

Figure 7: TabMEI encoding of Figure 4, first bar.

Applications

The TabMEI module has several immediate applications. First, a simple Verovio tablature renderer, taking TabMEI as input, exists.[3] It is compatible with the Verovio CMN and mensural music renderer — meaning that tablature can be displayed together with music in CMN (e.g., a transcription of the tablature) or mensural music (e.g., a vocal part in a lute song) flexibly. An example of the former is shown in Figure 8. The renderer facilitates basic playback.

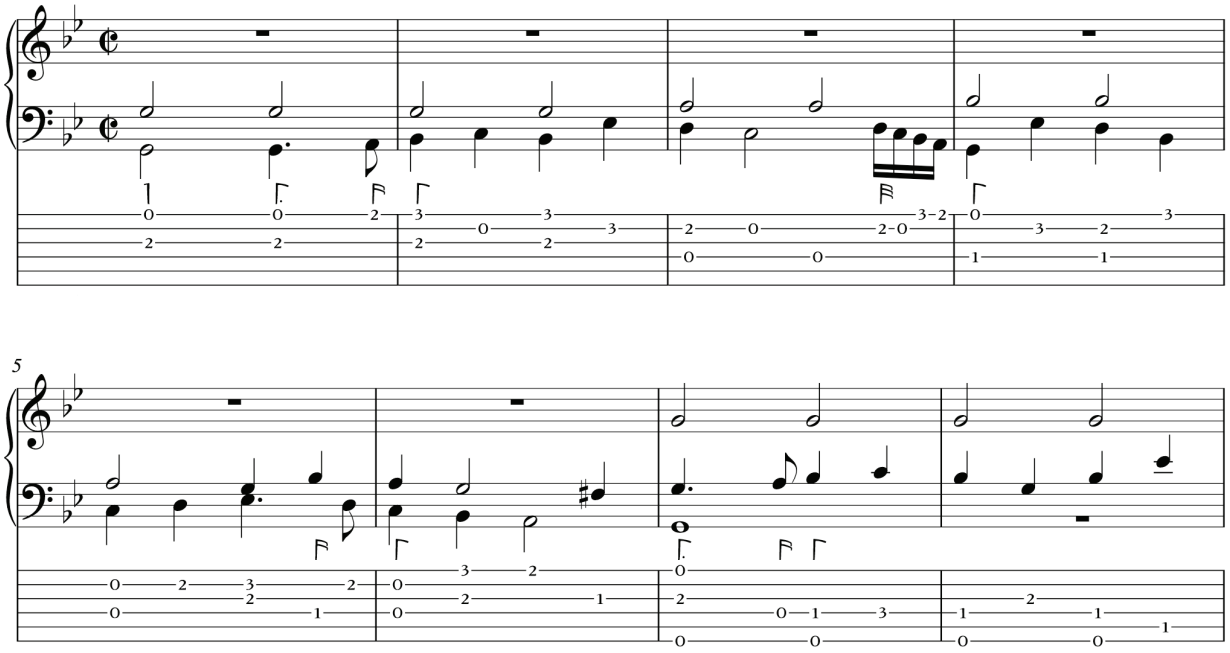

Figure 8: Verovio rendering of the tablature fragment shown in Figure 1, with a transcription in CMN superimposed.

Second, using a workflow involving the music21 tablature toolbox [2, 3] and a tablature mapping algorithm [8] or a voice separation model [7],[4] we can directly compare 16th-century lute intabulations — arrangements of vocal works — with their vocal models. Third, 'internet tabs' (i.e., online tablatures using an ASCII character set) can be ingested through the music21 tablature toolbox, displayed elegantly with Verovio, and analysed on a large scale, or connected to other digital datasets, for example through linked data techniques [6, 9, 10].

3 https://www.github.com/rism-ch/verovio/

4 https://www.web.mit.edu/music21/

Future work

In this early stage, there are many lines of future work to be explored. The most obvious — and most demanding — is to be more complete both in the coverage of repertories (e.g., for the historical guitar, or for the various historical keyboard instruments) and performance techniques. Furthermore, existing Standard Music Font Layout (SMuFL) fonts for displaying historical tablatures are incomplete, and should be extended;[5] this requires a discussion with SMuFL developers. Useful features, for example in the context of education or the preparation of scholarly or performance editions, would be interactive authoring and editing, and ingestion from a wider range of formats. Finally, the support of playback via soundfonts is envisaged.

Works cited

[1] Dart, Thurston, John Morehen, and Richard Rastall. "Tablature" in *The New Grove Dictionary of Music and Musicians*, ed. Stanley Sadie (2nd ed., vol. 24). London: Macmillan, 2001, 905-14.

[2] Ahmed, Ryaan, Reinier de Valk, Tim Crawford, and David Lewis. "A digital toolbox for exploring lute tablature" presented at the 47th Medieval and Renaissance Music Conference, Basel, Switzerland, July 3-6, 2019.

[3] Ahmed, Ryaan, Reinier de Valk, Tim Crawford, and David Lewis. "Hundreds of thousands of pieces in MEI: Encoding tablatures at scale" presented at the Music Encoding Conference, Vienna, Austria, May 29-June 1, 2019.

[4] Crawford, Tim, Jessica Schwartz, David Lewis, and Richard Lewis. "Encoding music as people play it: MEI and the role of tablatures in capturing musical performance" presented at the Music Encoding Conference, Montreal, QC, Canada, May 17-19, 2016.

[5] Lewis, David, Tim Crawford, and Daniel Müllensiefen. "Instrumental idiom in the 16th century: Embellishment patterns in arrangements of vocal music" in *Proceedings of the 17th International Society for Music Information Retrieval Conference* (ISMIR 2016), 524-30.

[6] Lewis, Richard J., Tim Crawford, and David Lewis. "Exploring information retrieval, semantic technologies and workflows for music scholarship: The Transforming Musicology project" Early Music 43, no. 4 (2015), 635-47.

[7] de Valk, Reinier. "Structuring lute tablature and MIDI data: Machine learning models for voice separation in symbolic music representations". City University London, 2015. PhD dissertation.

[8] de Valk, Reinier, Ryaan Ahmed, and Tim Crawford. "JosquIntab: A dataset for content-based computational analysis of music in lute tablature" in *Proceedings of the 20th International Society for Music Information Retrieval Conference* (ISMIR 2019), 431-38.

[9] Meroño-Peñuela, Albert, Reinier de Valk, Enrico Daga, Marilena Daquino, and Anna Kent-Muller. "The Semantic Web MIDI Tape: An interface for interlinking MIDI and context metadata" in *Proceedings of the Workshop on Semantic Applications for Audio and Music* (SAAM 2018), 24-32.

[10] David M. Weigl and Kevin R. Page. "A framework for distributed semantic annotation of musical score: "Take it to the bridge!"" in *Proceedings of the 18th International Society for Music Information Retrieval Conference* (ISMIR 2017), 221-28.

5 https://www.smufl.org/