

## **White Mensural Manual Encoding: from Humdrum to MEI\***

### **Codificación manual mensural: de Humdrum a MEI**

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**ABSTRACT**

The recovery of musical heritage currently necessarily involves its digitalization, not only by scanning images, but also by the encoding in computer-readable formats of the musical content described in the original manuscripts. In general, this encoding can be done using automated tools based with what is named Optical Music Recognition (OMR), or manually writing directly the corresponding computer code. The OMR technology is not mature enough yet to extract the musical content of sheet music images with enough quality, and even less from handwritten sources, so in many cases it is more efficient to encode the works manually. However, being currently MEI (Music Encoding Initiative) the most appropriate format to store the encoding, it is a totally tedious code to be manually written. Therefore, we propose a new format named **\*\*mens** allowing a quick manual encoding, from which both the MEI format itself and other common representations such as Lilypond or the transcription in MusicXML can be generated. By using this approach, the antiphony *Salve Regina* for eight-voice choir written by Jerónimo de la Torre (1607–1673) has been successfully encoded and transcribed.

**Key words:** Music Digital Encoding, Music, Hispanic White Mensural Notation, Baroque, Paleography, Music format, Digital humanities.

**RESUMEN**

La recuperación del patrimonio musical en el momento actual pasa necesariamente por su digitalización, no sólo mediante la obtención de imágenes digitales, sino también por la codificación en formatos legibles por un ordenador del contenido musical descrito en los manuscritos originales. En general, esa codificación se puede realizar mediante herramientas automatizadas basadas en lo que se denomina Reconocimiento Óptico de Música (OMR por sus iniciales en inglés), o manualmente escribiendo directamente el código informático pertinente. La tecnología OMR todavía no está lo suficientemente madura como para extraer con buena calidad el contenido musical de imágenes de partituras, y aún menos de fuentes manuscritas, por lo que en muchos casos es más eficiente codificar las obras manualmente. Sin embargo, es totalmente tediosa la escritura en el formato más adecuado para realizar esa codificación actualmente, MEI (Music Encoding Initiative). Por ello proponemos un nuevo formato denominado **\*\*mens** que permite escribir manualmente el código de manera rápida y sencilla, a partir del cual, además, somos capaces de generar tanto el propio formato MEI como otras representaciones habituales como son Lilypond o la transcripción en MusicXML. Usando este enfoque, se ha codificado y transcrito la antifona a ocho voces *Salve Regina* escrita por Jerónimo de la Torre (1607–1673).

**Palabras clave:** Codificación digital de la música, Música, Notación Mensural Blanca Hispánica, Barroco, Fuentes Tipográficas, Paleografía, Formato musical, Humanidades digitales.

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## 1. INTRODUCTION

The recovery of early music has gained interest in the last years. Many efforts are being done to restore old sources. In most cases a traditional approach has been followed: musicologists analyze and transcribe works into Common Western Modern Notation (CWMN) and accompany them with a discussion of the rationale of the decisions taken into the so-called critical edition.

Some new projects (Kirkman, 2015) are emerging that have their objective on making these transcriptions accessible through online services that, besides allowing for a much wider audience than printed editions, take advantage of computer based utilities such as the content based search. However, very few aisled projects (Rigaux et al., 2012) pay attention on the online reproduction of the original notation found in the manuscripts, and, for the best of our knowledge, there is no one reproducing fully diplomatic transcription scores. Thus, the need of having tools and computer formats available for digitally encoding early music has been limited to a restricted number of projects.

Some digital editions have been presented that explicitly encode early notation content in ad-hoc designed formats. One of the firsts attempts was proposed by Manion and Stinson in 1984 with the Scribe project (Stinson and Stoessel, 2014), where a software application and an encoding formats where developed (see Fig. 1 ).

LINE6  
C9  
FL8  
COB12 11.14 -2;A-  
MD12ISM11  
S10R11 10;mor  
MD11ISM12M13;da  
S12.12 0;po  
M11MD12ISM11MD10ISM11;che  
S9.8 4D7T8 6 7;tu

A - mor da po che tu ti

Fig. 1: Scribe encoding and rendering.

Maybe, the most serious attempt to create open tools for encoding mensural music so far has been the Computerized Mensural Music Editing (CMME) (Dumitrescu and Berchum, 2009). An eXtensible Markup Language (XML) based format (Selfridge-Field, 1997) was devised and both tools<sup>1</sup> for inputting music and visualizing it with a number of specific features such as choosing between early and modern clefs were released. However, besides the “The Other Josquin”<sup>2</sup> Jase Rodin’s project this work is not longer maintained.

Since then, the sounder proposal to encode early music in an open community driven format is the Music Encoding Initiative (MEI) (Roland, 2002, Roland et al., 2014). This XML based format allows the encoding not only common western modern notation music, but also analysis, traditional facsimile, critical, and performance editions, and what’s more

<sup>1</sup> <https://github.com/tdumitrescu/cmme-editor>

<sup>2</sup> <http://www.cmme.org/database/projects/14>

interesting, neumatic and mensural notations, allowing. Besides, it can be adapted to user's needs through a customization process.

Once MEI and its customization protocol had been made available, Scribe creators decided to make this project data more accessible by writing a customization of MEI named MEI NeoScribe. By using a command-line Unix tool, the original data in Scribe was ported to a MEI-like format (Stinson and Stoessel, 2014).

Created as “a tool for music editors in order to compare early music editions and re-editions when compiling comprehensive critical modern editions”<sup>3</sup>, the Aruspix project was the first available tool able to recognize printed mensural manuscripts and to convert them into a computer readable symbolic format (Pugin, 2009) using OMR. The music editing tools were conceived to correct the output of OMR and to superimpose and collate early music prints (see Fig. 2).



Fig. 2: Aruspix screenshot.

The absence of usable encoding tools was evinced by Elias and Desmond (Thomae Elias and Desmond, 2017), who introduced a method to encode mensural music using the Sibelius commercial notation editor. As this editor does not include tools to work with this

<sup>3</sup> <http://www.aruspix.net>



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Given this scenario, if a new project for encoding and transcribing early music is planned, it is currently difficult to know which workflow of tools and encoding formats should be chosen. It seems that the most sensible decision is to choose MEI as encoding format. Regarding the tools to be chosen, although OMR based tools are the most promising ones, nowadays there is not any robust enough application able to deal with all kinds of manuscripts, either those very well maintained or damaged handwritten papers (see Fig. 3). Thus, in this context, currently the best option to encode MEI is to manually write directly XML format or use the above mentioned Elias and Desmond's Sibelius workaround (Thomae Elias and Desmond, 2017). In fact, the community is using XML editors such as Oxygen<sup>7</sup> for the task.

However, due to the verbosity of the XML text to be written, this is a very tedious and error-prone method.



Fig. 4: OMR systems are currently unable to deal with this kind of manuscripts.

For filling this gap, in this work we propose a format to quickly encode by hand early notation music, specifically, white mensural polyphonic works, from which we are able to generate MEI encoding for their preservation. As our objective is not to substitute MEI, but to provide a tool for simplifying its writing, we defer any diplomatic nuance to its manual editing directly in the generated MEI file. Based on the previous experience of manually encoding CWMN works with Humdrum's **\*\*kern** format (Huron, 2002), such as most of the Chopin works, we have designed a new Humdrum format named **\*\*mens** for encoding white mensural notation. Repertory-specific issues similar to the ones referred to in (Zitellini and Pugin, 2016) are addressed using markup and tools to convert the data into MEI. The Verovio Humdrum Viewer (VHV)<sup>8</sup> (see Fig. 5) (Sapp, 2017) has been extended to work with **\*\*mens**. Thus, the user writes directly the content using **\*\*mens**, and VHV can represent visually the content rendered and export to MEI. Additionally, the IM3 library<sup>9</sup> has been also extended to convert from/to **\*\*mens** and MEI and other formats, such as Lilypond, and MusicXML or MIDI in their CWMN translation.

<sup>7</sup> <https://www.oxygenxml.com>

<sup>8</sup> <https://verovio.humdrum.org>

<sup>9</sup> <https://github.com/davidrizo/im3>

## WHITE MENSURAL MANUAL ENCODING: FROM HUMDRUM TO MEI

The approach has been used as the encoding method in the context of the *Patriarca project*<sup>10</sup> to transcribe 17th-Century late white mensural notation manuscripts at the Real Colegio Seminario del Corpus Christi in Valencia (*E-VAcP-Mus*) containing dozens of works of composers ranging from Diego Pontac (1603–1654) to Antonio Teodoro Ortells (1649–1706).

The screenshot shows the Verovio Humdrum Viewer interface. The title bar reads "Mozart, Piano Sonata No. 11 in A major, K 331 (300i), Mvmt. 1a". On the left, there is a list of metadata and encoding instructions, including:
 

- 1 !!!COM: Mozart, Wolfgang Amadeus
- 2 !!!CDT: 1756/01/27/-1791/12/05/
- 3 !!!CNT: German
- 4 !!!OTL: Piano Sonata No. 11 in A major
- 5 !!!SCT1: K1 331
- 6 !!!SCT2: K6 300i
- 7 !!!OMV: Mvmt. 1a
- 8 !!!OMD: Thema: Andante grazioso
- 9 !!!ODT: 1778-1873///
- 10 \*\*kern \*\*kern \*\*dynam
- 11 \*staff2 \*staff1 \*staff1/2
- 12 \*>[A,A,B,B] \*>[A,A,B,B] \*>[A,A,B,B]
- 13 \*>norep[A,B] \*>norep[A,B] \*>norep[A,B]
- 14 \*>A \*>A \*>A
- 15 \*cleff4 \*cleff2 \*cleff2
- 16 \*k[#c#g#] \*k[#c#g#] \*k[#c#g#]
- 17 \*A: \*A: \*A:
- 18 \*MG/8 \*MG/8 \*MG/8
- 19 \*MM72 \*MM72 \*MM72
- 20 =1- =1- =1-
- 21 \*^ \*
- 22 4e (8.AL (8.cc#L p
- 23 . 16Bk) 16ddk) .
- 24 8e 8AJ 8cc#J .
- 25 4e 4c# 4ee .
- 26 8e 8c# 8ee .
- 27 =2 =2 =2 =2
- 28 4e (8.G#L (8.bl .
- 29 . 16Ak) 16cc#k) .
- 30 8e 8G#J 8bJ .
- 31 4e 4B 4dd .
- 32 8e 8B 8dd .
- 33 =3 =3 =3 =3
- 34 4e 4F# 4a .

 The main area displays three systems of musical notation in treble and bass clefs, with dynamic markings like 'p' and 'sf'. The first system is labeled "Thema: Andante grazioso".

Fig. 5: Verovio Humdrum Viewer snapshot (1649-1706).

## 2. \*\*MENS FORMAT

The **\*\*mens** format has been developed based on the main Humdrum's **\*\*kern** philosophy. Music is encoded in text files that can be written using any text editor. Data is organized in columns, named *spines*, each one containing a voice: the leftmost column containing the bottom voice in the score (e.g. the bass in a choir sheet), the rightmost representing the top voice (e.g. the soprano in a typical SATB arrangement). Each item can represent either actual notes and rests, continuations of them, context modifiers such as key and time signatures or clefs, or some visual indicators such as bar lines. See an example in Figure 6.

<sup>10</sup>The Patriarca project is been developed during the academic year 2017/2018 by the authors and sponsored by the Instituto Superior de Enseñanzas Artísticas de la Comunidad Valenciana (ISEA.CV)

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```

**mens    **mens
*I"Rests  *I"Notes
*clefC3   *clefC3
Xr        Xc
Lr        Lc
Sr        Sc
sr        sc
Mr        Mc
mr        mc
Ur        Uc
ur        uc
=| |     =| |
*-       *-

```

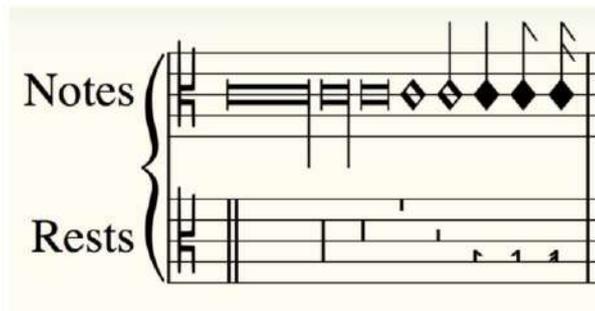


Fig. 6: Simple **\*\*mens** encoding of notes and rests.

Most of the encodings necessary to encode mensural notation are already available in **\*\*kern**, such as all metadata fields, key signature specification, or pitches. However, many other codes have been added that are not present in CWMN, such as the ones denoting perfection or mensuration. The complete grammar is detailed in IM3 source repository<sup>11</sup>.

Global comments, i.e., comments that take a full line, begin with the literal '!!!'. Metadata lines are a specific case of global comments where some specific three character codes follow that literal. Those metadata come from the main **\*\*kern** syntax: 'COM' is used to denote "composer", 'ENC' for "encoder", 'END' for the date the encoding was finished, and 'OTL' for encoding the title. In any other case, each line contains a sequence of one or more columns divided by tabulators, representing each one a different voice. If the work is a typical choir soprano, alto, tenor and bass arrangement, the file will have four columns, ordered from left to right as bass, tenor, alto, soprano, i.e., simulating the score layout as if it were rotated counterclockwise. Each column must start with the header **\*\*mens**. Usually, reusing **\*\*kern** syntax, the instrument name is denoted by a '\*I' code followed by the literal containing that name. Clefs are specified the same way as in **\*\*kern** by means of the '\*clef' code followed by one of 'G2', 'C1' to 'C5', 'F3', and 'F4' denoting the clef note name and its line position. Key signature is also denoted following the **\*\*kern** syntax, that is 'k[*ACCS*]' where '*ACCS*' is replaced by the sequence of altered pitches (e.g. '\*k[f#c#]' represents *D Major*, and '\*k[b-e-]' denotes *Bb Major*). Time signature can be specified using a mensuration sign using the code 'met(*MS*)', where '*MS*' stands for one of the mensuration signs listed in table found in Figure 7. If any bar line is found, it is encoded employing the **\*\*kern** format, by using '=' as minimal expression, that can be followed by a number of modifiers, such as the number of the bar.

<sup>11</sup>[https://github.com/davidrizo/im3/blob/master/imcore/src/main/antlr4/es/ua/dlsi/im3/core/score/io/kern/grammar\\_ebnf.txt](https://github.com/davidrizo/im3/blob/master/imcore/src/main/antlr4/es/ua/dlsi/im3/core/score/io/kern/grammar_ebnf.txt)

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C *met (C)	Φ *met (C )	⊕ *met (C.)	○ *met (O)	⊙ *met (O.)
2 *met (2)	3 *met (3)	C2 *met (C2)	C3 *met (C3)	O2 *met (O2)
Φ2 *met (C 2)	Φ *met (C. )	Φ *met (O )	Φ3 *met (O 3)	O3 *met (O3)
Φ3 *met (C 3)	9 *met (O/3)	$\frac{3}{2}$ *met (3/2)	○ *met (Cr)	‡ *met (C /3)
‡ *met (C /2)	Φ *met (C r)	C $\frac{3}{2}$ *met (C3/2)	‡ *met (C 3/2)	

Fig. 7: Mensuration signifiers.

The main content, that is made of notes and rests, use the `**kern` guidelines where some features have been added to represent specific white mensural notation. A rest is represented as the sequence `'DURr'`, where `'DUR'` stands for a duration modifier from Table 1 (see example in Fig. 6). This way, a maxima rest is encoded using the code `'Xr'`.

Duration signifier	Mensural figure
X	Maxima
L	Longa
S	Breve
s	Semibreve
M	Minima
m	Seminima
U	Fusa
u	Semifusa

Table 1: Mensuration signs.

The notation of pitches follows exactly the format used in `**kern`, i.e., `'DURpitch'` where `'pitch'` is represented as a sequence of either uppercase (for notes under C3), or lowercase (for notes above C3) characters 'a' to 'g', where the number of characters denote the octave. For encoding an optional accidental, the modifiers '-' for flat, '#' for sharp, and 'n' for natural are used.

Figure 6 contains a very simple sample of this format. Once encoded in `**mens`, it can be exported automatically either with VHV or IM3 to the MEI listing in Figure 8.

```

<score>
  <scoreDef>
    <staffGrp symbol="brace" barthru="true">
      <staffDef clef.shape="C" clef.line="3" n="1" notationtype="mensural.white" lines="5">
        <label>Notes</label>
      </staffDef>
      <staffDef clef.shape="C" clef.line="3" n="2" notationtype="mensural.white" lines="5">
        <label>Rests</label>
      </staffDef>
    </staffGrp>
  </scoreDef>
  <section>
    <measure right="dbl" n="0">
      <staff n="1">
        <layer n="1">
          <note dur="maxima" oct="4" pname="c" accid.ges="n" />
          <note dur="longa" oct="4" pname="c" accid.ges="n" />
          <note dur="brevis" oct="4" pname="c" accid.ges="n" />
          <note dur="semibrevis" oct="4" pname="c" accid.ges="n" />
          <note dur="minima" oct="4" pname="c" accid.ges="n" />
          <note dur="semiminima" oct="4" pname="c" accid.ges="n" />
          <note dur="fusa" oct="4" pname="c" accid.ges="n" />
          <note dur="semifusa" oct="4" pname="c" accid.ges="n" />
        </layer>
      </staff>
      <staff n="2">
        <layer n="1">
          <rest dur="maxima" />
          <rest dur="longa" />
          <rest dur="brevis" />
          <rest dur="semibrevis" />
          <rest dur="minima" />
          <rest dur="semiminima" />
          <rest dur="fusa" />
          <rest dur="semifusa" />
        </layer>
      </staff>
    </measure>
  </section>
</score>

```

Fig. 8: MEI encoding of \*\*mens code in Figure.

## 2.1. PERFECTION ENCODING

For some ternary mensuration signs, some figures can be interpreted having equivalent to the duration of two notes of lower order or three of them. This is named *perfection*: a note is *perfect* if it corresponds to three subdivisions, or *imperfect* when equate to two of them.

\*\*mens allows for this distinction by including the codes ‘i’ for *imperfect* and ‘p’ denoting *perfect*. The use of this code can be shown in Figure 9. Breve notes are explicitly encoded as *perfect* or *imperfect*, semibrevis is *imperfect* given the mensuration, so no code has to be written.

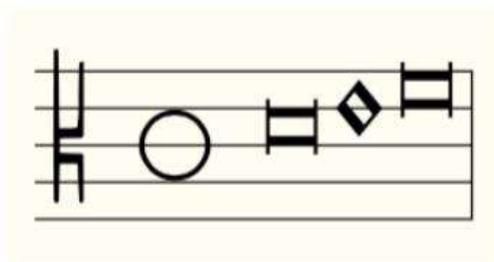
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```

**mens
*clefC3
*k []
*met (0)
Sid
se
Spf
=

```

(a) Encoding



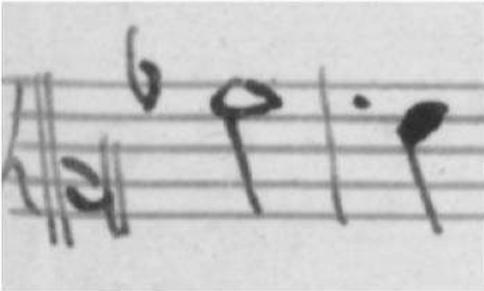
(b) Rendering

Fig. 9: Perfection.

## 2.2. DOTS

The dot symbol in white mensural notation can be given two different meanings depending on the context it is found. It can be a *punctus additionis*, with the same function as the one used in CWMN, that is, enlarge the duration of the preceding note with a half of its nominal duration, or a *punctus divisionis* used to disambiguate some specific sequences of figures. In `**mens`, the colon ‘:’ has been used as the code for denoting both kind of dots that can be appended to note (e.g. ‘Sf:’ denotes a breve F4 note).

In CWMN, *punctus additionis* evolved to what it is known as *augmentation dot*, that is represented in `**kern` as a dot after the duration signifier (e.g. ‘2.c’ is a C4 dotted half note). This same principle could be used in mensural notation if the encoder knows exactly it has that function. However, our guidelines is to always use the colon to encode. This decision allows us to encode some weird situations in which a bar line is found between the note figure and the dot, maybe because it was added afterwards on the original manuscript. Following as principle that in Humdrum music encoding for being able to be automatically analysed, this situation has been solved by explicitly dividing the duration broken by the bar line and encoding this eventuality with the signifiers ‘T’ and ‘t’, denoting tie start caused by a dot after a bar line and tie end (see Fig 10).



(a) Manuscript

```

**mens
*clefC2
*k [b-]
MaT
=
mat:
mg

```

(b) Encoding

Fig. 10: Punctus additionis encoding after a bar line.

### 2.3. ALTERATIO

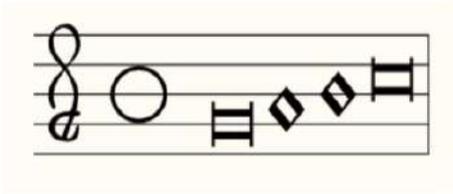
The duration of figures in the context of some mensurations depends on the surrounding elements. Thus, a sequence of breve, semibreve, semibreve, and breve figures in an O meter (*tempus perfectum, prolatio minor*), must be interpreted with durations 6, 2, 4, 6 (see Fig. 11) (Querol Gavaldá, 1975:55) in what is known as *alteratio*.

```

**mens
*met (O)
Sg
sa
sb
Scc
*-

```

(a) Encoding



(b) Rendering

```

**mens
*met (O)
Spg
sia
sIb
Spcc
*-

```

(c) Performance encoding

Fig. 11: Alteratio.

As above introduced, the dot can be given the function of disambiguate situations by separating notes. This is the case of the *punctus divisionis* shown in Figure 12.

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<pre>**mens *met (0) Sg sa: sb Scc *-</pre> <p>(a) Encoding</p>	 <p>(b) Rendering</p>	<pre>**mens *met (0) Sig sia: sib Sicc *-</pre> <p>(c) Performance encoding</p>
---	---	---

Fig. 12: Punctus divisionis.

## 2. 4. COLORING

Coloring of note heads is another specific feature of mensural notation. Depending on the period, note coloring adopts different meanings. In white mensural notation, only the differentiation between *void* note heads and *black* ones must be considered. Thus, a code has been introduced to be used optionally just next to the duration signifier (see Fig. 13) (Querol Gavaldá, 1975: 59).

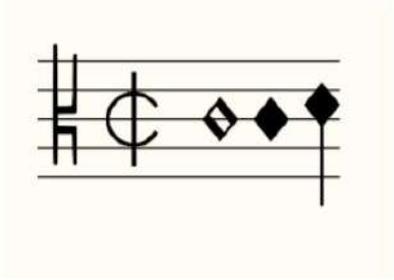
<pre>**mens *clefC3 *met (C ) sc s~ic md *-</pre> <p>(a) Encoding</p>	 <p>(b) Rendering</p>
---	---

Fig. 13: Coloring.

All kinds of coloring use the same graphical mark. Figure 14 shows two similar examples using or not the coloring code (Querol Gavaldá, 1975: 57).

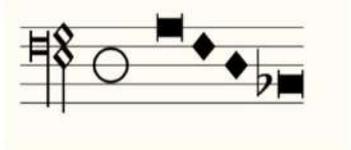
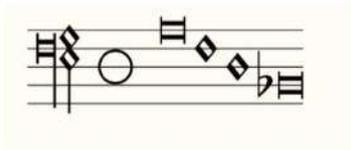
<pre> **mens *clefF4 *met(O) Si~A si~F si~D Si~BB- *- </pre>		<pre> **mens *clefF4 *met(O) SpA siF sID SpBB- *- </pre>	
(a) Major coloring encoding	(b) Major coloring rendering	(c) No coloring encoding	(d) No coloring rendering

Fig. 14: Major coloring.

## 2.5. LIGATURE

*Ligatures* are sequences of notes forming a melisma represented by a single figure body, each one with its own duration and pitch, even with a possible dot. Reusing all above explained note encoding, a ligature is specified in `**mens` just by surrounding the notes the ligature embeds with ‘<’ and ‘>’ delimiters.

There are ligatures whose visual representation depend on the duration of the involved notes (e.g. a ligature of longa descending notes, i.e., *sine proprietate et cum perfectione* (see Fig. 15 (a) and (b)). However, there are other cases where the shape, either *recta* or *obliqua* must explicitly encoded. For allowing this distinction, the encoder may use the suffixes ‘R’ and ‘Q’ respectively for *recta* and *obliqua* connections (see Fig. 15 (c) and (d)).

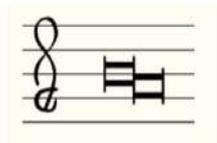
<pre> **mens *clefG2 *k[] &lt;Lb La&gt; *- </pre>		<pre> **mens *clefC3 *k[] &lt;sdR sG&gt; &lt;sGQ sc&gt; *- </pre>	
(a) Implicit shape encoding	(b) Rendering of implicit encoding	(c) Explicit shape encoding	(d) Rendering of explicit encoding

Fig. 15: Ligature.

## WHITE MENSURAL MANUAL ENCODING: FROM HUMDRUM TO MEI

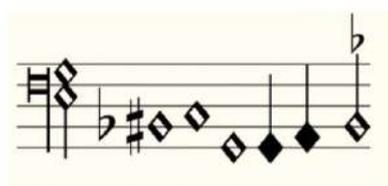
## 2.6. VISUAL SPECIFIC ASPECTS

There are some graphical symbols whose function differs from the one used in CWMN. This is the case of sharps, that if they are attached to a note that was previously affected by a flat, leaving it as a non-altered natural pitch (see Fig. 16). This example contains another interesting case: the last B pitch note should be interpreted as a B flat, however, this alteration is not explicitly written in the manuscript. This is solved by adding an editorial accidental ('xx' suffix). In both cases, the '!LO' prefixed field is denoting a visual specific aspect, that could be removed without changing the actual interpreted music content. This way, '!LO:N:va=#' is indicating that the note coming next should be visually altered with an accidental sharp.

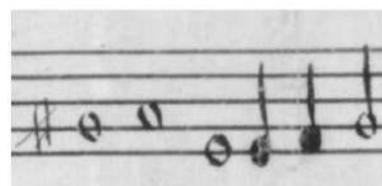
```

**mens
*clefF4
*k[b-]
!LO:N:va=#
sBBn
sC
sGG
mGG
mAA
MBB-i
*-
(a) Encoding

```



(b) Rendering



(c) Source manuscript

Fig. 16: Editorial accidental.

## 3. JERÓNIMO DE LA TORRE TRANSCRIPTION

The approach is being used as the encoding method in the context of the *Patriarca project* to transcribe 17th-Century late white mensural notation manuscripts at the Real Colegio Seminario del Corpus Christi in Valencia containing dozens of works of composers ranging from Diego Pontac (1603–1654) to Antonio Teodoro Ortells (1649–1706). In this paper, we present the encoding of the double choir eight-voice antiphony *Salve Regina* (see Fig. 17), under the symbol *E-VAcP-Mus / CM-T-4* in the archive, written by Jerónimo de la Torre (1607–1673) (De Jaime Gómez and De Jaime Lorén, 1988), composer and organist active in the Cathedral of Valencia from its access in 1645 until his retirement in 1665. Although the document lacks exact dating, it is possible to date it around 1650. The notation signs are the usual ones in the Hispanic baroque repertoire. Some precautions have been taken, such as avoiding the confusion between the *punctus additionis* and the horizontal stroke corresponding to the *minima* rest. In this case study, the original work has not the added difficulty of interpreting perfection; nevertheless, as above exposed, the system is designed to tackle with it.

Fig. 17: *Salve Regina*: “parte de tiple 1° del 1° coro”.

To compare the performance and suitability of the proposal, we have first encoded part of the content directly into MEI using Oxygen<sup>12</sup>, taking us between around 12 minutes per staff, being difficult to concentrate on the direct transcription process from the manuscript while writing XML code. When we have moved to the second and the rest of voices, the problem has been even worse due to the MEI staff separation architecture. In contrast, the encoding using `**mens` has taken us between 2 and 3 minutes for each staff, including the time to make those interpretation decisions of the original manuscript. Perhaps the most interesting feature is the ability of `**kern`, inherited by `**mens`, to represent in a very efficient way the simultaneity of voices, which has helped us in particular to deduce the correct transcription in situations of ambiguity so common in this kind of manuscripts, due in many cases to ink blots, paper holes and dropped ink, where sometimes we do not know which symbol the copyist wanted to represent (see Fig. 18).



Fig. 18: Some possible ambiguities.

<sup>12</sup><https://www.oxygenxml.com>



## DAVID RIZO VALERO, NIEVES PASCUAL LEÓN Y CRAIG STUART SAPP

```

<rest dur="minima"/>
<note pname="d" dur="minima" oct="5">
  <verse n="1">
    <syl wordpos="i">Re</syl>
  </verse>
</note>
<barLine/>
<note pname="e" dur="semiminima" oct="5" xml:id="N1">
  <verse n="1">
    <syl wordpos="m">gi</syl>
  </verse>
</note>
<note pname="d" dur="semiminima" oct="5"/>
<note pname="g" dur="semibrevis" oct="5"/>
<note pname="f" dur="minima" oct="5" xml:id="N2">
  <accid accid="s"/>
</note>
<slur startid="#N1" endid="#N2"/>
<barLine/>

```

Fig. 20: Extract of MEI encoding of manuscript.

```

!!!OTL: Salve a 8
*mens  **mens  **mens  **mens  **mens  **mens  **mens  **mens
staff8 *staff7 *staff6 *staff5 *staff4 *staff3 *staff2 *staff1
clefC4 *clefC3 *clefC2 *clefG2 *clefC3 *clefC2 *clefG2 *clefG2
k[b-]  *k[b-]  *k[b-]  *k[b-]  *k[b-]  *k[b-]  *k[b-]  *k[b-]
M4/4   *M4/4   *M4/4   *M4/4   *M4/4   *M4/4   *M4/4   *M4/4
met (C) *met (C)
Xr     sr     Xr     sr     sd     sr     sr     Mr
.      .      .      .      .      .      .      Mdd
!      !      !      !      =      !      !      =
.      sr     .      sr     sc#   sr     sr     mee
.      .      .      .      .      .      .      mff
.      .      .      .      .      .      .      sgg
!      !      !      !      =      !      !      !
.      sr     .      sr     sd     sr     sr     .
.      .      .      .      .      .      .      Mff#
!      !      !      !      =      =      =      =
.      sr     .      sr     MG     sdd-   Mr     Mgg
.      .      .      .      MB-   .      Mdd   Mgg
!      !      !      !      =      =      =      =
.      sr     .      sr     sA    scc#   mee   saa
.      .      .      .      .      .      mff   .

```

Fig. 21: Extract of Humdrum encoding using \*\*mens.

## WHITE MENSURAL MANUAL ENCODING: FROM HUMDRUM TO MEI

Verovio engraving excerpt showing a choir score with eight parts: Tiple 1º de 1º coro, Tiple 2º de 1º coro, Alto de 1º coro, Tenor de 1º coro, Tiple 1º de 2º coro, Alto 1º de 2º coro, Tenor de 2º coro, and Bajo de 2º coro. The lyrics "Re gi na re gi na re gi na re gi na sal ve re gi na" are written under the first two staves.

Fig. 22: Verovio engraving (excerpt).

Lilypond engraving excerpt titled "Salve a 8" showing a choir score with eight parts. The notation includes various musical symbols such as notes, rests, and accidentals.

Fig. 23: Lilypond engraving (excerpt).

#### 4. CONCLUSIONS

In this article an efficient alternative to encode transcriptions directly in MEI format has been introduced that uses an extension of \*kern syntax named \*\*mens, and solutions for issues specific to white mensural notation have been detailed. From the \*\*mens input, some examples of different outputs has been presented that show the suitability of the approach. Given the fact \*\*mens has been processed both by Verovio Humdrum Viewer and IM3 library, we demonstrate the proposed encoding is complete and well-formed, not depending on any specific framework as happens with Lilypond.

The work is still in progress, so many options are to be still implemented in the near future.

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