# The LMLO* Goes MEI:
# An Exercise in Melodic Encoding Translation

**Katherine Eve Helsen**, **The University of Western Ontario**

**Yaolong Ju**, **McGill University**

**Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT)**

**Music Encoding Conference 2018**

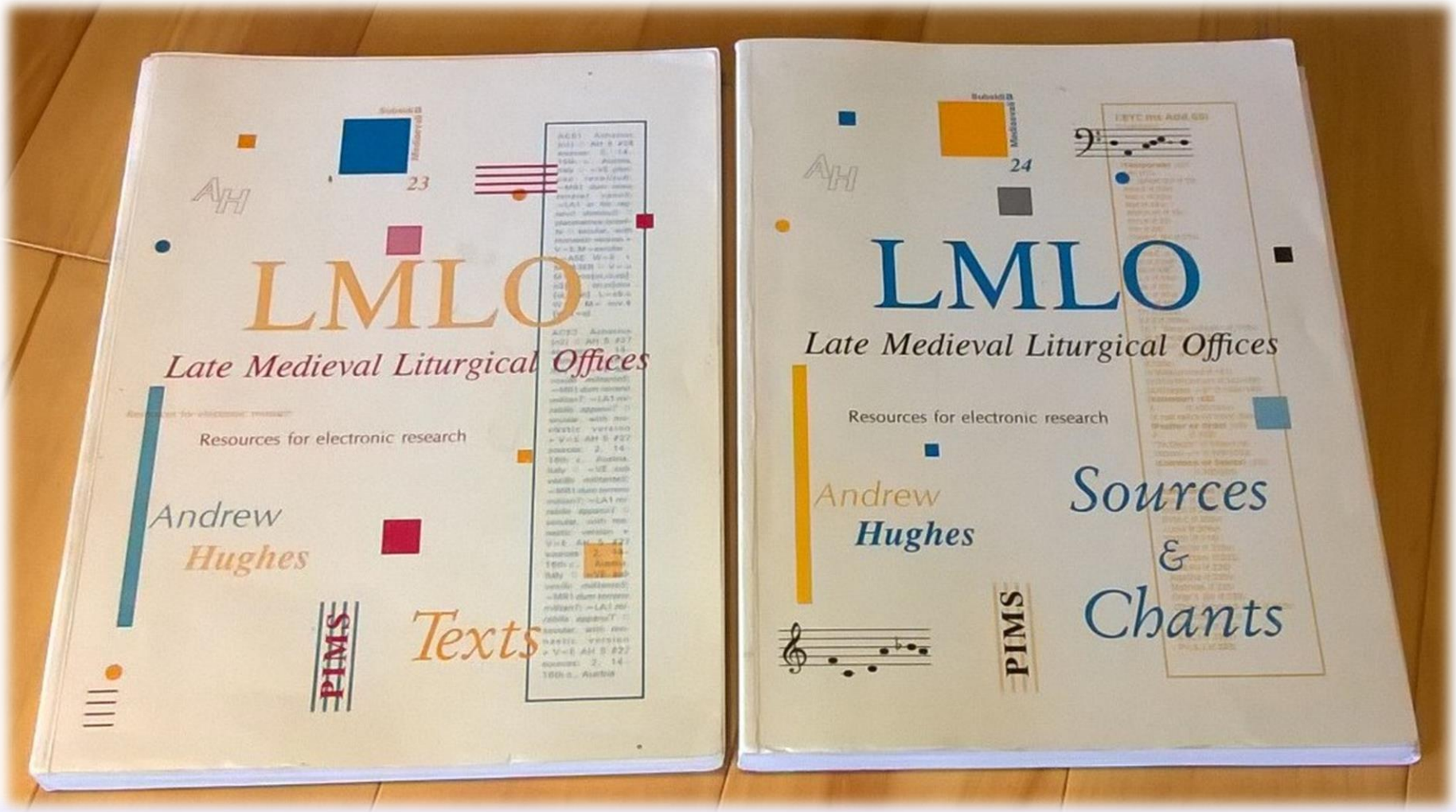
May 24th, 2018

*LMLO: Late Medieval Liturgical Offices

# Outline

1. Introduction
2. LMLO Encoding Schema
3. Translation Methodology
4. Challenges & Solutions
5. Results & Applications

# 1 Introduction



# 1 Introduction

Late Medieval Liturgical Offices: Tools for Electronic Research

- Vol. 1 (book and floppy disks): Texts (1994)
- Vol. 2 (book and floppy disks): Sources and Chants (1996)
- Now available as e-books and CD-ROMs

The author of LMLO: Andrew Hughes (1937–2013):

- A medieval musicologist at University of Toronto
- An early adopter of computer technology in the 1970s
- He had amassed chants and committed the melodies to his computer over the years

# 1 Introduction

**Late Medieval** refers to the time period from 1100 to 1500

**Liturgical Offices** means services held over the course of a day in honour of a "feast" or event in a church year, such as:

- Christmas
- A saint's day (e.g., St. Patrick's Day)

# 1 Introduction

An office contains Latin poetries with chant melodies, for the following services:

- Lauds (morning)
- Vespers (evening)
- Compline (before bed)
- Matins (in the middle of the night)

# 1 Introduction

Late Medieval Liturgical Offices (LMLO):

- Includes 200+ late medieval church feasts
- Includes 5000+ chant melodies
- LMLO did not receive enough attention from the chant research community
  - Chants were encoded in a special format, which was hard to understand
  - Although he provided a parser, it was difficult to use

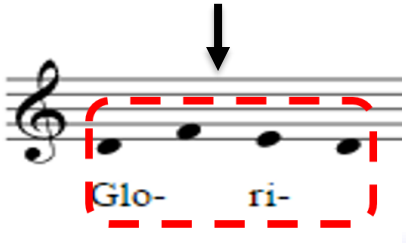
# 1 Introduction

gloria.13.21

LMLO encodings

```
<note pname="d" oct="4" dur="4" stem.dir="up" stem.len="0">
    <verse n="1">
        <syl>Glo-</syl>
    </verse>
</note>
<note pname="f" oct="4" dur="4" stem.dir="up" stem.len="0" />
<note pname="e" oct="4" dur="4" stem.dir="up" stem.len="0">
    <verse n="1">
        <syl>ri-</syl>
    </verse>
</note>
<note pname="d" oct="4" dur="4" stem.dir="up" stem.len="0" />
```

MEI encodings




The rendered score

# 2 LMLO Encoding Schema

In "v2-CHNT.txt" (3.76MB), all chants are organized hierarchically:

**File**: Organize saints' names alphabetically (e.g., |F_CH-A)

**Office**: Services for the feast throughout the day (e.g., |.AD00)

Office metadata: General information (e.g., |g1)

Office metadata: Proper names (e.g., |g2)

**Services**: Lauds, Matins, Vespers and Compline (e.g., |.AD00=V)

**Chant ID** (e.g., |g19 =VE.1d)

**Chant body**

# 2 LMLO Encoding Schema

```
|g2 [Names]
(#&)

/ &adalardI.01.32'12.21.12; &adalarde.32.10.121.1 &adalarduS.32.10.1231.1;
&adalarduS.54543'45.10'123.23.#(#21;)/ &adalarduS.13.32.12.2; &adalarde.3.4.5.5
&caroli.12.10.0 &hildemanno.354=.1.234'565=4,.4 /()

(#:)

/ :beneventaniS.4565.5.54,.4543.#(#3;)/ :spoletaniS.3.21.35434.2321; /()
```

Level 3: Proper names

```
MDBO    |.AD00=V    MDNM
```

Level 3: Service

```
|g19 =VE.1d
```

Level 4: Chant ID

```
gloria sanctoruM rex unica christe tuoruM nos in laude tuI fac convotos adalardi
ut per eum cuius sollemnia concelebramuS te laudando deuM mereamur in ethere
regnuM /()
```

The lyric line

```
\ gloria.13.21.2 sanctoruM.10,.121.1; $ rex.32 unica.34.43.45 christe.5423.21
tuoruM.21.01.1; nos.2 in.45 laude.56.54 tuI.4513.3; fac.3=2 convotos.12.10.0
adalardI.01.32'12.21.12; ut.21, $ per.4 eum.45.543'452 cuius.343=2.1 $
sollemnia.12.2.10.0 concelebramuS.10,.2.343.1.1; $^ te.57=6 laudando.45=45434.45.5
deuM.57'865'745.5; mereamur.57.654.5675.5 in.54 ethere.5654.5.43'21
regnuM.03=245'1032=.1; ! \()
```

The melody line

Level 5: Chant body

# 2 LMLO Encoding Schema

Chant ID (|g19 =VE.2d)

- "1" is serial number. "|g**23**9" means **23**rd chant in the service
- "9" is the genre ID

| | | | |
|---|---|---|---|
| 0 | see after 9 | 6 | I invitatory |
| 1 | A antiphon | 7 | H hymn, Q sequence |
| 2 | R responsory | 8 | D dialogue (versicle and response), B benediction |
| 3 | V responsory verse | 9 | E Gospel and other antiphons coded with genre letter E |
| 4 | $ suffrage, usually an antiphon | 0 | X doxology, L lesson, U alleluia verses, and other items |
| 5 | W verses other than responsory and alleluia verses | | |

- "V" is the abbreviation of the service Vespers
- "E" is the abbreviation of the genre
- "2" is the mode ID
- "d" is the final

# 2 LMLO Encoding Schema

We use the melody line

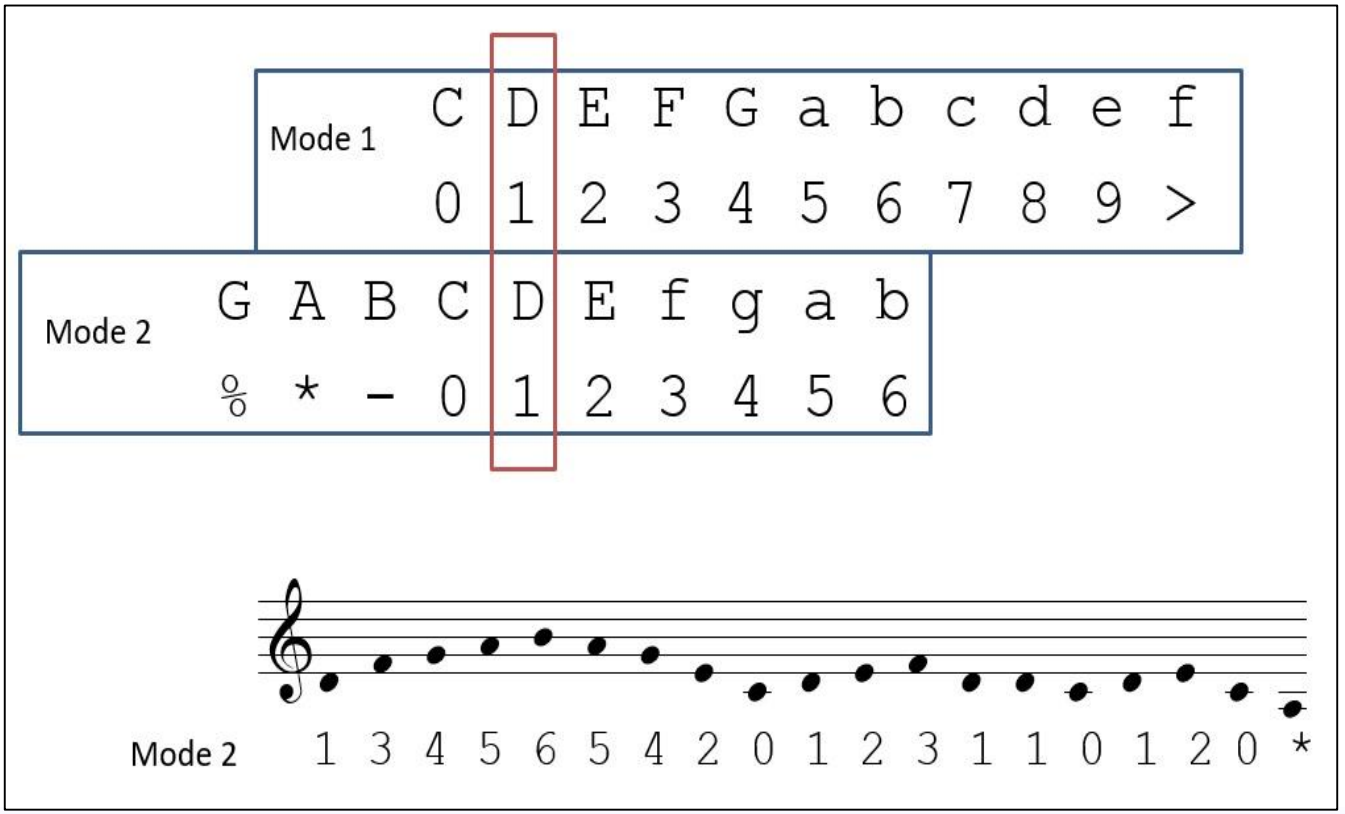
- Melodic encoding: How are the numbers translated into pitches
- Lyric encoding: How are the lyrics aligned with the melody

```
\ gloria.13.21.2 sanctoruM.10,.121.1; $ rex.32
unica.34.43.45 christe.5423.21 tuoruM.21.01.1; nos.2
in.45 laude.56.54 tuI.4513.3; fac.3=2 convotos.12.10.0
adalardI.01.32'12.21.12; ut.21, $ per.4 eum.45.543'452
cuius.343=2.1 $ sollemnia.12.2.10.0
concelebramuS.10,.2.343.1.1; $^ te.57=6
laudando.45=45434.45.5 deuM.57'865'745.5;
mereamur.57.654.5675.5 in.54 ethere.5654.5.43'21
regnuM.03=245'1032=.1; ! \()
```

# 2 LMLO Encoding Schema

Melodic encodings:

- |g19 =VE.2d: Mode 2, and d is the final



# 2 LMLO Encoding Schema

Melodic encodings:

- Syllable separator (.) `gloria.13.21.2`
- Ligature (') `deuM.57'865'745.5`
- Repercussive (repeated) pitches (=) `fac.3=2`

Lyric encodings:

- Segmenting the word correctly `glo|ri|a.13.21.2`

# 3 Translation Methodology

Encoding format: Music Encoding Initiative (MEI)

- Easy to include metadata
- Supports not only common music notation, but also early music notation (e.g., Mensural notation)
- Allows for a schema customization

Build “LMLO Chant Parser”

- Written in Python
- Use Python binding for LibMEI (pyMEI) to generate MEI files efficiently

# 3.1 Chant Hierarchy

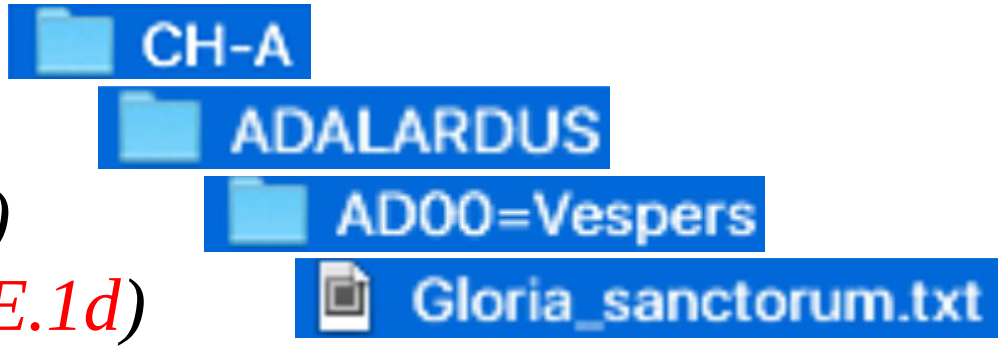
Chant hierarchy is represented as a file structure

Office ID and Chant ID were translated

The body for each chant is extracted and saved in a text file

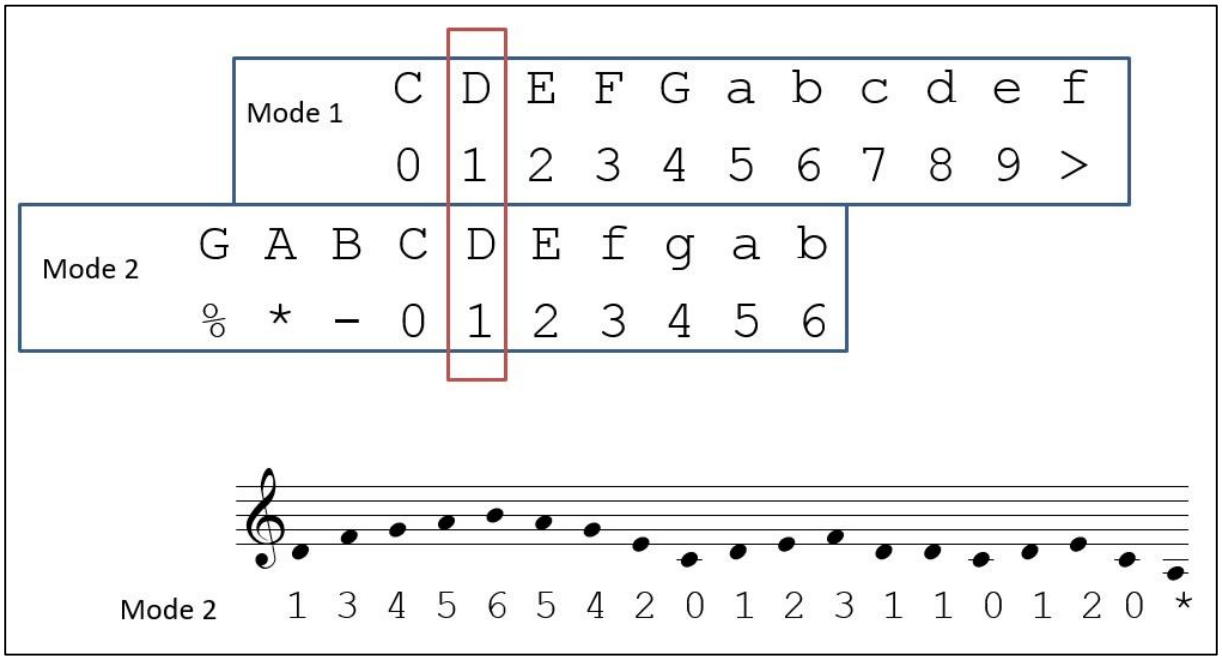
Example:

*File (|F_CH-A)*
*Office (|.AD00)*
*Service (|.AD00=V)*
*Chant (|g19 =VE.1d)*



# 3.2 Melodic Encodings

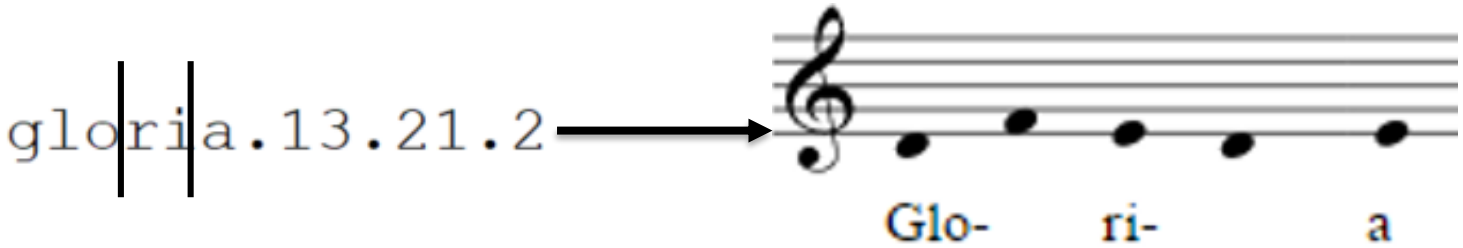
|g19 =VE.2d: Mode 2, and d is the final




Ligature (’) 57'865'745.5 →

# 3.2 Lyric Encodings

Syllabify the word correctly




A syllabification tool is needed

- Classical Language Toolkit (http://cltk.org/)
  - Developed by Dr. Burns (New York University) and others
  - Offers natural language processing support for languages of Ancient, Classical, and Medieval Eurasia
  - The Latin syllabifier is used

# 4 Challenges & Solutions

Andrew Hughes' encodings contained exceptions, which were not explained in his books, causing the parser to fail

- The lyric line should end with "/()", but some ending with "/"

```
/ hic itaque non solum spectabili senatorum prosapia verum
eciam religiosam vitam duxit /()

/ hic itaque non solum spectabili senatorum prosapia verum
eciam religiosam vitam duxit /
```

- Lyrics do not match between the lyric line and the melody line

```
/ odiens salutis actuS rotas parit vir pretactuS /()

\ odiens.5'6765.43.454 salutis.53.45.45 ^
actuS.5'676.75; rotas.4543.45 parit.5=6.5654 vir.54
infectuS.4'565'686.654356.53#(#43;)\ \()
```

# 4 Challenges & Solutions

When the Latin Syllabifier was applied, it failed to align with the melody in 690 out of 5900 chants. The reason is:

- Syllabification errors from the Latin syllabifier (237 cases)
- Lyrics do not match between the lyric line and the melody line (103 cases)
- LMLO provided the wrong number of syllables (350 cases)

# 4 Challenges & Solutions

Syllabification errors from the Latin syllabifier (237 cases)

Mistakes to syllabify two vowels

| Example | Syllabifier | Correct syllabification |
|---|---|---|
| “dei” | “dei” | “de-i” (“ei” has two syllables) |
| “suavitatis” | “su-a-vi-ta-tis” | “sua-vi-ta-tis” (“ua” has one syllable) |
| “sanguine” | “san-gu-i-ne” | “san-gui-ne” (“ui” often has two syllables, but if “ui” is proceded by “g” or “q”, “ui” has one syllable) |

We modified the syllabifier accordingly

# 4 Challenges & Solutions

However, lyrics did not match between the lyric line and the melody line (103 cases)

Originally, we used the lyrics from the lyric line

```
lyrics in the lyric line : odiens salutis actuS rotas parit vir pretactuS
lyrics in the melody line: odiens salutis actuS rotas parit vir infectuS

lyrics in the lyric line : magnificavit eum in conspectu regum Et dedit illi coronam glorie
lyrics in the melody line: magnificavit eum in conspectu regum

lyrics in the lyric line : omnes virtutes et omnis milicia celorum merito gloriamini cum beato n
lyrics in the melody line: omnes virtutes et omnis milicia celorum intercedite pro nobis cum beato cuthberto
```

We finally used the lyrics from the melody line

All mismatches are saved in the log file

# 4 Challenges & Solutions

LMLO provided the wrong number of syllables (350 cases)

| Example | LMLO | Correct syllabification |
|---|---|---|
| “schemate” | 1 syllable | “sche-ma-te” |
| “olerum” | 4 syllables | “o-le-rum” |
| “celestibus” | 3 syllables | “ce-les-ti-bus” |

The errors are saved in the log file

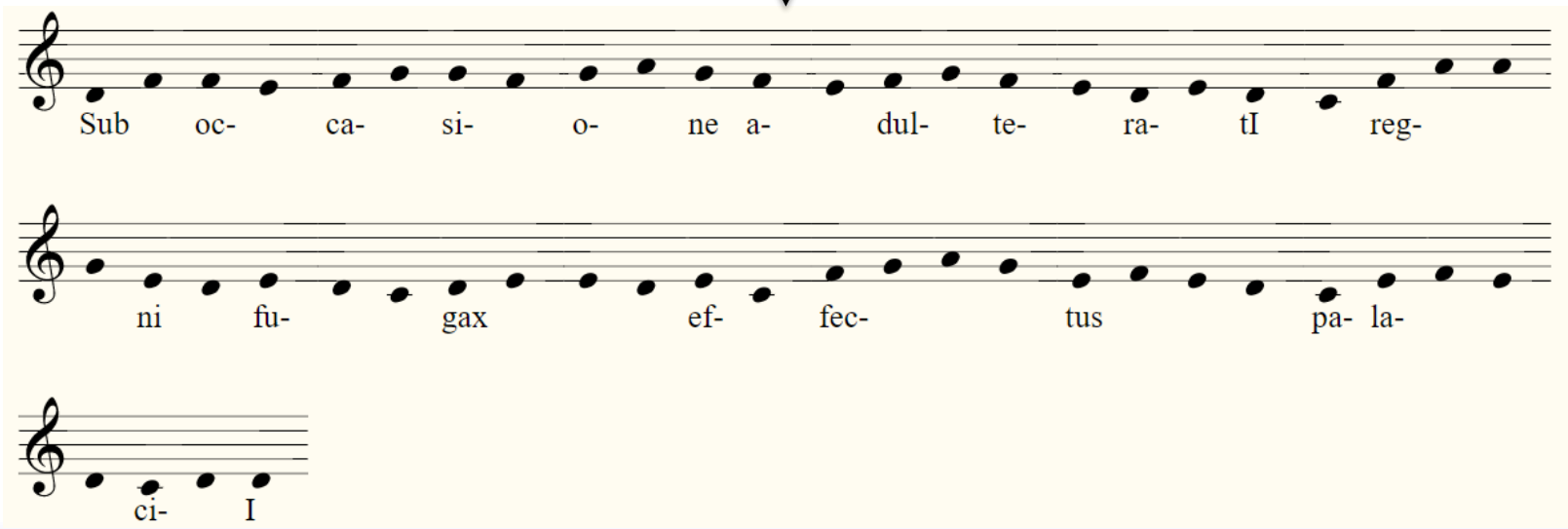
We used the results from the syllabifier for these examples

# 5 Results & Applications

5900 chants are translated into MEI files, which can be rendered by Verovio (https://www.verovio.org)

```
|g113 =MV2.2d

\ sub.13 occasione.32.34.43.45.4 adulteratI.32.34.32.12.10; regni.35=4.21
fugax.210.12=1 effectus.20.3454.2321 palaciI.0.2321.01.1; \()
```



# 5 Results & Applications

The source code, MEI files, log files and the documentation are available on GitHub (https://github.com/DDMAL/Andrew-Hughes-Chant/)

- Metadata such as mode, final, service, office and lyrics are stored in <meiHead>
- Other metadata (e.g., office metadata begins with |g1 and |g2) are extracted and saved in text files

# 5 Results & Applications

The resulting MEI files will be an invaluable pedagogical, scholarly, and artistic resource for musicians, composers, and music researchers alike.

# The LMLO goes MEI: An Exercise in Melodic Encoding Translation

Social Sciences and Humanities Research Council of Canada

Conseil de recherches en sciences humaines du Canada

Canada

SIMSSA | Single Interface for Music Score Searching and Analysis

Verovio

Music Encoding Initiative MEI

McGill

Schulich School of Music École de musique Schulich

DDMAL Distributed Digital Music Archives & Libraries Lab

CIRMMT Centre for Interdisciplinary Research in Music Media and Technology

Fonds de recherche Société et culture Québec