

# Encoding and Analysis of Early Music: Aquitanian and Square Music Scripts

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**Music Encoding Conference (MEC)**  
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# ECHOES PROJECT

- Automatic analysis of plainchant found in Portuguese manuscripts 12<sup>th</sup>–17<sup>th</sup> centuries currently kept in Braga and Guimarães
- Chants in two music scripts:
  - Neumatic Aquitanian (earlier notation style)
  - Square notation (later notation style)
- **Goal:** Create a prototype of a music-analysis tool for this corpus encoded in MEI



# ECHOES PROJECT – The Challenge

Encode and retrieve musical information originally written in two styles of notation

## Aquitanian neumes

- Provide **limited** information related to **pitch**
- + Provide some information on the nuances of vocal delivery by the **various forms of the neumes**



# ECHOES PROJECT – The Challenge

Encode and retrieve musical information originally written in two styles of notation

**Square notation** (later system)

- + More exact in terms of pitch precision
- But it lost information on the nuances of vocal delivery



# ECHOES PROJECT – The Issue for Encoding

- Oldest sources (12th–14th c.) are often in poor material conditions and fragmentary state
- Using of optical music recognition (OMR) to encode the little music information found in these fragments in such poor conditions would be an overkill
- Moreover, for the purposes of building a **prototype** tool for music analysis, we are working with a reduced sample of ca. 100 chants

# ECHOES PROJECT – The Methodology

- Decided to manually input the chants into the computer
- Using the **GABC format** (text-based typesetting language)
- And convert them later into MEI Neumes
- **Using GABC as an intermediate format**
- **Python script to convert from GABC to MEI**

<https://github.com/ECHOES-from-the-Past/GABCtoMEI>

# Why Using GABC as the Intermediate Format?

- Fairly quick to type compared to MEI
- Allows to capture both note pitch/height and neume shape information that other easy-to-type formats do not
  - ***Volpiano*** captures only pitch information, not neume shape
  - ***MonodiPlus*** captures pitch and ornamental neume shapes, but it does not make a distinction between punctum and virga shapes

# ECHOES PROJECT – GABC Encoding

- We followed the GABC specifications<sup>[1]</sup>
- But we also adapted our “GABC encodings” for the needs of our corpus by **restricting the GABC characters used** and **adding others for unsupported features**



# ECHOES PROJECT – GABC Encoding

- We followed the GABC specifications<sup>[1]</sup>
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for the needs of our corpus by:

## a. Restricting the characters used

*neumatic cut*

f/h f//h f/θh f/[3]g

*Examples of spaces*

# ECHOES PROJECT – GABC Encoding

Gregorio will automatically add virgae (the thin vertical stems) to most note groups which require them. If you require a virga which does not normally appear it can be added to the note with `v` (virga on the right) or `V` (virga on the left). If an unwanted virga appears, it can be suppressed by prepending the note group with a `@`.

The diagram illustrates the GABC encoding for notes with and without virgae. It shows two musical staves. The left staff has three square notes with thin vertical stems, enclosed in a green rounded rectangle. Below it are the GABC codes 'g', 'gv', and 'gV'. The right staff has four notes: a square note with a stem, a square note with a stem, a square note with a stem and a curved line, and a square note with a stem and a curved line, enclosed in a red rounded rectangle. Below it are the GABC codes 'ge', '@ge', 'gef', and '@gef'.

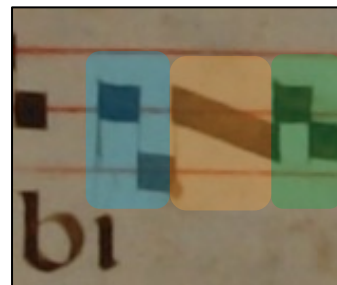
*Adding and suppressing virgae*

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  - a. Restricting the characters used
  - b. Adding characters to encode missing features**



(c4) **bi**(fdfe)

# ECHOES PROJECT – GABC Encoding

## Interdisciplinary discussions

- Our encoding guidelines and the details of the transformation of the GABC to MEI code are provided in GitHub
- Our team: music paleographers, historical musicologists, and music technology scholars
- All the specificities of the encoding as they will have a cascade effect on the musical analysis to be performed at a later stage

# ECHOES PROJECT – Current Contributions

- About a hundred **GABC** and **MEI files** (in GitHub)
- **Digital images** of the Braga and Guimarães sources  
→ Portuguese Early Music (PEM) Database
- **Table** with visual samples of all the notational shapes (Aquitanian and square) along with the MEI Neumes encoding:
  - We will develop OMR models to recognize the symbols of both notations as found in some well-preserved books
  - Valuable resource for the MEI Neumes community

# ECHOES PROJECT – Music Analysis Prototype Tool

[Corpus Search](#)[Cross Comparison](#)[Project Wiki](#)[Update Database](#)

Client version: 0.2.7 | Remote version: 0.2.7

## Search Panel

Search for chant with the following music script:

Aquitanian  Square

Filter by mode(s):

Mode 1  Mode 2  Mode 3  Mode 4  
 Mode 5  Mode 6  Mode 7  Mode 8  
 All Modes  Undetected

Search for chants that has ornamental figure(s):  
(No selection will display all chants)

Liquescent  Quilisma  Oriscus

Melisma(s) with at least  notes in a syllable

< >

Search

## Database

View database

## Search Results

Title	Music Script	Mode	Text	Source	Links
Dicit dominus	aquitanian	undetected	Dicit dominus implete hydrias aqua et ferte architriclino dum gustasset architriclinus aquam vinum factum dicit sponso servasti vinum bonum usque adhuc hoc signum fecit Jesus primum coram discipulis suis	P-BRad 15, 026	<a href="#">PEM - 84540</a> <a href="#">Display Chant 005_C05</a>
Tu mandasti	aquitanian	undetected	Tu mandasti mandata tua custodire nimis utinam dirigan tur vie mee ad custodiendas justificationes tuas	P-BRad Pastas 009, 035r	<a href="#">PEM - 83869</a> <a href="#">Display Chant 040_C40</a>

## Chant Information

Chant information will display here

Click on the chant's file name to display

Work by Antoine Phan (McGill University)

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Music Scripts

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## Search Results

Title	Music Script	Mode	
Dicit dominus	aquitanian	undetected	Dicit dominus <u>in</u> <u>fer</u> te archi <u>tri</u> architric <u>li</u> nus aqu sponso <u>ser</u> vas adhuc hoc sign coram
Tu	aquitanian	undetected	Tu <u>mandasti</u> <sup>16</sup> <u>mar</u> utinam dis



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[Liquescent](#)  [Quilisma](#)  [Oriscus](#)

Mode

## Search Results

Title	Music Script	Mode	
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- This information is **not in the metadata**
- We **developed heuristics** to compute the mode based on the *finalis*, *ambitus*, *repercussio*, and *rhombus position*

Tu	aguitanian	undetected	Tu <a href="#">mandasti</a> <sup>17</sup> <a href="#">mar</a> utinam dis
----	------------	------------	---

Aquitanian  Square

Filter by mode(s):

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View database

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Tu mandasti	aquitanian	undetected	Tu <u>mand</u> asti <u>man</u> utinam diri custodi <u>en</u> das

Ornamental shapes

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Melisma(s) with at least  notes in a syllable



Search

Melodic  
density

## Database

View database

Title	Music Script	Mode					
Dicit dominus	aquitanian	undetected	Dicit dominus <a href="#">i</a> <a href="#">fer</a> te archi <tr><td>Tu mandasti</td><td>aquitanian</td><td>undetected</td><td>Tu <a href="#">mand</a>asti <a href="#">man</a> utinam diri custodi<a href="#">en</a>da</td></tr>	Tu mandasti	aquitanian	undetected	Tu <a href="#">mand</a> asti <a href="#">man</a> utinam diri custodi <a href="#">en</a> da
Tu mandasti	aquitanian	undetected	Tu <a href="#">mand</a> asti <a href="#">man</a> utinam diri custodi <a href="#">en</a> da				

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Tu			Tu mandasti mandata tua custodire nimis	P-BRad	<a href="#">PEM - 84540</a> <a href="#">Display Chant C40</a>

Coming → Melodic search  
(based on pitch / height / contour similarity)

Chant information will display here  
Click on the chant's file name to display

Work by Antoine Phan (McGill University)

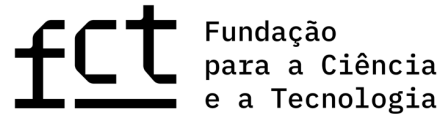
# ECHOES PROJECT – Conclusions

- Music encoding and analysis are crucial components in our project on Portuguese plainchant written in Aquitanian neumatic and Iberian square music scripts
- Contribute to the discussion about methodologies for describing and encoding early notations that have not been explored so far and to the creation of digital tools for early music research

# Thank you!



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# References

- **Echoes Project website:** <https://echoes.fcsh.unl.pt>
  - Echoes Project GitHub Association: <https://github.com/ECHOES-from-the-Past>
    - GitHub repository for GABC to MEI (guidelines, conversion table, and files): <https://github.com/ECHOES-from-the-Past/GABCtoMEI>
    - GitHub repository for MEI Analyser: <https://github.com/ECHOES-from-the-Past/mei-analyser>
    - Website (GitHub page) for MEI Analyser: <https://echoes-from-the-past.github.io/mei-analyser/>
  - Portuguese Early Music (PEM) database: <https://pemdatabase.eu/>
  - Neume spreadsheet with MEI encoding:  
<https://docs.google.com/spreadsheets/d/1QDRywn4oUXgU9liCZo6PJFvTkTCyML1pFikKtZjs0eg/edit?usp=sharing>
- <sup>[1]</sup> GABC specifications: <https://gregorio-project.github.io/gabc/index.html>. GABC examples: <https://gregobase.selapa.net/scores.php>.