PAM: Plainchant Analyser for MEI Neumes

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Check PAM here!
https://echoes-from-the-past.github.io/PAM/

I. Introduction

Plainchant was transmitted orally for centuries, with its compositional principles grounded in formulaic structures that reused melodic segments across varying texts. From the 11th century onwards, transmission gradually shifted from orality to writing. The plainchant repertory, comprising thousands of melodies sung over many centuries and across various regions, was preserved in a wide range of notational styles.

Regarded as sacred, this body of texts and melodies was generally not subject to significant voluntary alteration. The stability of plainchant enables tracing melodic material across time and space. Due to the repertory's vastness and the complexity of notations, scholars have typically focused on small subsets, rarely engaging in large-scale comparative analysis. The **Plainchant Analyser for MEI Neumes (PAM)** addresses these limitations by using computational methods to find and analyse melodies across different music scripts within a broader comparative framework.

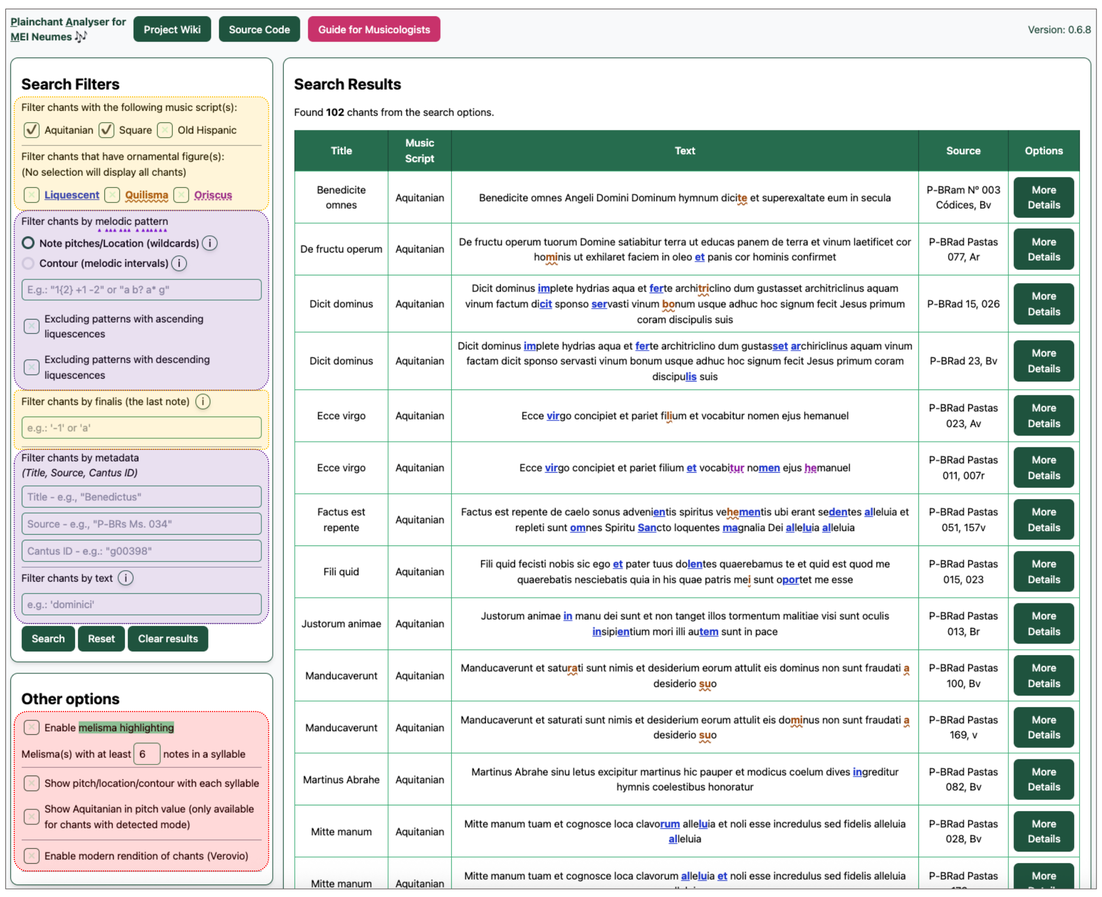
PAM is one of the main outputs of the project *Echoes from the Past: Unveiling a Lost Soundscape with Digital Analysis* (2022.01957.PTDC)

II. Corpus and data encoding

- Plainchant melodies found in manuscripts (books and fragments) in archives of Braga and Guimarães (Portugal), written between the 12th and 17th c.
- Initial corpus: approximately **fifty melodies** (across over one hundred sources) preserved in **two notational styles**: **Aquitanian neumes** and **square notation**
  - Each notation conveys different levels of complexity and types of musical information
- Total of ca. 100 chant entries
- Encoded in MEI Neumes

III. The interface of PAM

PAM includes various search functionalities (in purple highlight), filtering tools (in yellow), and visualization options (in red) as shown below.



A. Search functionalities

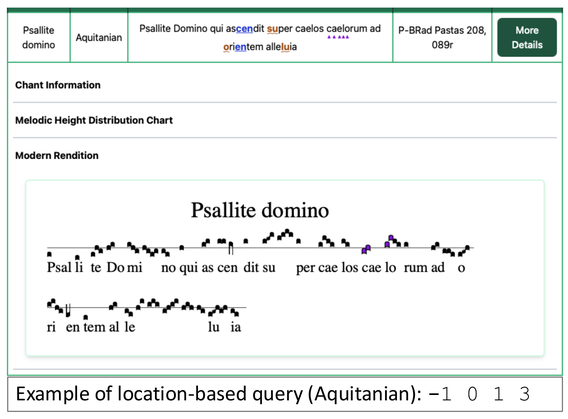
PAM supports **standard text-** and **metadata-based searches**: users can retrieve chants by title (text incipit), manuscript source, Cantus ID, or any segment of the associated liturgical text. In addition to this, PAM supports very flexible melodic queries, allowing users to **search for melodic patterns** either by note height or by contour.

1) Melodic patterns: Search by note height (pitch/location) and the use of wildcards

This type of query is notation specific:

- In **square notation**, the query consists of a sequence of **pitch values** (`@pname` values in MEI)
- In **Aquitanian notation**, the query consists of a sequence of **integer values** indicating the note's height (or **location**) with respect to the reference line (`@loc` values in MEI)

The results are shown in the chant text with purple triangular markings, and in Verovio with the notes highlighted in the same color.



Example of location-based query (Aquitanian): `-1 0 1 3`

Further flexibility in the melodic search is allowed with the use of **wildcards**. These wildcard operators allow the queries to include arbitrary notes (`.`), optional notes (`?`), and repetitions (`*`).

Wildcard	Use	Example Pattern	Example Results

.	Arbitrary note	`a g . e`	`a g g e`
			`a g d e`
			`a g e e` (and more)

?	Optional note	`a g? e`	`a g e` `a e`

		`a .? e`	`a g e`
			`a c e`
			`a e` (and more)

*	Search for any number of repetitions (0 or more occurrences)	`a g* e`	`a e`
			`a g e`
			`a g g e`
			`a g g g e` (and more)

{ }	Exact number of repetitions (it could be one number or a range)	`a g{3} e`	`a g g g e`
		`a g{2,3} e`	`a g g e` `a g g g e`

2) Melodic patterns: Search by contour

Two types of contour-based searches allow for different levels of precision:

- **General contour:** using characters to represent directions up (`u`), down (`d`), same (`s`), and unknown (`n`)
- **Specific contour:** using integers values to indicate exact intervallic movement (e.g., `+2 -1 0`)

The two contour-based approaches are applicable to Aquitanian and square scripts.

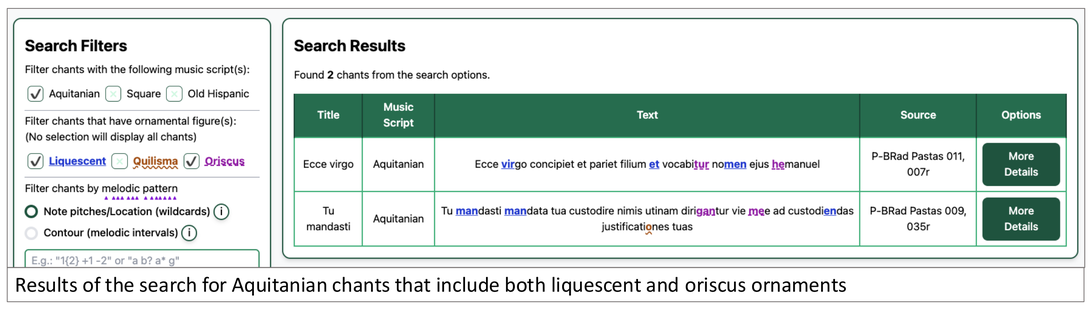
Both **note-height-** and **contour-based searches** allow for the exclusion of patterns containing liquescent neumes, whether ascending, descending, or both.

B. Filtering tools

Filtering options allow users to refine results according to three criteria:

- **Music script:** Aquitanian, square, or (in future versions) Old Hispanic
- **Ornamental figures:** liquescent, quilisma, and oriscus
- **Finalis:** the final pitch of the chant, relevant for modal analysis

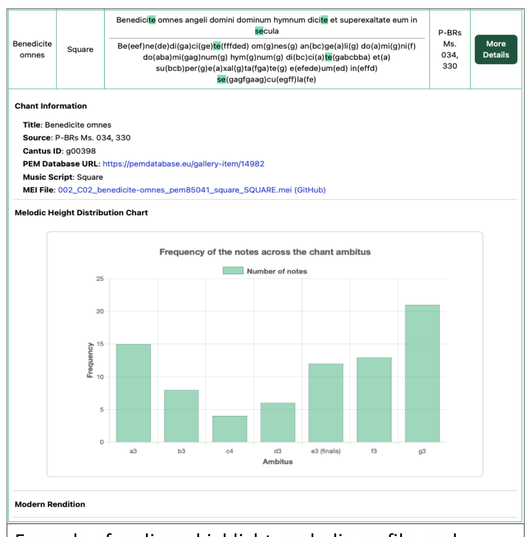
These filters can be combined to isolate subsets of chants sharing specific musical or notational characteristics, as in the following example.



Results of the search for Aquitanian chants that include both liquescent and oriscus ornaments

C. Visualization options

- Feature highlighting (for melismas, ornamental neumes, melodic patterns)
- Melodic profile of the piece (which includes its range/ambitus and finalis)
- Display of text and melody
  - Through Verovio
  - Or in the chant text (with pitch/location information provided in each syllable)
- Display of pitch information for Aquitanian chants, when the mode is identified
- Mode identification for Aquitanian chants through an expert system



Example of melisma highlight, melodic profile, and display of text and melody within the chant's text

IV. Conclusions and future work

- PAM bridges **computational methods** and **musicological research**
- Enables **comparative analysis** of chants in square and Aquitanian notations
- Supports **identification and study** of **melodic variants across sources and traditions.**
- Designed for **scalability**, PAM can be expanded to include more melodies and notational styles, including Eastern neumes and modern staff notation
- Contribute to **the reconstruction of historical plainchant transmission**
- Future work includes corpus expansion and new notational systems (next up, Old Hispanic)

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