Mode Classification and Natural Units in Plainchant

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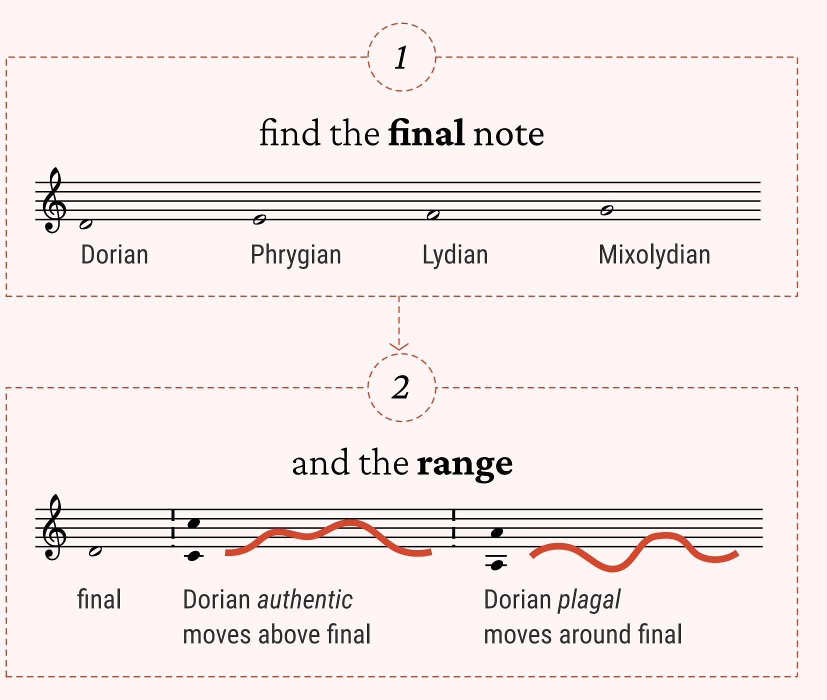
We study **3 approaches** to **mode classification** in medieval **plainchant** using **20.000 melodies** from the **Cantus database**.

1. Modes

To determine the mode of a chant:



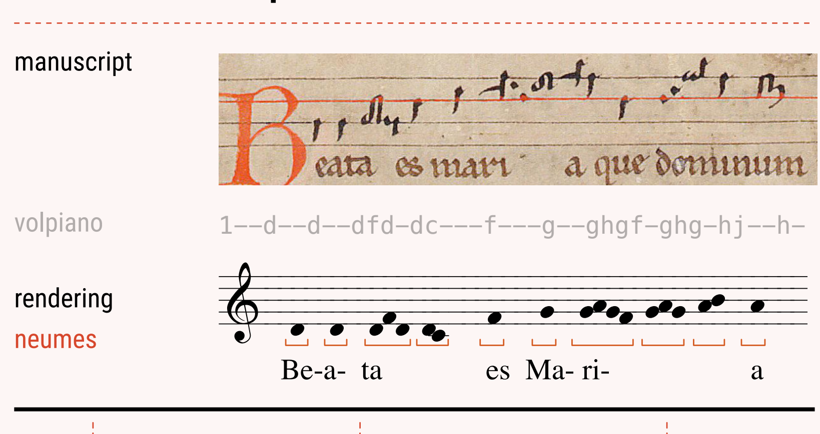
Plainchant uses **8 modes**, grouped in 4 pairs.

Modes in a pair use the same **final** note, but have a different **range**.

Authentic modes move mostly above the final, *Plagal* modes descend further and move around the final.

2. Overview

A Melodic transcriptions in Cantus

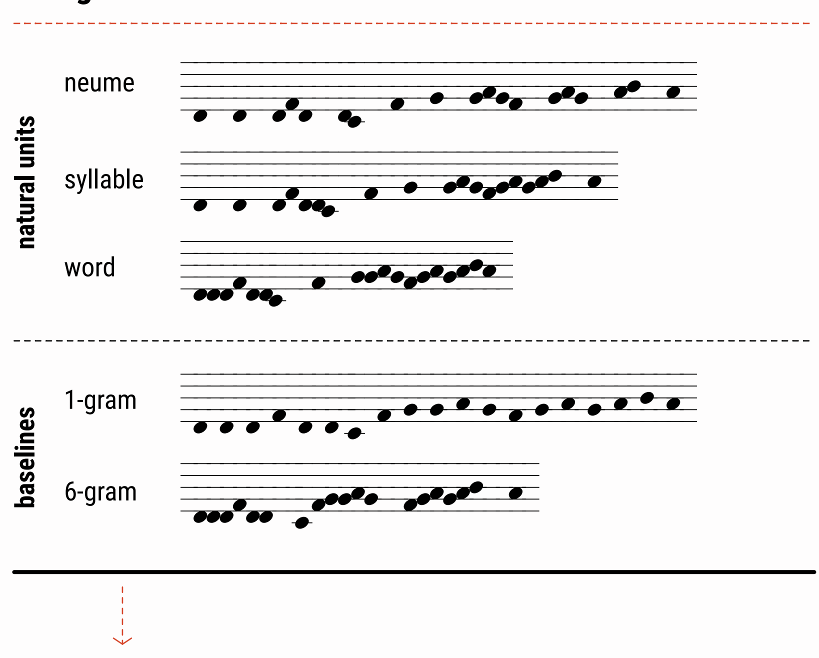


B Classical
final, range, initial
random forest

C Profile
pitch (class) profile
k-NN classifier

D Distributional
tf–idf vectors
linear SVC classifier

E Segmentations



F Melodic representations

Intervals in semitones up or down; and contour up ^, down v.
Omitted interval or contour to previous unit: .

G tf–idf vectors

tf–idf describes the importance of a term for a document.

$$\text{tf–idf}(t,d) = \text{term freq} \times \text{inverse document freq}$$

$$= \text{term freq} \times \log\left(\frac{1}{\text{document freq}}\right)$$

plus some smoothing
fraction of documents containing the term

documents = chants; terms = melodic units

The **Cantus database** contains over **60,000** transcribed **melodies**, with mode annotations.

We use **two genres**: 7,000 *responsories* and 13,000 *antiphons*.

We study 3 approaches to mode classification.

The distributional approach represents chants as **vectors of weighted motif frequencies**.

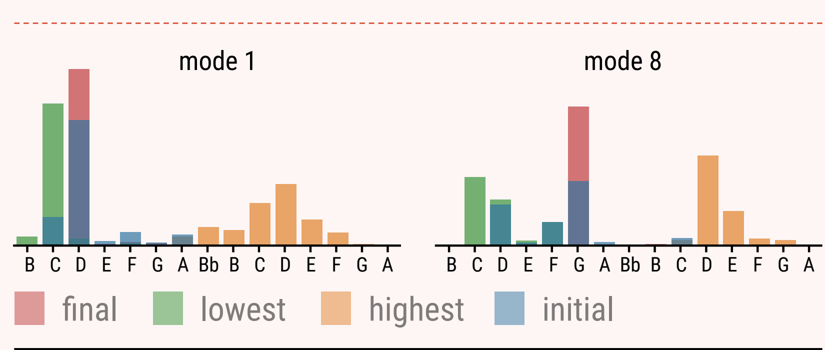
We compare different motifs or units: **natural units** group notes that form neumes, syllables or words. Baselines include n-grams.

We compare pitch, intervalic and contour **representations**.

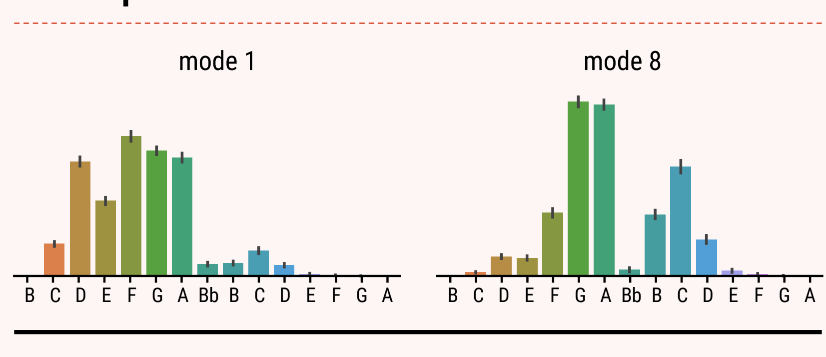
We use the **tf–idf** weighting from textual information retrieval. It corrects overly common terms (units) in favour of more specific terms, frequent in fewer documents (chants).

3. Features

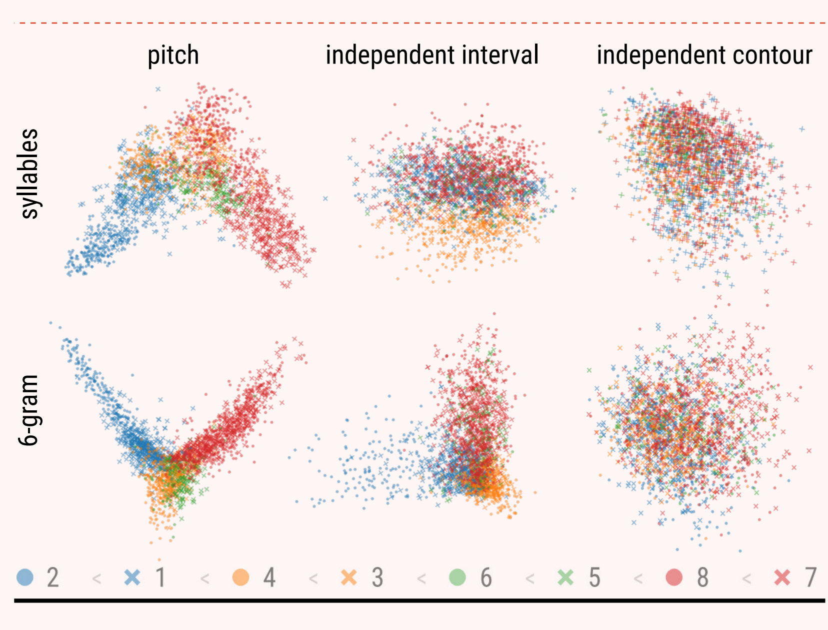
A Classical features



B Pitch profiles



C tf–idf vectors



Modes are clearly distinguished by both the classical features and the pitch profiles.

The distributional approach aims to capture the melodic aspect of mode, even without pitches.

And as we move to interval or contour representations, the modes are less clearly distinguished.

Shown are PCA embeddings of the chant vectors, coloured by mode.

4. Results

A Classical approach

final	40
range	56
initial	37
final & range	89
final, range & init.	**90**

B Profile approach

pitch class profile	85
pitch profile	**88**
repetition profile	81

0% Weighted F₁–score 100%

C Distributional approach

units	pitch	interval	contour
neume	92	79	52
syllable	**93**	86	76
word	90	**86**	**81**
1-gram	87	7	7
2-gram	91	38	17
3-gram	92	65	23
4-gram	91	75	34
5-gram	91	81	43
6-gram	88	82	51
8-gram	82	78	60
10-gram	76	74	66
12-gram	71	69	65

representation →
segmentation →

Results

- All three approaches work well
- Natural units perform better than n-gram baselines, and perform well even without pitch information

What does this show?

- Contours alone are very informative.
- Perhaps: is (this) music built from units, just like a sentence is composed of words?

Code: github.com/bacor/ISMIR2020
CantusCorpus: github.com/bacor/CantusCorpus
Chant21 Python package: github.com/bacor/chant21
Volpiano & gabc in music21; see our DLfM paper.

Manuscript shown in the header and the overview: Köln, Erzbischöfliche Diözesan- und Dombibliothek, 1161, fol. 091r.