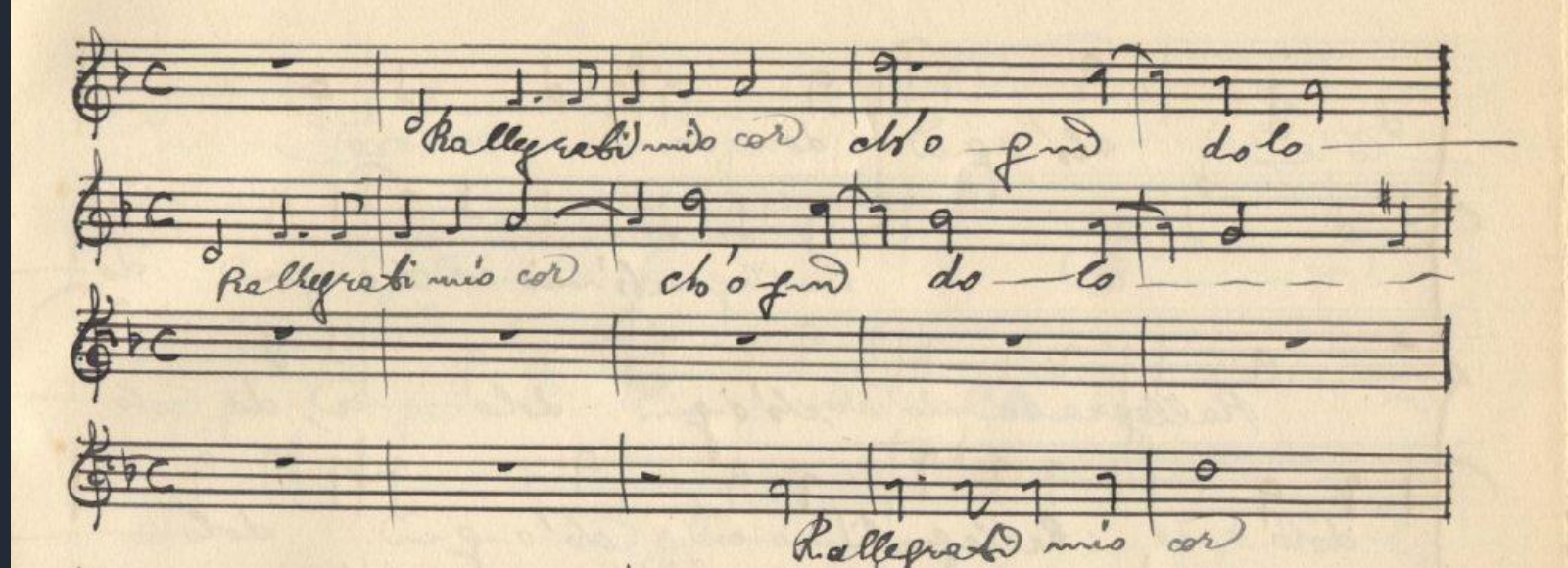# The stylistic origin of the anonymous 16th century masses transcribed by Siro Cisilino (1903-1987) at the Fondazione Cini:
A statistical and machine learning approach

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Table 1. Catalogue of the anonymous masses transcribed in the Siro Cisilino's volumes, with their corresponding source and author attribution

Cisilino's volume	Anonymous work at the Fondazione Cini	Source where the work is located	VV.	Author attribution	Observations
3: "Messe a 4 voci di Jo. Mouton, Andrea De Silva, Anton. Bruhier, Pieresson de la Rue, Josquin de Pres, Anonimi: Trascrizione in partitura da testimone manoscritto"	*Missa II* "Sile fragor" (pp. 33-71)	*I-CMac* Cod. Mus. M, ff. 9v–19	4	Anonymous	Indication of the title "Sile fragor" in the bassus voice of the manuscript. It does not correspond to the anonymous *Sile Fragor* mass of F-CA MS 4, ff. 13v-27r. See the incipit in Crawford, David Eugene (1975. Sixteenth Century Choirbooks in the Archivio Capitolare at Casale Monferrato. RMS. American Institute of Musicology.
9: "Codici Gonzaga I cod. 18 Messa a 5 anon. II cod. 34 Messa a 5 voci di Giulio Bruschi III cod. 35 Messa a 5 voci Dominicalis, di Giac. Castrati IV cod. 10 Sei Benedictus Dom. Deus Israel, a 4 voci anonimi: Trascrizione in partitura da testimone manoscritto"	[Missa anónima] (pp. 1-62)	*I-Mfd* Santa Bárbara 18, f. 12	5	Anonymous	

Table 1. Catalogue of the anonymous masses transcribed in the Siro Cisilino's volumes, with their corresponding source and author attribution

Cisilino's volume	Anonymous work at the Fondazione Cini	Source where the work is located	VV.	Author attribution	Observations
8: "Tre Messe anonime e Messa Quaeramus cum pastoribus a 4 voci: Trascrizione in partitura da testimone manoscritto"	*Missa In illo tempore* (pp. 54-78)	*I-Mc* Santa Barbara SB.3	4	According to Cisilino (1974), the author is Monteverdi or Giovanni Spataro (Vol. 8 p. 54)	It does not coincide with Palestrina's, Monteverdi's, or Jacquet of Mantua's *In illo tempore* masses.
	Missa Ave Domine Jesu Christe (pp. 79-110)	*I-Mc* Santa Barbara SB.3	4	According to Cisilino (1974), the author is Monteverdi	
	Missa Tu es pastor ovium (pp. 111-136)	*I-Mc* Santa Barbara SB.3	4	According to Cisilino (1974), the author is Monteverdi	Comparing with the Haberl's edition (1884). *Opera omnia Ioannis Petraloysii Praenestini,* Vol.XVI. Breitkopf & Härtel, p. 85, it is not Palestrina's mass. Also does not coincide with Silva's homonymous mass. It is not based on any of the motets by Palestrina or Lasso, nor the anonymous one in ms. 7 of Treviso.

Table 2. Titles and attributed sources used by Siro Cisilino for his handwritten musical editions.

Nº	Title	Attributed source
1	"Passii della Settimana Santa di Maitre Jan, di Adriano Willaert e di Vincenzo Ruffo con alcuni mottetti del predetto Willaert e una messa di autore anonimo: Trascrizione in partitura da testimone manoscritto"	*I-Bc* Q24
2	"Antifone de Communi Sanctorum a 4; 2. Inni de festis, et de Communi; 3. Magnificat negli otto Toni; 4. Una messa a quattro voci pari di autore anonimo: Trascrizione in partitura da testimone manoscritto"	*I-Bc* Q22
3	"Messe a 4 voci di Jo. Mouton, Andrea De Silva, Anton. Bruhier, Pieresson de la Rue, Josquin de Pres, Anonimi: Trascrizione in partitura da testimone manoscritto"	*I-CMac* FM 1 [Fondo Musicale 1]
4	"Liber Motectorum cum quattuor, quinque et sex vocibus Adriani Havillis: Trascrizione in partitura da testimone manoscritto"	*I-CARcc* (s. n.)
5	"Liber Motectorum quattuor, quinque et sex vocibus: Trascrizione in partitura da testimone manoscritto"	*I-MOd* MS Mus. IX
6	"Liber II Motectorum sex et septem vocum Repertorio della Cappella musicale di Alfonso II d'Este duca di Ferrara: Trascrizione in partitura da testimone manoscritto"	*I-MOe* MS C.314
7	"Motetti, antifone, litanie Introiti, Inni a 4 e 5 voci, anonimi: Trascrizione in partitura da testimone manoscritto"	*I-Mc* Santa Barbara Ms. 2
8	"Tre Messe anonime e Messa Quaeramus cum pastoribus a 4 voci: Trascrizione in partitura da testimone manoscritto"	*I-Mfd* Librone 4 (Ms. 2266) *F-CA* [perhaps it is the mss. 3, 4, 18]
9	"Codici Gonzaga I cod. 18 Messa a 5 anon. II cod. 34 Messa a 5 voci di Giulio Bruschi III cod. 35 Messa a 5 voci Dominicalis, di Giac. Castrati IV cod. 10 Sei Benedictus Dom. Deus Israel, a 4 voci anonimi: Trascrizione in partitura da testimone manoscritto"	*I-MA* 10, 18 y 34
10	"Messe a cinque voci a cori spezzati alternate col canto gregoriano: Trascrizione in partitura da testimone manoscritto"	*I-Mc* Santa Barbara Ms. 7 y 14
11	"Manoscritto N. 7 del duomo di Treviso contiene 79 mottetti a quattro voci (pochissimi a 5 voci) Molti sono per i Santi proprii della città di Treviso: Trascrizione in partitura da testimone manoscritto"	*I-TVcap* 7

Stylistic features of each mass

Vol. 3: *Missa II* "Sile fragor"

- *I-CMac* Cod. Mus. M, ff. 9v–19 (together with other composers such as Mouton, Silva, Bruhier, La Rue or Josquin)
- 4-voice mass
- It does not correspond to the anonymous *Sile Fragor* mass of F-CA MS 4, ff. 13v-27r
- Style typical of this generation of Franco-Flemish composers
- The modality coincides with that of the Compères's motet *Sile fragor*: mode 1 in G, with cadential points to F, D, and A.

Beginning of Compère's motet *Sile fragor* (above) together with the anonymous *Missa Sile fragor* (below)
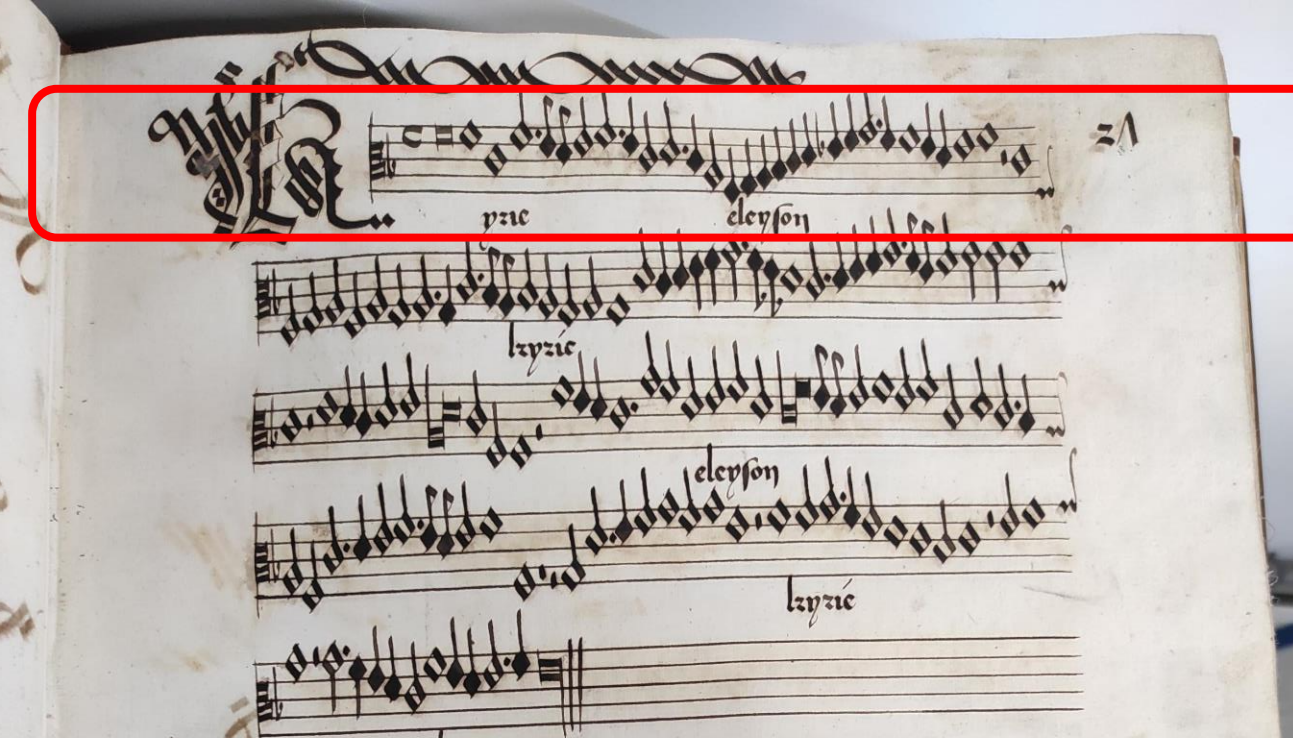
Stylistic features of each mass

Vol. 9: Missa

- *I-Mfd* Santa Bárbara 18, f. 12 (containing that mass only)
- 5-voice mass
- Similar to Brushchi and Castrati: for the Santa Barbara ducal church
- Counterpoint more typical of the mid-sixteenth century
- Mode 1 in G with many accidentals

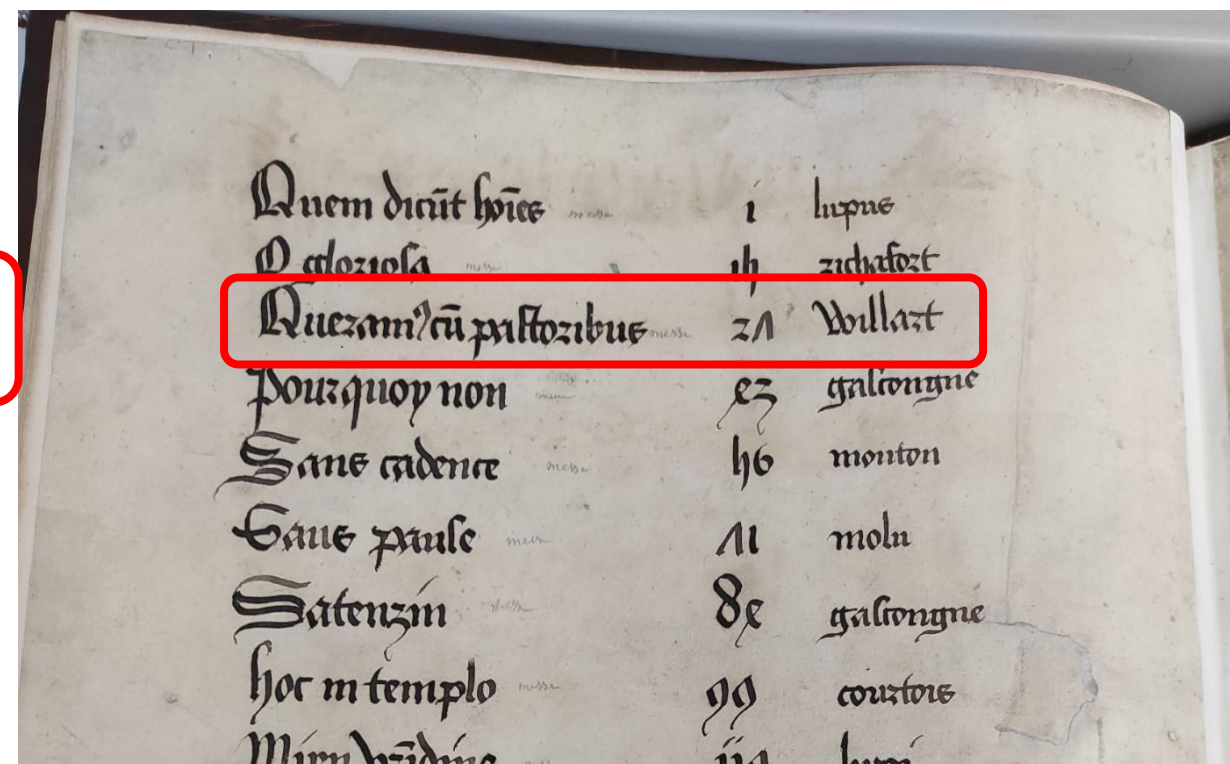# Missa [vol. 9]. Codex Gonzaga (*I-Mfd* Santa Bárbara 18, f. 14)

Anónima
Ms. Siro Cisilino 9
María Elena Cuenca (ed.)

Missa Quaeramus cum pastoribus [A. Willaert] (Cisilino's vol. 8)

- Preserved in *F-CA* (Médiathèque au Labo culturel), ms. 3, ff. 26v-42r

Stylistic features of each mass

Vol. 8: based on *I-Mc* Santa Barbara SB.3 source

4-voice masses:

- *Missa In illo tempore* & *Missa Ave Domine Jesu Christe*: based on Morales's motets

- *Missa Tu es pastor ovium*: unidentified model

Hypothesis:

- Cisilino, S. (1974). *Claudio Monteverdi (1567 – 1643). 3 Missae*. Universal Edition.
  • attributes these works to Monteverdi (middle period).

- Arnold, D. (1975):
  • First period of Monteverdi? Ingegneri?
  • Attribution inconclusive

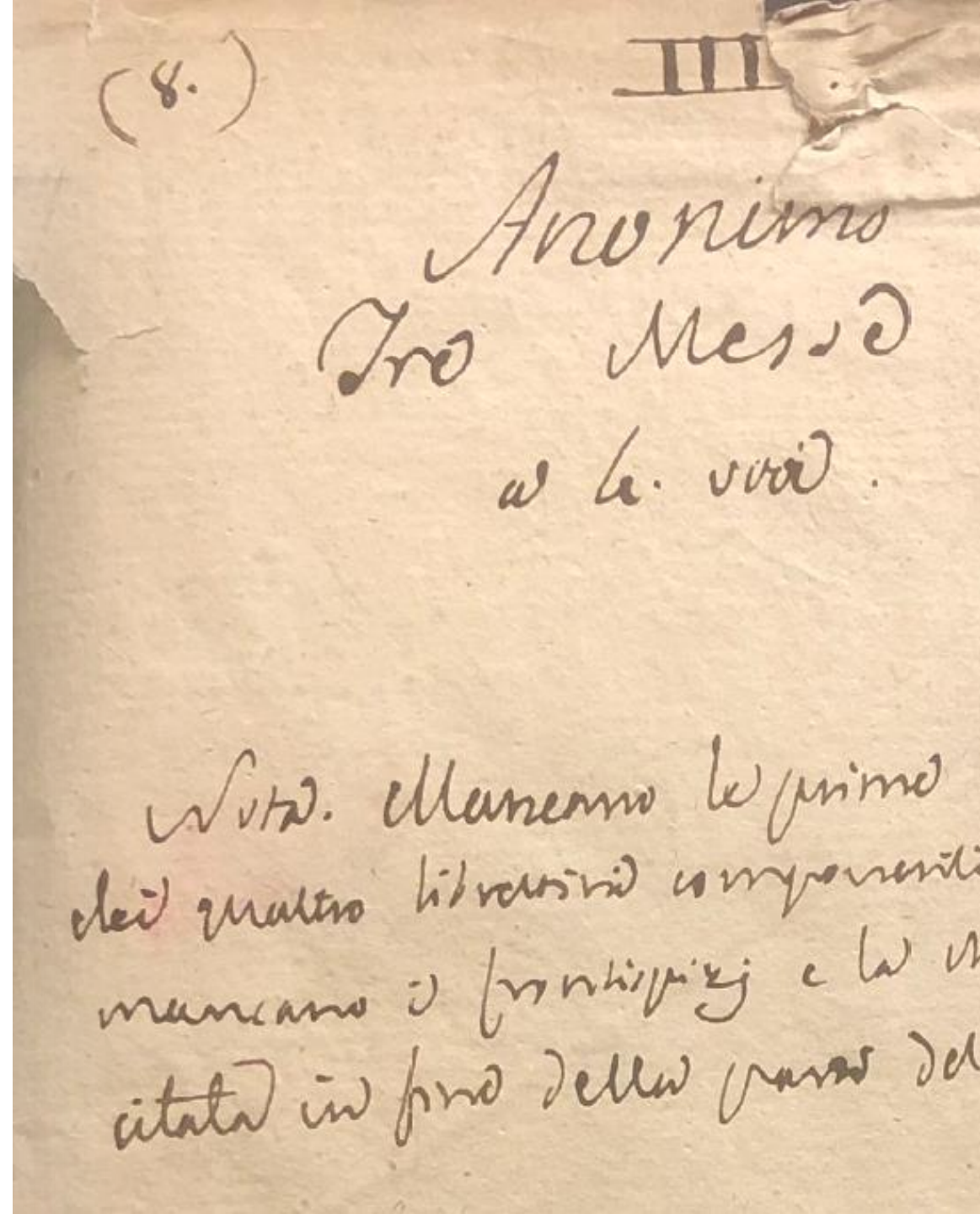- Our hypothesis: polyphony of the second half of the 16th century

Table 3. List of composers used as training data for the statistical analysis and machine learning experiments, ordered by generation and stylistic tradition.

Italian	Spanish	Franco-Flemish
Before 1520s		
	F. Peñalosa; J. Anchieta; P. Escobar; A. Pérez de Alba; A. de Mondéjar; A. de Ribera; Tordesillas; J. de Urrede (Flemish origin)	A. Busnois; J. Ockeghem A. Févin; M. Pipelare; J. des Prés; J. Mouton; L. Compère; A. Agricola; P. de La Rue; J. Obrecht; M. de Orto; J. Prioris; J. Ghiselin
1520-1560		
C. Festa; J. of Mantua (French origin); Maistre Jhan (French origin); A. de Silva (Portuguese or Spanish origin)	C. de Morales	T. Crecquillon; N. Gombert; J. L'Heritier; J. Richafort; C. Sermisy; P. Verdelot; A. Willaert; D. Phinot; P. de Manchicourt; J. Clemens non papa
After 1560s		
G. P. da Palestrina M. A. Ingegneri	F. Guerrero T. L. de Victoria	O. di Lasso
C. Monteverdi (*stile antico* works)		

What is a "feature"?

- A piece of information that measures a single characteristic of a musical item in a consistent and precisely-defined way
  - Permits clear comparisons between musical items
- Represented using a number
  - Can be a single value, or can be a set of related values (e.g., a histogram)
- Provides a summary description of the characteristic being measured
  - Typically examines macro (musical item as a whole) rather than local characteristics

A basic sample feature: *Range*

- Range: Difference in semitones between the highest and lowest pitches in a musical item

- Value of this feature for this music: 7
  - G - C = 7 semitones

- In practice, of course, one will wish to calculate and compare many features, not just one

jSymbolic

- The jSymbolic software (McKay et al. 2004; 2006; 2018; etc.) can be used to automatically extract such features from digital scores (e.g., MIDI files)

jSymbolic features used in this study

- jSymbolic can extract 1497 separate feature values (when multidimensional features are expanded)
  - 246 unique features
- Only 552 of these 1497 feature values were used in this particular study
  - Excluded features not relevant to this corpus
    - e.g., dynamics
  - Excluded features vulnerable to editorial and encoding bias
    - A problem when a corpus is assembled from sources where the music was encoded using different practices or workflows (Cumming et al. 2018)

jSymbolic 2.2's feature types

- Pitch statistics
  - e.g. Range
- Melody / horizontal intervals
  - e.g. Most Common Melodic Interval
- Chords / vertical intervals
  - e.g. Vertical Minor Third Prevalence
- Texture
  - e.g. Parallel Motion
- Rhythm
  - e.g. Note Density per Quarter Note
- Instrumentation
  - e.g. Note Prevalence of Unpitched Instruments
- Dynamics
  - e.g. Variation of Dynamics

Machine learning methodology

- Trained a set of independent support vector machine (SVM) classifiers to distinguish between different classes (categories) of interest in our corpus of known music
  - The only input to the training framework was jSymbolic features pre-extracted from the corpus of known music, and their ground truth labels
  - Also performed 10-fod cross-validation on the training data as a preliminary phase of each of our experiments to get an approximate sense of each model's reliability
- Then independently classified each of the anonymous mass movements with each of these trained models
  - The only input to the pre-trained classifiers was jSymbolic features pre-extracted from each of the anonymous mass movements
  - Results were manually aggregated across the movements for each anonymous mass

Experiments performed (10 total)
(1 classifier trained for each)

- Classification by time period (generation)
  - 1 classifier trained on just mass movements (3 classes)
  - 1 classifier trained on both mass movements and motets (3 classes)

- Classification by region
  - 1 classifier trained on just mass movements (3 classes)
  - 1 classifier trained on both mass movements and motets (3 classes)

- Classification by joined time period and region pairings
  - 1 classifier trained on just mass movements (8 classes)
  - 1 classifier trained on both mass movements and motets (8 classes)

- Classification by composer (excluding Monteverdi and Ingegneri)
  - 1 classifier trained on just mass movements (20 classes)
  - 1 classifier trained on both mass movements and motets (37 classes)

- Classification by composer (Monteverdi or Ingegneri or Everyone Else)
  - 1 classifier trained on just mass movements (2 classes, Ingegneri excluded)
  - 1 classifier trained on both mass movements and motets (3 classes)

Aggregated results for the first 8 experiments *(excluding Monteverdi and Ingegneri)*

Anonymous Mass	Time Period	Region	Composer
Missa Ave Domine Jesu Christe	Likely after 1560s	Inconclusive, but probably not Italian	Inconclusive, but Guerrero and Lasso performed strongest
Missa II. Sile Fragor	Before 1520s	Franco-Flemish	Inconclusive, but Josquin most likely, then La Rue, Ockeghem, Obrecht and Mouton
Missa In illo tempore	After 1560s	Spanish	Inconclusive, but Guerrero is a possibility
Missa Tu es pastor	Either 1520-1560 or after 1560s	Inconclusive, but probably not Italian	Morales is a reasonably good possibility, followed by Lasso
Missa	Inconclusive	Likely Franco-Flemish	Inconclusive, but Josquin is a possibility
Missa Quaeramus cum pastoribus	Either before 1520s or 1520-1560	Probably Franco-Flemish	Inconclusive (proven later to be Willaert)

Caveats

- The individual composer results on the previous slide were largely inconclusive because some composers were individually underrepresented relative to others in the training data (and we did not have music from all possible composers)
  - To specify the extremes, of the total 2618 training mass movements and motets, Palestrina had 378 but L'Héritier had only 10
  - As expected, cross-validation performance was low for composer experiments
    - Happily, cross-validation performance was high for the time period, region and pairings of the two
- Some pairings of region and time period were represented by fewer composers than others
  - In the two extreme cases, 1520-1560 Spanish music and Franco-Flemish music after the 1560s each had one composer

Results for Monteverdi vs. Ingegneri vs. Everyone Else experiments

- All 30 anonymous mass movements were classified as being by neither Monteverdi nor Ingegneri
  - In both the mass movements only experiment and the mass movements and motets combined experiment
- This is strong evidence that none of the anonymous masses tested are in Monteverdi's style
  - Cross-validation accuracy was also quite high with respect to Monteverdi (for both fall positives and false negatives), adding confidence to this prediction
- There is more uncertainty about the Ingegneri result, as there were some unresolved encoding issues with his masses (but not his motets)
  - The preliminary results still strongly suggest the anonymous masses are not by him either

Conclusions

- Identification of 14 out of 19 anonymous masses copied in Cisilino's volumes from 16th century sources with composers from the 16th century

Anonymous masses	Qualitative analysis	Quantitative analysis
Missa II "Sile fragor" (vol. 3)	Pre-1520 Franco-Flemish composers	= (possible composer: Josquin)
[Missa anónima] (vol. 9)	Mid 16th century composers related to the Guglielmo Gonzaga's court	Inconclusive. Franco-Flemish origin?
Missa In illo tempore (vol. 8)	Not Monteverdi or Ingegneri. Associated to the Morales' respective motets	Not Monteverdi or Ingegneri. Spanish composers after 1560 possible composer: Guerrero
Missa Ave Domine Jesu Christe (vol. 8)		
Missa Tu es pastor ovium (vol. 8)	Not Monteverdi or Ingegneri Composers from the mid 16th century	Not Monteverdi or Ingegneri Either 1520-1560 or after 1560s Morales? Lasso?

Thanks for your attention

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