

Feature extraction, feature-indexed
databases, features in musicology and
evolution with feature; Also, features

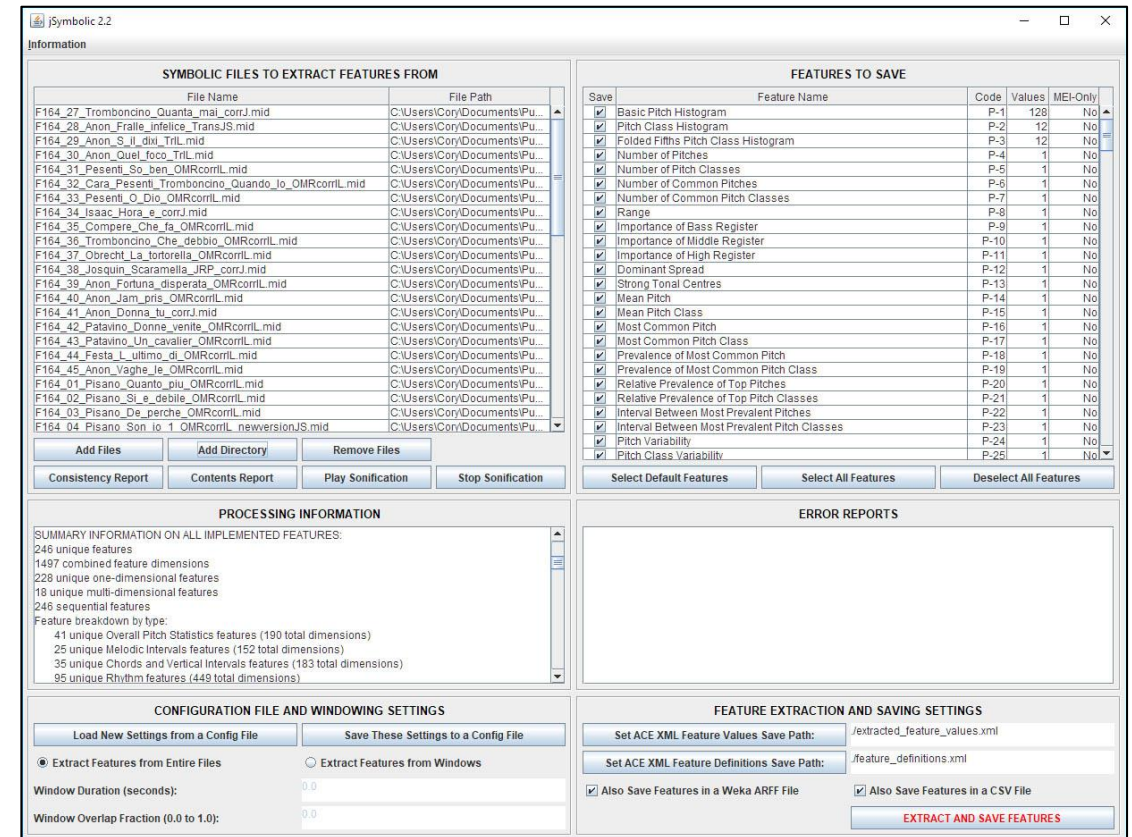
Cory McKay

Marianopolis College, Canada

CIRMMT, Canada

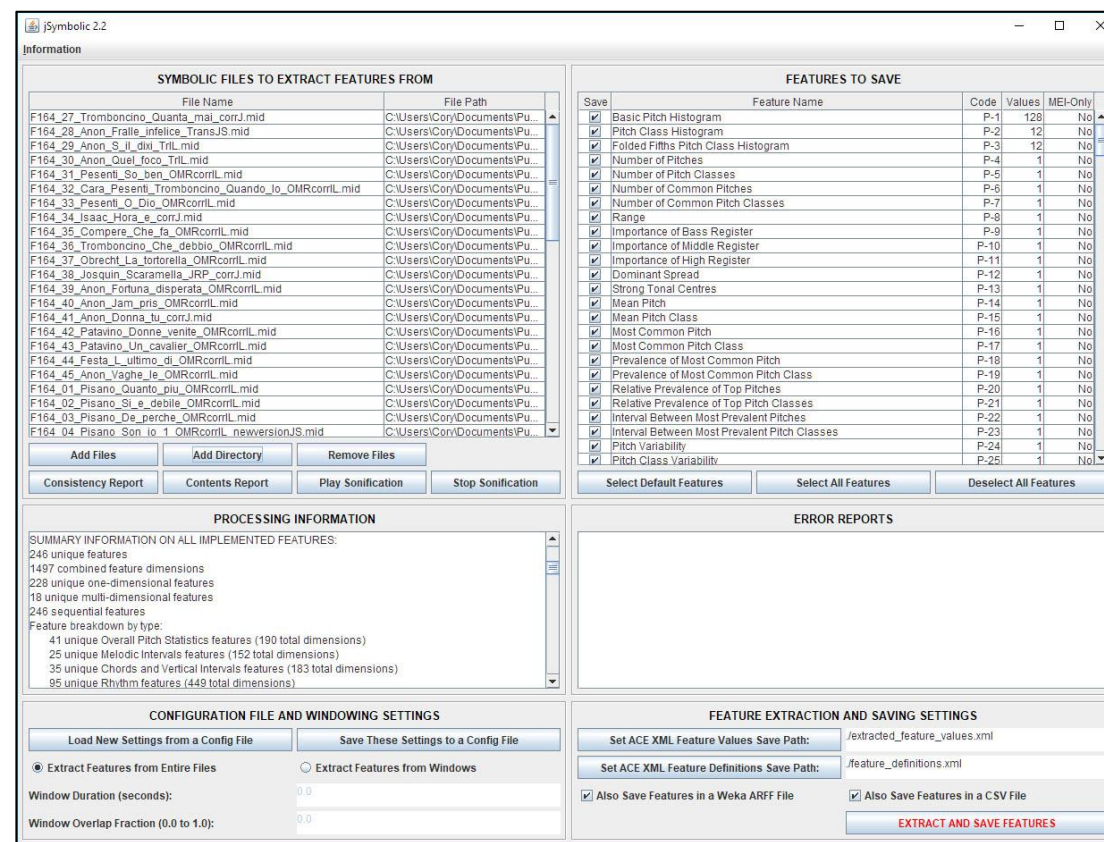
Extracting features with jSymbolic

- The **jSymbolic** research software (2004 to present) automatically extracts **features** from **symbolic digital scores** (MIDI and MEI)
 - Open source
- Features used for:
 - Training models using machine learning
 - Direct musicological analysis
 - Statistical or manual



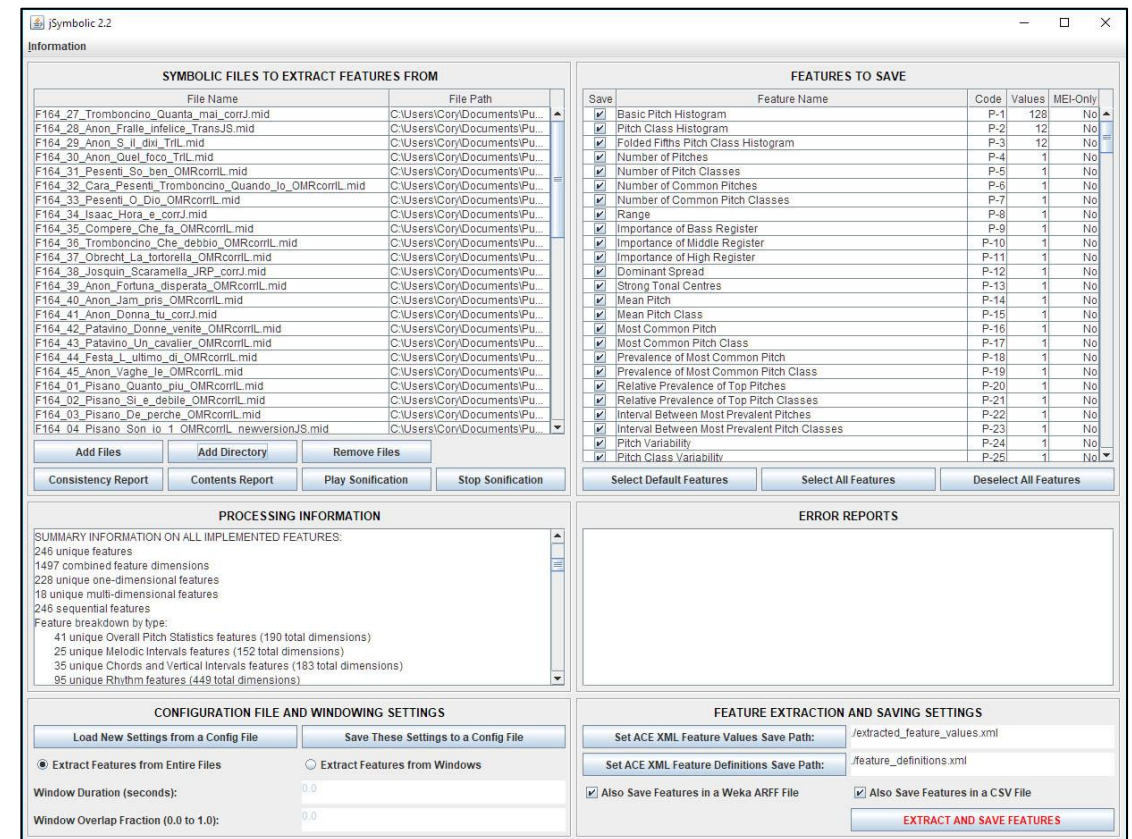
jSymbolic's feature types

- 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



Extracting features with jSymbolic

- The newest version (**jSymbolic3**) is currently undergoing final code review and testing
- Extracts **533 unique features** and **2040 feature values**
 - Up from the current (2.2) release version's 246 and 1497, respectively
- Includes new features based on **n-grams**
 - Horizontal / melodic
 - Vertical / harmonic
 - Rhythmic



Current musicological research projects based on features (with CIRMMT partners)

- Origins of the madrigal
 - Cumming & McKay 2018; Cumming & McKay 2021
 - Soon to be revisited with an expanded corpus
- Josquin attribution certainty
 - McKay, Cumming & Fujinaga 2017
 - Currently working on new a book chapter validating published source-based judgements with content-based feature analysis
- Empirically delineating the styles of Josquin and Pierre de la Rue
 - Cumming, McKay, Schubert, Nápoles López & Margot (in press)

Current musicological research projects based on features (**with Iberian partners**)

- Regional style in Iberian Renaissance music
 - Musical influences of Pedro Fernández Buch (Cuenca & McKay 2022)
 - Musical Influences of Cristóbal de Morales and Francisco Guerrero (McKay & Cuenca 2021)
- Attribution of anonymous and doubtfully attributed works
 - Masses transcribed by Siro Cisilino (Cuenca & McKay 2023)
 - Coimbra manuscripts (Cuenca & McKay 2021)
 - *Ave verum corpus* and *O decus virgineum* (Rodríguez-García & McKay 2021)
 - *Ave festiva ferculis* (Rodríguez-García & McKay 2021)
 - Gaffurius Codices (McKay 2021)
- Currently part of an application for a Proyectos de Generación de Conocimiento grant in Spain

SIMSSA DB

- A prototype database of **symbolic music files** intended for research in computational musicology
 - And, eventually, associated images, audio recordings, texts, etc.
- Searchable by:
 - Free text
 - Faceted metadata
 - **Feature values**
 - Auto-annotated by jSymbolic

The screenshot displays the SIMSSA Database interface. On the left, there is a search bar with the text 'Thomme armé' and several faceted search options including 'Sort By', 'Composition Year From/To', 'Genre (Type of Work)', 'Genre (Style)', 'Composer', 'Instrument/Voice', 'Sacred or Secular', and 'File Format'. The main area shows search results for '3 Musical Works for query "Thomme armé" and selected facets'. The first result is 'Missa L'homme armé I' by La Rue, Pierre (1460-1518). The second result is 'Missa L'homme armé super voces musicales' by des Prez, Josquin (1440-1521), with sections listed as 'Sanctus (Benedictus)', 'Sanctus (In nomine)', and 'Sanctus (Qui venit)'. The right side of the interface features a 'Please note' section and a list of feature values, including 'Chords and Vertical Interval Features', 'Dynamics Features', 'Instrumentation Features', 'Melodic Interval Features', 'Amount of Arpeggiation', 'Average Interval Spanned by Melodic Arcs', 'Average Length of Melodic Arcs', 'Chromatic Motion', 'Direction of Melodic Motion', 'Distance Between Most Prevalent Melodic Intervals', 'Mean Melodic Interval', 'Melodic Embellishments', and 'Melodic Large Intervals'. Each feature has a numerical range and a corresponding slider control.

SIMSSA DB

- Additional priorities:
 - Chains of provenance
 - Authority control (using VIAF)
 - Models relationships between data, sources and (abstract) works, sections and parts
 - Corpora can be associated with specific studies (e.g., for repeatability of research)
- To be linked with other music repositories as part of the long-term **LinkedMusic** project (2022-2029)
 - Involves other CIRMMT members, including Ichiro Fujinaga, Julie Cumming and Audrey Laplante, as well as numerous international partners

The screenshot shows the SIMSSA Database search results for the query "Thomme armé". The interface includes a search bar with the query, a "Sort By" dropdown set to "Best Match", and various filter options for "Composition Year From/To", "Genre (Type of Work)", "Genre (Style)", "Composer", "Instrument/Voice", "Sacred or Secular", and "File Format". The results are displayed in a list format, showing three musical works. The first work is "Missa L'homme armé I" by La Rue, Pierre (1460-1518). The second work is "Missa L'homme armé super voces musicales" by des Prez, Josquin (1440-1521), with sections listed as "Sanctus (Benedictus)", "Sanctus (In nomine)", and "Sanctus (Qui venit)". The third work is "Sanctus (Benedictus)". The right sidebar contains a list of features for analysis, including "Chords and Vertical Interval Features", "Dynamics Features", "Instrumentation Features", "Melodic Interval Features", "Amount of Arpeggiation", "Average Interval Spanned by Melodic Arcs", "Average Length of Melodic Arcs", "Chromatic Motion", "Direction of Melodic Motion", "Distance Between Most Prevalent Melodic Intervals", "Mean Melodic Interval", "Melodic Embellishments", and "Melodic Large Intervals".

Multi-modal music classification

- My original doctoral dissertation (2010) focused on multi-modal music classification
 - Investigating if, when and how information drawn from different types of musical data can be usefully combined using machine learning
 - jSymbolic was originally just part of this project
- Currently working on using **genetic algorithms** to explore different combinations of **modalities** and **feature types**
 - Features extracted from **audio**, **lyric** texts, **symbolic** scores, album cover **images**, semantic **tags** and **playlist co-occurrences**
 - Evaluated based on “**importance**,” “**redundancy**” and “**stability**”
 - Vatolkin & McKay 2022a; Vatolkin & McKay 2022b
- Currently part of an application for DFG funding in Germany

Thanks for your attention

cory.mckay@mail.mcgill.ca



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sciences humaines du Canada

Canada

