Characterizing Composers using jSymbolic2 Features

SIMSSA | Single Interface for Music Score Searching and Analysis

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jMIR

Overview

Statistical features extracted from large collections of symbolic music can be of important musicological value. This utility is explored here via several experiments involving Renaissance composers: training machine learning models to identify the composer of a piece; statistically analyzing feature values in order to learn what empirically differentiates compositional styles; and using machine learning to investigate composer attribution validity. This work also demonstrates the general potential of the jSymbolic2 feature extraction software and its feature catalogue.

jSymbolic2 Software Overview

- Extracts features from MIDI and MEI files
  - See below for details
- Open-source Java implementation
  - Part of the jMIR software suite
- Can perform windowed or overall extraction
- Variety of interfaces:
  - Graphical user interface (Figure 1)
  - Command line interface for batch jobs
  - Java API for programmatic use
  - Rodan workflow for distributed processing
- Flexible configuration file to store settings / jobs
- Detailed on-line manual
- Highly extensible architecture
  - New features can be added as plug-ins

jSymbolic2 Features

jSymbolic2 extracts **172 unique features** (and growing), for a total of **1230 feature values** in all (when multidimensional features are separated out). Can be divided amongst the following 7 types:

- **Pitch Statistics:** How common are various pitches relative to one another, in terms of both absolute pitches and pitch classes? How tonal is the piece? What is its range? How much variety in pitch is there?
- **Melody:** What kinds of melodic intervals are present? How much melodic variation is there? What can be observed from melodic contour measurements? What types of phrases are used and how often are they repeated?
- **Chords and Vertical Intervals:** What vertical intervals are present? What types of chords do they represent? How much harmonic movement is there, and how fast is it?
- **Rhythm:** Features are calculated based on both the durations of notes and the rhythmic intervals between note attacks. What meter and what rhythmic patterns are present? Is rubato used? How does rhythm vary between voices?
- **Instrumentation:** Which instruments are present, and which are emphasized relative to others? Both pitched and non-pitched instruments are considered.
- **Texture:** How many independent voices are there and how do they interact (e.g., polyphonic or homophonic)? What is the relative importance of different voices?
- **Dynamics:** How loud are notes and what kinds of variations in dynamics occur?

RenComp7 Dataset

- We collected 1584 MIDI files by 7 Renaissance composers by joining:
  - Josquin, de la Rue, Ockeghem, Busnoys and Martini music from the Josquin Research Project (JRP)
  - Palestrina music collected by John Miller
  - Victoria music from Jon Wild & Andie Sigler

Composer	Number of Pieces
Busnoys	69
Josquin (only the 2 most secure Jesse Rodin groups)	131
de la Rue	197
Martini	123
Ockeghem	98
Palestrina	705
Victoria	261

- 726 of the 1230 jSymbolic2 features extracted
  - Chosen to avoid bias based on source

Composer Attribution Experiments

- Reliable composer attribution is an important practical problem in early music studies
- Classified the RenComp7 music by composer in 10-fold cross-validation experiments
  - Used Weka's SMO SVM implementation
  - Performed separate experiments on all 7 composers as well as various subsets:

Composer Group	Classification Accuracy
All 7 composers	**92.7%**
Ockeghem / Busnoys / Martini	87.2%
Ockeghem / Busnoys	84.4%
Ockeghem / Martini	94.6%
Busnoys / Martini	93.8%
Josquin / Ockeghem	**93.9%**
Josquin / Busnoys	96.0%
Josquin / Martini	88.2%
Josquin / de la Rue	**85.4%**
Victoria / Palestrina	99.9%

- For comparison, the most similar work to date was published by Brinkman et al. (2016)
  - Achieved 63% on a dataset consisting of 5 Renaissance composers and Bach

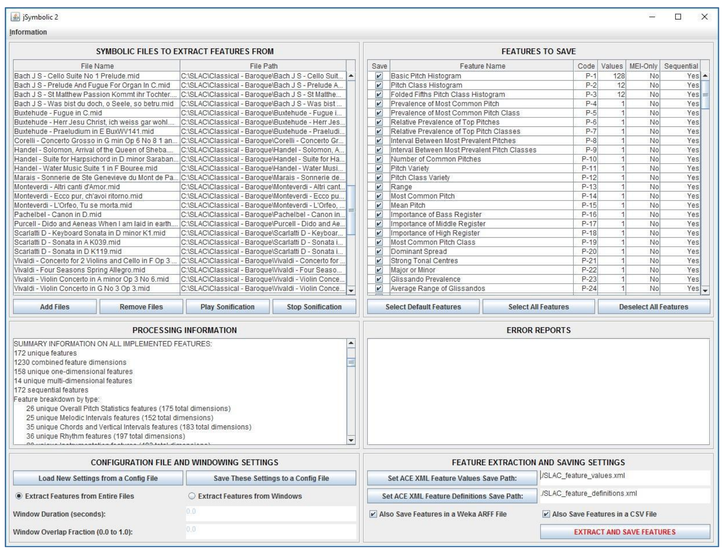

Figure 1: The jSymbolic2 GUI

Composer Style Experiments

- Empirically compared differences between composers by looking for patterns in the feature values extracted for from their RenComp7 music
- Focused on 2 pairs of composers
  - Josquin vs. Ockeghem *(relatively different)*
  - Josquin vs. de la Rue *(relatively similar)*
- Began by asking expert scholars (Julie Cumming and Peter Schubert) what characteristics they expected would differentiate the composers
  - Before looking at the actual feature values
- Resulting expert predictions of the characteristics that would be more evident in Ockeghem than Josquin and, in colour, what the feature data actually indicated:
  - YES: Less music for more than 4 voices
  - YES: More 3-voice music
  - YES: More triple meter
  - SAME: Less stepwise motion
  - SAME: More low notes
  - SAME: More simultaneities without a third
  - SAME: More varied rhythmic note values
  - OPPOSITE: More leaps larger than a 5th
  - OPPOSITE: More dissonance
- Key:
  - YES = the prediction is correct
  - SAME = no significant difference between the two composers
  - OPPOSITE = the prediction is reversed
- Also combined the results of seven Weka feature analysis techniques to determine the features ranked as the most discriminating:
  - Josquin vs. Ockeghem:
    - Ockeghem tends to have more vertical sixths and diminished triads, as well as longer melodic arcs
    - Several rhythmic features also important
  - Josquin vs. de la Rue:
    - Josquin tends to have: more vertical unisons and thirds; fewer vertical fourths and octaves; and more melodic octaves
- Many of these results were unexpected
  - Highlights the need for and potential of similar large-scale empirical studies

Attribution Certainty Experiment

- There is particular uncertainty about whether Josquin composed certain pieces
- Jesse Rodin has broken Josquin's music into 6 levels of attribution certainty
- We trained a 2-class Josquin vs. NotJosquin SMO (SVM) model on the music of 21 JRP Renaissance composers similar to Josquin, and on the Josquin music in the 2 most secure Rodin levels
- Used this model to classify the Josquin music in the remaining 4 Jesse Rodin levels:

Rodin Certainty Level	% Classified as Josquin
Level 3 "Tricky"	48.6%
Level 4 "Questionable"	17.2%
Level 5 "Doubtful"	14.0%
Level 6 "Very doubtful"	5.5%

- The more insecure a piece, the less likely it was to be classified as being by Josquin
  - Demonstrate some empirical support for Rodin's categorizations

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