A Pattern Recognition Approach to the Attribution of Early Seventeenth-Century Keyboard Compositions using Repeating Melodic Patterns in Diminutions in Solo Parts

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Outline

• Introduction.
• The case: authorship problems among early 17th century keyboard compositions from the Southern Netherlands involving Peter Philips.
• The method: quantification of musical style and application of pattern recognition methods.
• Results: classification of disputed compositions.
• Conclusions and future work.

English Influences in the Southern Netherlands

During the late 16th and early 17th century, keyboard music in the Southern Netherlands has deeply been influenced by composers from England.

Peter Philips (1560/61-1628)
Antwerp 1590-1597, Brussels court 1597-1628.

John Bull (1562-1628)
Continental visit 1601-02, Antwerp 1613-1628.

William Browne (?-?)
Only few details about his life are known.

Authorship Questions Peter Philips

Recently, some anonymous pieces have been attributed to Peter Philips.

Siegbert Rampe includes the following pieces in his Philips-edition:
• Almande d’amor (Wien, Minoritenkonvent, Ms XIV 714)
• Che fa hoggi il mio sole (Berlin, Staatsbibliothek, Ms Lyr A 41)
• Den lustelijken mei (Wien, Minoritenkonvent, Ms XIV 714)
• Liquide perle amor (Wien, Minoritenkonvent, Ms XIV 714)
• Se desio di fugir (Berlin, Staatsbibliothek, Ms 93114)

Question: Could stylistic comparison with compositions of Philips, Bull and Browne shed new light on its authorship?

Method: Quantization of Style

Aim: discover statistical regularities (patterns) that are unique for the personal style of a certain composer.

In previous studies successful application to:
• Style recognition of baroque composers (Handel, Telemann, Bach)
• Authorship discussions of organ fugues ascribed to J.S. Bach.

Ms. Vincentius de la Faille (1625)

Manuscript Vincentius de la Faille
• Only preserved in a (handwritten) 20th-century copy by Charles van den Borren.
• Vincentius de la Faille was the first owner.
• Dated 1625.
• Brussels area; connection with English immigrants.
• Includes high quality set of variations on ‘une jeune fillette’.

Question: Could stylistic comparison of ‘une jeune fillette’ with compositions of Philips, Bull and Browne shed new light on its authorship?
Quantization of Style: Example

G.F. Handel vs. G.Ph. Telemann, Orchestra Pieces

C4.5 Decision Tree


“Style is a replication of patterning, whether in human behavior or in the artifacts produced by human behavior, that results from a series of choices made within some set of constraints.”

Three Levels for Constraints:
- Laws
- Rules
- Strategies ← Authorship

Empirical Musicology

Nicolas Cook:

"Empirical Musicology can be thought of as musicology that embodies a principled awareness of both the potential to engage with large bodies of relevant data, and the appropriate methods for achieving this."

From ‘data-poor’ to ‘data-rich’.

Current Study: Diminutions

- Occurrence rate of most common patterns
- Avg. number of 8\textsuperscript{th} notes
- Avg. number of
- Avg. number of
- Avg. number of

Furthermore: 50 features from jSymbolic (McKay, 2010)

- Amount_of_Arpeggiation
- Average_Melodic_Interval
- Average_Note_Duration
- Chromatic_Motion
- Combined_Strength_of_Two_Strongest_Rhythmic_Pulses
- Direction_of_Motion
- Distance_Between_Most_Common_Melodic_Interval
- Dominant_Spread
- Duration_of_Melodic_Arcs
- Harmonicity_of_Two_Strongest_Rhythmic_Pulses
- Interval_Between_Strongest_Pitch_Classes
- Interval_Between_Strongest_Pitches
- Melodic_Fillers
- Melodic Fifths
- ETC.
Compositions

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<thead>
<tr>
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<tbody>
<tr>
<td>Allemande d’amor</td>
<td>Den lustelijken mei</td>
</tr>
<tr>
<td>Che fa</td>
<td>Liquid perle amor</td>
</tr>
<tr>
<td>O lien</td>
<td>Ms. de La Faille</td>
</tr>
<tr>
<td>Prelude &amp; Fantasia</td>
<td>Une jeue fille</td>
</tr>
<tr>
<td>Fantasia</td>
<td>Chi fara fed’al ciel</td>
</tr>
<tr>
<td>Fantasia</td>
<td>Fantasia Pavana</td>
</tr>
<tr>
<td>Prezioso</td>
<td>Almande</td>
</tr>
<tr>
<td>Allegro</td>
<td>Laat ons met herten reijne</td>
</tr>
<tr>
<td>Allegro</td>
<td>Een kindeken is ons…</td>
</tr>
<tr>
<td>Allegro</td>
<td>Een kindeken is ons…</td>
</tr>
<tr>
<td>Allegro</td>
<td>Den lustelijken mei</td>
</tr>
<tr>
<td>Allegro</td>
<td>Marble’s goodnight</td>
</tr>
</tbody>
</table>

Diminutions - Inventory

In total: 2444 patterns. 237 unique patterns.

Occurrence rates of 11 most common patterns (in %)
in all compositions:

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Philips</th>
<th>Bull</th>
<th>Browne</th>
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</thead>
<tbody>
<tr>
<td>1-1</td>
<td>0.01</td>
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<td>0.01</td>
<td>0.19</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Right Hand

Selected features:
- 1-1-1
- 11-21
- Avg. Number of 8\textsuperscript{th} notes
- Position of 8\textsuperscript{th} notes
- Direction of Motion
- Most Common Pitch
- Repeated Notes

Left Hand

Selected features:
- Duration of Melodic Aims
- Most Common Melodic Interval
- Dominant Spread

Classifications

Models: Philips vs. Bull and Browne

General Procedure

To derive a model from the data:

1. Apply a feature selection procedure.
   This results in a set of features that have discriminative power for the classification problem at hand.

2. Train a logistic classifier.
   This results in a function that maps the feature values to a value between 0 and 1, indicating the class the instance belongs to.

3. Test the classifier using leave-one-out cross-validation.
   This indicates how many of the training examples are classified correctly.

Classification – Edition Rampe

Alemande d’amor
- Other $0.563$
- Den lustelijken mei $0.862$
- m. 19-21 (R) $PP 0.505$
- m. 39-41 (L) $PP 1.000$
- m. 39-41 (L) $PP 0.652$
- m. 48-49 (R) $PP 0.597$
- m. 50-52 (R) $PP 0.977$

Che fa
- Other $0.649$
- m. 19-21 (L) $PP 0.866$
- m. 19-21 (L) $PP 0.505$
- m. 19-21 (L) $PP 0.591$
- m. 19-21 (L) $PP 0.921$

Liquide perle amor
- m. 17-19 (L) $PP 0.866$
- m. 20-23 (R) $PP 0.505$
- m. 42-45 (L) $PP 0.828$
- m. 51-53 (R) $PP 0.585$

These results are not very conclusive.
### Classification – Ms. De La Faille

<table>
<thead>
<tr>
<th>Piece</th>
<th>Measure Range</th>
<th>PP Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Une jeune fillette</td>
<td>m. 5-7 (R)</td>
<td>0.998</td>
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<td>m. 17-23 (R)</td>
<td>0.992</td>
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<tr>
<td></td>
<td>m. 49-52 (R)</td>
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<tr>
<td></td>
<td>m. 53-55 (L)</td>
<td>0.845</td>
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<td></td>
<td>m. 59-63 (L)</td>
<td>0.604</td>
</tr>
<tr>
<td></td>
<td>m. 77-80 (R)</td>
<td>0.913</td>
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These results show that from the three involved composers, Philips seems the most likely candidate.

### Concluding Remarks

- It seems possible to discern authorship from characteristics of diminutions, to a certain extent.
- It is possible to derive a quantitative, computational model that discriminates between diminutions of Peter Philips at the one hand and those of Bull and Browne at the other hand.

We applied this to diminutions from ‘Une jeune fillette’ (Ms. De La Faille) and pieces attributed to Philips by S. Rampe.
- However, we cannot draw final conclusions. There might be other composers; it is possible to have exceptions.
- We consider this study a successful pilot.

### Future Work

- Integrate the current results in ongoing authorship discussions.
- Musicological interpretation of the derived computational models.
- Add other composers (E.g., Byrd, Cornet, Sweelinck, Erbach, etc.)
- Apply to interesting cases. E.g.
  - “Aria del Granduca” (Berlin Staatsbibliothek Mus. Ms. 40516).
  - Other compositions in Ms. De La Faille.
  - Oxford Ch. Ch. Ms. 89.
- Involve other musical features (harmonic patterns, rhythmic structures, etc.)