Discovering the line of fifths in a large historical corpus

Future Directions of Music Cognition Virtual Conference

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EPFL

Corpus Studies – Music Theory – Music Analysis

A sketch of the corpus studies cycle:

1. analyze a piece or some salient aspect
2. compare it to other pieces and wonder whether observation holds more generally
3. gather/create suitable corpus to study question on a large scale
4. operationalize question for quantitative analysis
5. test against data
6. usually: new (general) observations
7. do they apply to individual pieces?
8. go back to 1.

Different realizations of hexachords

Comparing tonal material

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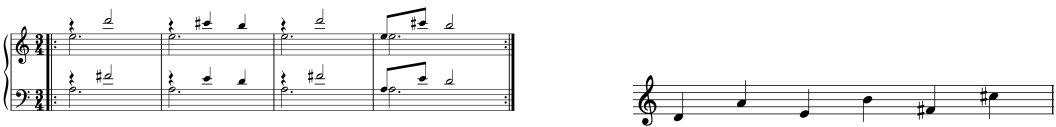
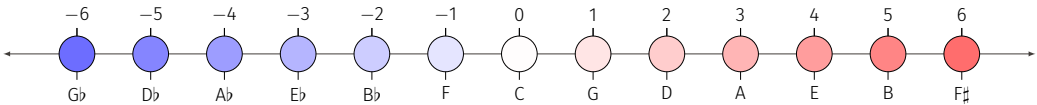


Figure 2: Chick Corea, *Children's Song No. 2* (1984), mm. 1–4.

The Line of Fifths

Theoretical model: the *Line of Fifths* (LOF) (Temperley, 2000).



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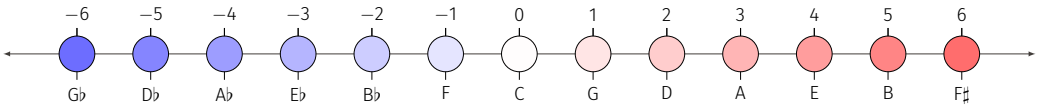

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The LOF contains many common scales as contiguous subsegments, e.g.

- diatonic
- pentatonic
- chromatic
- hexachord (Desprez, Corea)
- ...

Research question

If the line of fifths (and its subsegments) are central for tonal organization in many pieces, we should be able to see its relevance in a corpus study.

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Operationalization

- vector-space model: a piece is represented by the distribution of its pitch classes
- representation of notes as tonal pitch-classes (e.g. F♯, G♭, A♯♯, ...)
- restriction fo F♭♭ to B♯♯ (35 dimensions)
- important: no inherent ordering of pitch classes

The corpus

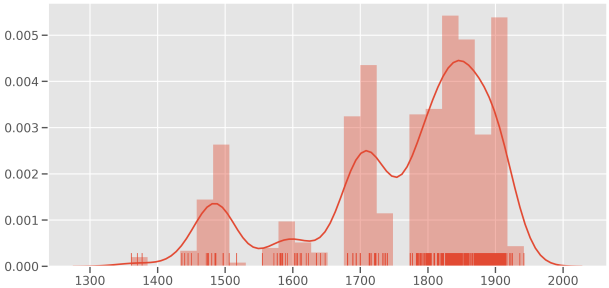

Figure 4: Convenience sample of 2012 pieces by 75 composers, 1361–1942 (Moss, Neuwirth, and Rohrmeier, 2020).

Method

Principal Components Analysis (PCA)

- We use PCA for dimensionality reduction.
- Principal components are dimensions that maximize variance in the data.
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Procedure

- corpus ‘lives’ in 35-D space, all dimensions are assumed to be independent
- we inspect the first two principal components, explaining 64% of data variance
- each data point is colored according to its most frequent pitch class

Structure Discovery with Dimensionality Reduction

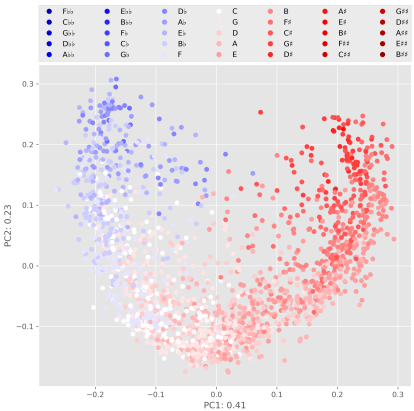

Figure 5: PCA, global view.

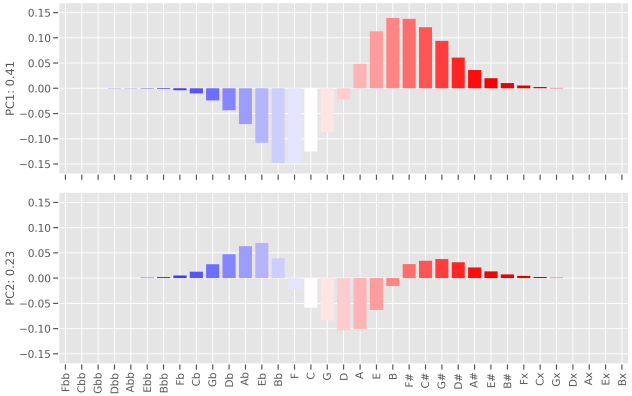

Figure 6: PCA, first two components: distance to center D (top) and 'accidental regions' (bottom).

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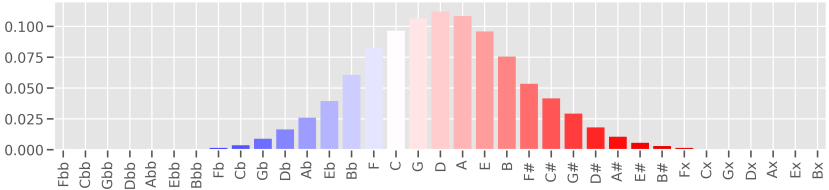

Figure 7: Average tonal pitch-class distribution in the corpus.

Observations:

- almost normally distributed
- centered on D (mid-point on line of fifths)

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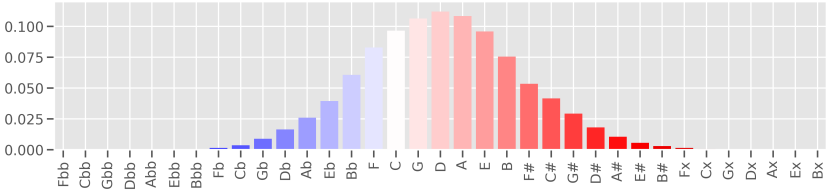

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This is a global statistic. What does it look like under a historical perspective?

Pitch-Class Co-Evolution

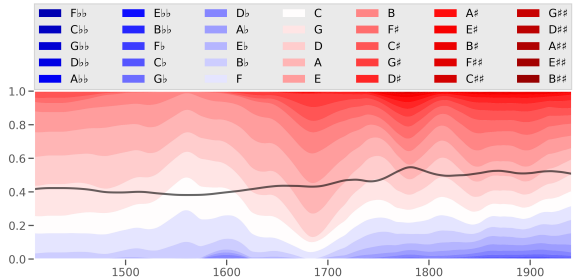

Figure 8: Relative pitch-class frequencies over time.

- local variations possibly due to specific sample (corpus)
- amount pitch-classes with one or several accidentals increases
- entropy remains relatively stable
- relative frequencies appear to be correlated

Pitch-Class Co-Evolution

- high correlations
  around the central axis

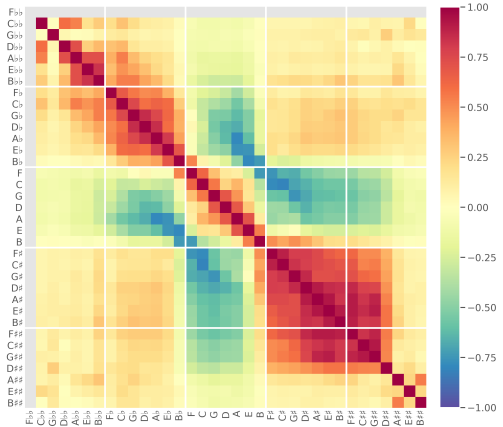

Figure 9: PC co-evolution *across* historical periods.

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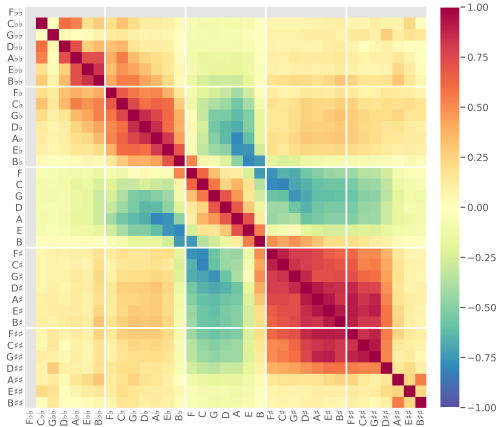

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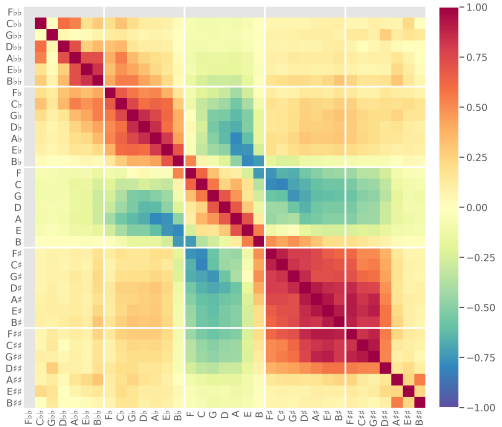

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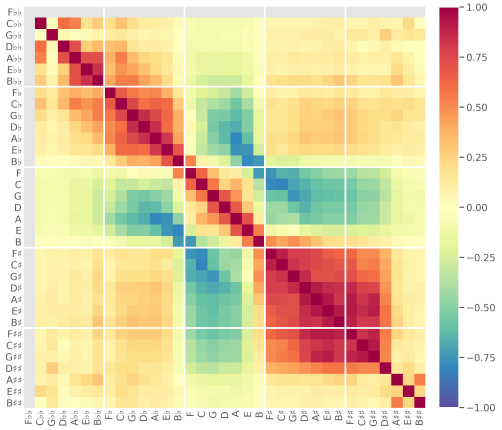

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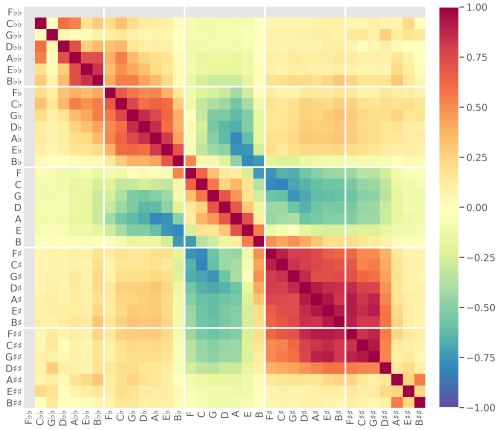
→ pieces further away from the LOF center are generally more chromatic



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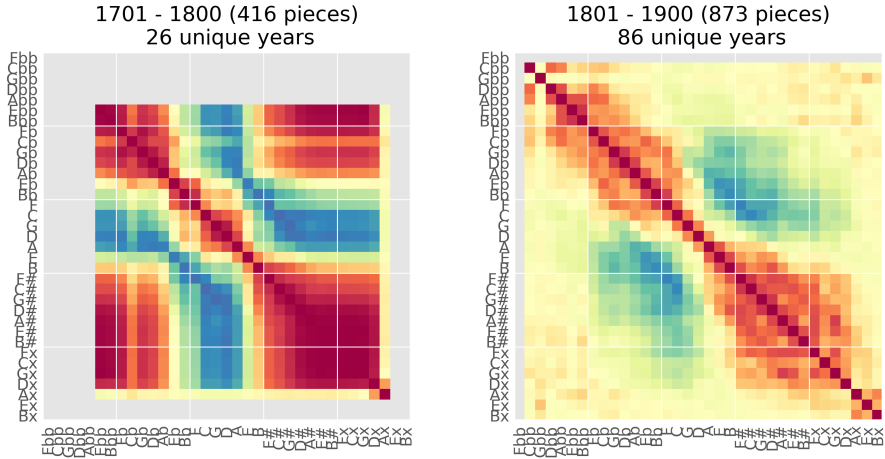

Figure 10: PC co-evolution in the 18th (left) and 19th (right) centuries.

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Future work

- expanding the corpus (also beyond canon)
- taking other parameters into account (harmony, meter, form…)
- zooming on from the global view

Thank you for your attention!

Slides available at fabian-moss.de

References

Moss, F. C., Neuwirth, M., & Rohrmeier, M. (2020). Tonal Pitch-Class Counts Corpus (TP3C) (Version v1.0.0). Zenodo. https://doi.org/10.5281/zenodo.3600088

Temperley, D. (2000). The line of fifths. *Music Analysis*, *19*(3), 289–319. https://doi.org/10.2307/854457