Tonality

Perspectives of historical musicology and corpus studies

Fabian C. Moss

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- I. The concept of "Tonality" and its origins
- II. Musical style analysis
- III. Case study: history of the modes
- IV. Questions and discussion

I. The concept of "Tonality" and its origins

Origins of tonality



(a) Alexandre-Étienne Choron (1771–1834): Dictionnaire historique des musiciens (1810).



(b) François-Joseph Fétis (1784–1871): Traité complet de la théorie et de la pratique de l'harmonie (1844).

Figure 1: Inventors of "Tonality".

"Tonality emerges from the collection of necessary relations (successive or simultaneous) of the notes of the scale."

"La tonalité se forme de la collection des rapports nécessaires, successifs ou simultanés, des sons de la gamme."

Fétis, François-Joseph. (1844). Traité complet de la théorie et de la pratique de l'harmonie (2nd ed.). Maurice Schlesinger, p. 22 "the term [tonality] is sometimes used as an equivalent for what Rousseau called a sistême musicale, a rational and self-contained arrangement of musical phenomena [...]. While tonality qua system constitutes a theoretical (and thus imaginative) abstraction from actual music, it is often hypostatized in musicological discourse, converted from a theoretical structure into a musical reality."

Hyer, B. (2001). Tonality. In S. Sadie & J. Tyrrell (Eds.), *The New Grove Dictionary of Music and Musicians* (2nd ed., pp. 583–594). Macmillan Publishers

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This narrative has a long-standing tradition in music historiography (e.g. Dahlhaus, Schönberg). However, the reality is more complex, with competing styles at the same time and recurring trends.

II. Musical style analysis

Musical style analysis



Figure 2: Hierarchical model of style analysis.

Meyer, L. B. (1989). Style and Music. Theory, History, and Ideology. University of Chicago Press Jan, S. (2007). The Memetics of Music: A Neo-Darwinian View of Musical Structure and Culture. Ashgate 6/23 III. Case study: history of the modes

Example of our most recent research:

• Harasim, D., Moss, F. C., Ramirez, M., & Rohrmeier, M. (in press). Exploring the foundations of tonality: Statistical cognitive modeling of modes in the history of Western classical music. *Humanities & Social Sciences Communications*

- 1. How can we find modes automatically?
- 2. How can the concept of a mode be operationalized?
- **3.** Can we do it without knowing how many modes there are and what they look like (unsupervised learning)?
- 4. How do modes change historically?



- 21'000 pieces from https://classicalarchives.com
- MIDI format
- user-generated (quality?)
- biases
- metadata: composer names, keys, composition date, ...
- representativeness?
- almost no early music examples \longrightarrow add from other projects
 - 1. Citations: The Renaissance Imitation Mass Project (CRIM)
 - 2. The Lost Voices Project



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 \implies in total 13'402 pieces (ca. 55 million notes) with given composition year (but not key)





Figure 3: Historical distribution of pieces in the corpus.

- 1. pieces can be represented by pitch-class counts
- 2. enharmonic equivalence
- 3. transpositional invariance

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 \implies explitic modeling



Figure 4: Pitch-class counts of an example piece in C major.

Examples





Abstand zwischen zwei Stücken p und q im key space \mathbb{K} :

$$d_{\mathbb{K}}(p,q) = \left\| \frac{p}{\sum_{i} p_{i}} - \frac{q}{\sum_{i} q_{i}} \right\|_{2}, \qquad (1)$$

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Abstand zwischen zwei Stücken p und q im mode space \mathbb{M} :

$$d_{\mathbb{M}}(p,q) = \min_{i \in \mathbb{Z}_{12}} d_{\mathbb{K}}(\sigma_i(p),q) = \min_{i \in \mathbb{Z}_{12}} d_{\mathbb{K}}(p,\sigma_i(q)), \tag{2}$$

The optimal mode:

$$(R^*, M^*) = \operatorname*{argmax}_{(R,M) \in \mathbb{Z}_{12} \times \{1, \dots, m\}} p(R, M \mid T, P, D).$$
(3)

In words: Given a piece P in a time period T in the corpus D, the best (mode, root) pair (M^*, R^*) is the one that maximizes the probability p.

Automatically finding modes



Figure 5: Three models for automatic mode finding.

Quality of the model



Figure 6: Accuracy scores of our model in five historical periods.

The major and minor modes

Pitch-class distributions of all pieces in the Baroque and Classical periods:



Figure 7: Pitch-class distribution of the major and minor modes.

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- 2. This system undergoes historical changes
- **3.** Using large datasets (corpora) of musical pieces allows to study historical changes of the relations between notes
- **4.** As a case study, the number of modes and their characteristics undergo substantial changes
- 5. Historical musicology and corpus studies complement each other

Questions and Discussion

References

Fétis, François-Joseph. (1844). Traité complet de la théorie et de la pratique de l'harmonie (2nd ed.). Maurice Schlesinger.

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