A Model of Metric Coherence

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- Inner Metric Analysis
  - Metric weight, Metric Coherence

- Further developments
  - JMetro, Spectral weight

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- Listening Tests
I define the meter of a work as the union of all layers of motion (i.e., series of regularly recurring pulses) active within it.

Harald Krebs

… the importance of pitch structure, specifically of change in the harmonic or melodic domain, in the formation of layers; new-event accents are among the most frequent producers of layers of motion.

Dynamic accent, placement of long durations among short ones (agogic or durational accents), thickly textured events among more thinly textured ones (density accents),…, by registral high and low points (registral accents), by the affixing of an ornament to a note.

\[ m_{s,d,k} = \{ s + id, i = 0, \ldots, k \} \]
\[ W_{l,p}(k) = \sum_{\forall m_k, k \geq 1, \alpha \in m_k} k^p \]
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Inner metric structure

Outer metric structure

Symphony C Major K. 551

1. Movement (4/4)

Wolfgang A. Mozart

Excerpt from Metric weight $W_{2,2}$ of the exposition (bars 1-55)

Adieu sweet Amarillis (4/4)

John Wilbye

$W_{2,2}$

Tanzen und Springen (3/4)

Hans Leo Haßler

$W_{2,2}$
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3. Symphony, 1. movement (6/4)
Johannes Brahms

Excerpt from Metric weight $W_{2,2}$ of the exposition (bars 1-36)

2. Symphony, 1. movement
Johannes Brahms

B Minor Mass
Pleni sunt coeli (3/8)
Johann Sebastian Bach

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Metric Coherence

- correspondence between inner and outer metric structure
- presupposition: occurrence of regularity (weight layers corresponding to specific periods)
- a metric subscale of outer metric hierarchy significant in the inner metric weight
- phase-coincidence, phase-displacement

Guillaume Dufay
Mass: Se la face ay pale
Kyrie II, Soprano

Welltempered Clavier
Johann Sebastian Bach
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Welltempered Clavier
Johann Sebastian Bach

All voices

Bass

Welltempered Clavier
Johann Sebastian Bach

Welltempered Clavier
Johann Sebastian Bach

Spectral Weight of the all 3 Voices (Excerpt)

Spectral Weight of the Bass (Excerpt)
“where subsurface melodic progression occurs at a regular rate; a rising arpeggiation of the tonic triad is succeeded by a descending stepwise line, each pitch of both the rising and the falling gestures occupying twelve eighth-note pulses”. Harald Krebs (Fantasy Pieces).
Sarabande
Suite d-Minor
Georg Friedrich Händel
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3rd Symphony (Rhenish Symphony)
Robert Schumann

Analysis of bars 1-20
Spectral weight of the theme: Bars 1-20
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3rd Symphony (Rhenish Symphony)
Robert Schumann

Analysis of bars 1-20 (4/4)

Spectral weight of the theme, interpreted as 4/4

Analysis of the Exposition

Spectral weight of First Violins of the exposition (excerpt)

Spectral weight of First Violins of the exposition (3/2)

Spectral weight WITHOUT local meters of period 1/2

Bach, WTK I Fugue 4

Metric Weight of the Bass Voice (Excerpt)

Spectral Weight of the Bass Voice (Excerpt)
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Haydn
Presto from Sonata Hoboken XVI: 24

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Spectral weight of measures 1-40

Metric weight of measures 1-40

Spectral weight WITHOUT local meters of period 4 and multiples

Spectral weight WITHOUT local meters of period 3 and multiples

Spectral weight of the left hand

Spectral weight of the right hand (interpreted as 4/4)
For the set of national anthems, a correct beat can be defined as a beat that is compatible with the meter notated in the score. For short patterns that form the beginning of more than one anthem we counted a beat as correct whenever it fitted the meter of one of those anthems.

Result: Longuet-Higgins/Le: 60% correct

Spectral weights: 63%

l=2, p=2

Spectral weights: 19%

Spectral weights distinguish even/odd: 82%

Spectral weights: 17%

l=2, p=4

How about pitch?

One aspect of this problem is that at any given timepoint, accents may arise in many simultaneously varying musical dimensions, and it is unclear how to sum the contributions from all these dimensions.

Roeder 1995
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David Lewin
On Harmony and Meter in Brahms’s Op.76, No.8

Computational and experimental models are timebased!

J. Snyder & C. Krumhansl: Tapping to Ragtime - Cues to Pulse Finding

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Il Pompeo
„O cessate di piagarmi”
Alessandro Scarlatti

2. Symphony, 3. movement
Johannes Brahms

Bars 33-106: 2/4

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RUBATO

score

performance

analysis
Empirical Experiment

- **Metric weights** → **Performance**
  - Do metric weights with a high degree of coherence produce performances where the interpretation is more "clearly" structured?

Metric weights of different degree of coherence of the same piece

- Last measures of the altus of Gratias:
  Analysis of the whole piece $\leftrightarrow$ Analysis of the part

- Beginning of Credo, all voices:
  Analysis of the whole piece for all voices $\leftrightarrow$ Analysis of the whole piece for separate voices

Credo: single voices

Credo: all voices
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Mystic Circles of the Young Girls

The Rite of Spring
Igor Stravinsky