Re-Considering the Affinity between Metric and Tonal Structures in Brahms’ Op. 76 No. 8

Anja Volk and Elaine Chew

Brahms’ Capriccio Op. 76, No. 8
- David Lewin: On Harmony and Meter in Brahms’ Op. 76, No. 8
- Two independent mathematical models:
  - Inner Metric Analysis (metric domain)
  - Spiral Array (tonal domain)
… they contain the Cs in the bass line, along with the bs that inflect them…

… triggered by the strongest subdominant event of the passage, the bass and root F.

… triggered by and prolonging the big dominant event, bass and root e.

-both the metric relation of 6/4 to 3/2 and that of 6/4 to 12/8 involve the play of the ratios 2:3 and 3:2. And these are the same ratios involved in pitch relationships of a fifth, the dominant and subdominant relations to a tonic pitch.

-the relation of 6/4 to 12/8 inverts the relation of 6/4 to 3/2, which is numerically analogous to the inversion of tonic-dominant and tonic-subdominant pitch relations.
We must not try to push too far the tonal analogy for these figures.

The idea of a deep affinity between pitch and time is as Platonist as the Wendisch Mägdlein’s vision of eternal love. am I suggesting, that such relationships are more eternal than iron and steel? am I not altogether sure.

Richard Cohen: Complex Hemiolas, Only-Hill-Graphs and Metric Spaces

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Harald Krebs:

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.
Mathematical Model: Inner Metric Analysis

Symphony C Major K. 551
1. Movement (4/4)
Wolfgang A. Mozart

Johannes Brahms!

Nonpareil Rag
Scott Joplin

Johannes Brahms

Max Frisch:
The main theme ... begins to project a metrical profile, but one that fits more clearly into 3/2 than 6/4. Only in bar 7 is the duplet division of the bar firmly supported in all parts: the theme, the motto, and the harmonic voices move every half bar.
Inner Metric Analysis: Johannes Brahms, 4. Symphony

1. theme

2. theme

Bars 1-43

Bars 44-117

Bars 118-186

Analysis of the Exposition

Graham Phipps

David Lewin: On Harmony and Meter in Brahms's Op. 76, No. 8

Capriccio.

Creation of new gene: change, genetic change

Left Hand: bars 1-15

Right Hand: bars 1-8

Right Hand: bars 9-15

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The Spiral Array (Chew 2000)

Spiral Array (tonal domain)

Longuet-Higgins’ (1962ab) harmonic network

The tonnetz in neo-Riemannian Theory

C G B F# C# G# D# A# E# B# F C
Db Ab Eb Bb F# E Ab Eb Bb F# E Ab Eb Bb F C
Db Ab Eb Bb F# E Ab Eb Bb F# E Ab Eb Bb F C
Db Ab Eb Bb F# E Ab Eb Bb F# E Ab Eb Bb F C
The Spiral Array (Chew 2000)


Chew's spiral in the spiral array (2000)

Modeling Tonality

Spiral Array (Chew 2000)

\[ \text{C}(k) = P(k) + P(1) + r \sum_{i} S_i = L \]

where \( k \geq 0 \), \( P(k) \geq 0 \), \( P(1) \geq 0 \), \( r \geq 0 \), \( \sum S_i = 1 \).
Modeling Tonality

Spiral Array (Chew 2000)
- discrete space
- continuous space
- exact membership
- reduction to single-point representation

Key-Finding

Center of Effect Generator (Chew 2000)
- clustering of pitches in a key
- generate center of effect
- perform nearest neighbor search for closest key

monophonic example

polyphonic example

\[ k_i = \sum_{j=1}^{n} d_{ij} \] where \( d_{ij} = \sum_{t=1}^{m} d_{tij} \)
Key-Finding

Center of Effect Generator (Chew 2000)

Simple Gifts from Copland’s Appalachian Spring

From Chew 2000 p.104.

Key-Finding: Comparisons

J.S. Bach’s Well-Tempered Clavier Bk 1

From Chew 2000 p.105.
The c.e. as proxy for context

as key context

Pitch Spelling

- Algorithm: cumulative window (Chew & Chen, 2003)
- General Algorithm: bootstrapping (Chew & Chen, 2005)

Pitch Spelling: Result (Chew & Chen, 2005)

The c.e. as proxy for context

key context

choose nearest neighbor
The c.e. as proxy for context

Distance peaks at boundary

Measuring contextual distance

Argus algorithm for automatic segmentation (Chew 2004)
Argus: RT Segmentation (Chew 2004)

Advantages:
- Computes in real-time, O(n)
- Eliminates dependence on key representations
- Segments by pitch collection (more general)

Applied to two Regards in Messiaen’s Vingt Regards sur l’Enfant Jesus (Chew 2004)

Argus: Schubert D780 No.6 (Chew 2005)

Results when w=18 eighth notes (3 bars)

Results when w=9 eighth notes (1.5 bars)
Argus: Schubert D935 No.3 (Chew 2005)

Results when \( w = 48 \) sixteenth notes (3 bars)

Argus: Brahms: \( f = 12, b = 12, \mu = 0.1987, s = 0.1304 \)

Argus: Brahms: \( f = 24, b = 24, \mu = 0.2010, s = 0.1434 \)
Inner Metric Analysis: Brahms’ Capriccio op. 76, No. 8

Comparison: Harmony and Meter in Brahms’ Op. 76, No. 8

Lewin’s analysis

Our analysis

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Conclusions

- Computational models for analysis (metric & tonal)
- Real separation of metric & tonal information