A Spatial Perspective on Long-Range Voice Leading and Beethoven’s *Heiliger Dankgesang*

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II. DFT and Triadic Orbits
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   2. Triadic orbits

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   1. Scalar context and triadic orbits
   2. The D–C motive
   3. Strength and weakness
I. Schenker, Brahms, and Keys

1. Schenker’s syllogism
2. Examples: Beethoven Bagatelle op. 119 no. 7
   Brahms Cello Sonata op. 99, subordinate theme
3. An alternative: DFT phase space and tonal regions
4. Beethoven and Brahms examples in DFT phase space
The Schenkerian Syllogism

Premise: Long-range structure is contrapuntal (based on voice-leading).

Conclusion: Long-range structure is reductive—i.e., it consists of relationships between non-adjacent harmonies.

Problematic

Hidden Premise: Voice leading is always a relationship between individual harmonies.

False!
Example:

Beethoven *Bagatelle* op. 119 no. 7
Beethoven *Bagatelle* op. 119 no. 7

N° 7.

C major
I

\[ V^7/V - V - V^7/V - V \]

[G major]

Sequence

[C major]

F major

[D minor]

\[ V^7 \]

\[ V^7 \]

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Beethoven Bagatelle op. 119 no. 7

C major:
V of F major
not I of C major
Samarotto’s analysis reflects only the structural chords, not their tonal contexts. This analysis mistakenly represents the bagatelle as tonally closed.
Beethoven *Bagatelle* op. 119 no. 7


However, the higher-level progression of tonal contexts shows that the bagatelle is actually **tonally open**, in accord with its function as prelude to no. 8.


Tonal contexts: C major - - - - - - - - - - - - - → F major

Chords: C major - - - - - - - - - - - - - → C major

Samarotto’s analysis reflects only the structural **chords**, not their tonal contexts. This analysis mistakenly represents the bagatelle as **tonally closed**.
Schenker, Brahms, and Keys

Alternative:
A spatial concept of tonality . . .

DFT phase space


Phase of 3\textsuperscript{rd} Fourier Component

Phase of 5\textsuperscript{th} Fourier Component

Pcs a major third apart have the same 3\textsuperscript{rd} component

Pcs a perfect fifth apart are close on the 5\textsuperscript{th} component
Dyads are halfway between their constituent pcs.

Phase of 5th Fourier Component

Phase of 3rd Fourier Component

Fifths
Dyads are halfway between their constituent pcs
Minor thirds

Dyads are halfway between their constituent pcs

Phase of 3rd Fourier Component

Phase of 5th Fourier Component
Major and minor triads are between their constituent pcs.
Schenker, Brahms, and Keys

Properties of DFT Phase Space

- Objects are pcsets, multisets, or statistical pc distributions
- Toroidal geometry
- Vertical axis indicates circle-of-fifths position
- Horizontal axis captures triadic voice-leading properties
Properties of DFT Phase Space

• Many kinds of harmonic objects exist in the space: single pcs, harmonies, scales, etc.

• Space is continuous—paths connect points via a potential infinite series of intermediate states (pc distributions)

• Nearness in the space (its topology) is based on common pc content.
Tonal Regions

Dominant 7th's are colocated with perfect 5th's

Two parallel perfect-fifths axes separate major and minor regions

Boundaries separate fifth-related regions so that each region contains its dominant
Each tonal region in the bagatelle is represented by motion between its tonic and dominant (doubled lines).
Properties of DFT Phase Space

A **path** can represent a motion from $A$ to $B$, but it can also represent “$B$ in the context of $A$.”

**Combination** of pcsets is highly tractable: the position of $A + B$ is easily predictable from the path $A \rightarrow B$.

Averaging over *more objects* (pcs, triads) restricts the range of activity.
Beethoven *Bagatelle* op. 119 no. 7

Double-lined arrows denote “in the context of”
Dashed arrow shows the temporal progression
Brahms, F major Cello Sonata, op. 99,

Subordinate Theme
Schenker, Brahms, and Keys

Brahms *Cello Sonata* Op. 99, first movement

Schenker: *Der Freie Satz* Fig. 110d(2)
Structure is based on *large-scale voice leadings*, which must occur between *distinct musical objects* (*chords*). This leads to a *reductive* approach.
Schenker, Brahms, and Keys

Cadential points must take precedence as structural events
Schenker, Brahms, and Keys

Cadential points must take precedence as structural events

Persistence of C major context is obscured
Important key-defining progressions occur within regions.

Other progressions average to the appropriate tonal center.

Positions of chords:

Combinations of chords indicate the tonal region of a progression.
Brahms *Cello Sonata* op. 99

**Progression of chords**

- **C maj.** / **A min.**
- **A min.**
- **E min.**
- **E7**
- **B7**

**Chords:**

- C maj.
- A min.
- E min.
- E7
- B7

**Keys:**

- C major
- A minor
- E minor
- E7
- B7

**Musical Notation:**

- C major
- A minor
- E minor
- E7
- B7

**Note:**

- Musical notation and chord progression for Brahms' *Cello Sonata* op. 99.
Brahms *Cello Sonata op. 99*

Progression of keys
2. DFT and Triadic Orbits

1. DFT components as sinusoidal approximations
2. Triadic orbits
Discrete Fourier Transform on Pcs sets


DFT components

C major triad

Component 1:
magnitude = 0.043

Component 2:
magnitude = 0.083
C major triad

DFT components

Component 3:
magnitude = 0.186

Component 4:
magnitude = 0.144

...
DFT components

C major triad

Component 5: magnitude = 0.161

Component 6: magnitude = 0.083

+ ...
The triadic orbits go from trough to trough, and group pcs that may be considered displacements of those in the triad.
The troughs of the sinusoid are the boundary points.
The peaks of the sinusoid are shown by the dashed lines.
Any pc-distribution can define a set of triadic orbits, including scales.

Regions of stability:
- Pitch classes at the center of a region are more stable.
- Pitch classes at the periphery of regions are unstable.

Periphery: Unstable upper and lower neighbors.

Displacements:
Triadic Orbits

Triadic orbits as a **voice leading** property:

- Clockwise and counter-clockwise movement of triadic orbits corresponds to ascending or descending efficient voice leading between triads.
- The spatial relationship of one harmonic object to its context indicates its voice-leading stability and whether it resolves with upward or downward voice leading in the context.
- The triadic voice-leading properties of the 3\textsuperscript{rd} DFT component apply to sets of *any cardinality*, not just trichords, on the basis of common pc content with consonant triads.
3. *Heiliger Dankgesang*

1. Scalar contexts and triadic orbits
2. The D–C motive
3. Strength and weakness
Heiliger Dankgesang: Scalar Contexts

C–A hexachord

Central position

Peripheral Upper Neighbor

Ambiguous position

Recording: Muir Quartet, Ecoclassics

First intonation and chorale

C diatonic

Upper neighbor to C

Recording: Muir Quartet, Ecoclassics

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Heiliger Dankgesang: Scalar Contexts

Evolution of scalar contexts over the first intonation and chorale

{F, G, A, C}

C diatonic

A–C hex.

Dankgesang
Ending high in the orbit gives the effect of suspension
Heiliger Dankgesang: Scalar Contexts

C diatonic
A is central
D diatonic

D is central

Neue Kraft fühllend
Andante
The diagram illustrates the structural status of keys in scalar contexts. It shows the relationship between different pitch classes and chords in various musical contexts. Key features include:

- **D diatonic**: Central orbit
- **D melodic minor**: On the boundary of two orbits
- **Upper periphery of orbit**: D,A
- **F major triad** and **pitch-class A** in different contexts
- **C diatonic**
- **C hexachord**

The diagram highlights the status of pitch classes and chords in scalar contexts, such as the F major triad and its relationship with pitch-class A.
Heiliger Dankgesang: Motivic D–C

Final form of the intonation:
Heiliger Dankgesang: Motivic D–C

C–A hexachord

D as upper neighbor to C
Heiliger Dankgesang: Motivic D–C

Chorale phrases 1–2:

F maj. context: D resists descent

C maj. context: D as lower neighbor to C, upward striving

C–A hexachord

C diatonic

C maj. tonality
Heiliger Dankgesang: Motivic D–C

End of Neue Kraft section

Molto adagio
Weakness and Strength

In an F major context, the step C–D is a weak neighbor motion.

In a C major context, it is a strong completion of passing motion.

Within orbit

Between orbits
Weakness and Strength

As upper neighbor in F major context

As passing note in C major context
Heiliger Dankgesang: Final Chorale

Chorale tune

D – C (PAC!)

Strong in C maj.

Weak in F maj.

End of chorale phrase

D – C

Heiliger Dankgesang: Final Chorale

Chorale tune

D – C!
Conclusions

• DFT phase space effectively reflects tonal process at multiple levels of structure.

• It does so through processes of combination rather than reduction.

• Relating levels through combination better reflects the traditional notion of keys.

• Motions in DFT phase space can be construed as a kind of voice leading through the idea of triadic orbits.

• Triadic orbits also have hermeneutic value in showing the gravitational forces that color tones and distinguishing strong and weak melodic motions.
Bibliography


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Appendices:

A1: Derivation of tonal regions
Derivation of Tonal Regions

Boundaries between major and minor follow the circle of fifths through diatonic scales and dominant sevenths / individual pcs.
A characteristic hexachord is at the center of the major regions. Boundaries between fifth-related major regions are parallel to an axis that approximately passes through this hexachord.
Minor region boundaries are parallel to an axis that approximately passes through the harmonic minor scale.

Derivation of Tonal Regions

- C maj. hex.
- F maj. 7–5 hex.
- F7
- F min. 7–5 hex.
- F h.min.
- A♭ diat.
- A♭ maj. hex.
- C maj. 7–5 hex.
- C7
- V7 + F
- V7 + C
- Diatonic ST axis
- C min. 7–5 hex.
- C h.min.
- E♭ diat.
- E♭ maj. hex.
- E♭ maj. 7–5 hex.
- E♭7
- G7
- G min. hex.
- G h.