

Hochschule für Musik Karlsruhe

Blockvorlesung

Advanced Audio-Based Music Processing

6. Corpus Analysis

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Dissertation: Tonality-Based Style Analysis

Christof Weiß

*Computational Methods for Tonality-Based Style Analysis of
Classical Music Audio Recordings*

PhD thesis, Ilmenau University of Technology, 2017

https://www.db-thueringen.de/receive/dbt_mods_00032890

Chapter 7: Clustering and Analysis of Musical Styles

Corpus Analysis

Motivation

- Harmony analysis: individual pieces
- **Musical corpora:**
 - Closed set of pieces of a genre
 - Comprehensive set of pieces by a composer / artist
 - Representative set for a certain musical style
- **Corpus analysis:**
 - Analysis of individual pieces
 - **Aggregate** piece-wise results
 - **Visualize** results to see trends **on the large scale**

Corpus Analysis

Overview

Three example studies:

- Chord transitions in Western classical music
- Tonal complexity in Western classical music
- Tonal complexity in jazz solos

Corpus Analysis

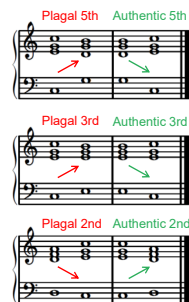
Overview

Three example studies:

- Chord transitions in Western classical music
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Chord transitions: Plagal vs. Authentic

- Authentic progressions: „falling“, „moving forward“, „directional“
- Plagal progressions: „opening“, „archaic“ („A-men“), colorful



Interval	Δ	Complem.	Δ	Quality
P1	0	P8	-12	None
m2 ↗	+1	M7 ↘	-11	Authentic
M2 ↗	+2	m7 ↘	-10	Authentic
m3 ↗	+3	M6 ↘	-9	Plagal
M3 ↗	+4	m6 ↘	-8	Plagal
P4 ↗	+5	P5 ↘	-7	Authentic
+4 ↗	+6	[♯] 5 ↘	-6	None
P5 ↗	+7	P4 ↘	-5	Plagal
m6 ↗	+8	M3 ↘	-4	Authentic
M6 ↗	+9	m3 ↘	-3	Authentic
m7 ↗	+10	M2 ↘	-2	Plagal
M7 ↗	+11	m2 ↘	-1	Plagal
P8 ↗	+12	P1	0	None

Chord transitions: Plagal vs. Authentic



Psalm 128, SWV 233

Comelius Becker (1561-1604) Heinrich Schütz (1585-1672)

Soprano Alto Tenor Bass

1. Wohl dem, der in Got-tes-furcht steht und auch auf sei-nem We-ge geht,
dein ei-gen Hand dich näh-ren soll, so lebst du recht und geht dirs wohl.

Σ P: 14 A: 13



7

Chord transitions: Plagal vs. Authentic



"Durch Dein Gefängnis" (Johannespassion) J. S. Bach

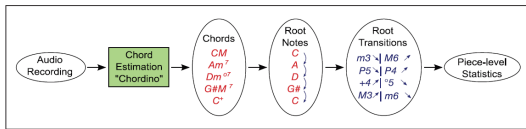
Durch dein Ge-fing-nis, Göt-tes Sohn, muß uns die Frei-heit kom-men;
Dein Ker-ker ist der, Gna-den-thon, die Frei-statt al-ler From-men;
Denn gingst du nicht die Knecht-schaft ein, müßt uns-re Knecht-schaft ewig sein.

Σ P: 9 A: 20



8

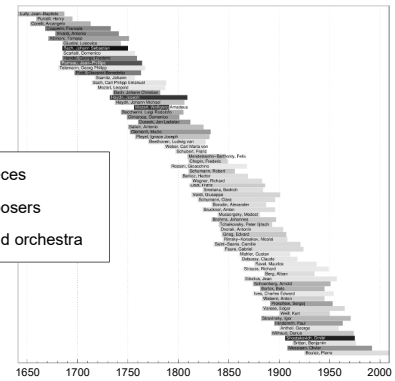
Chord transitions: Plagal vs. Authentic



9

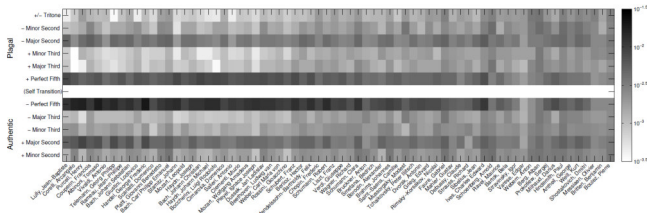
Chord transitions: Plagal vs. Authentic

- 2000 pieces
- 70 composers
- piano and orchestra



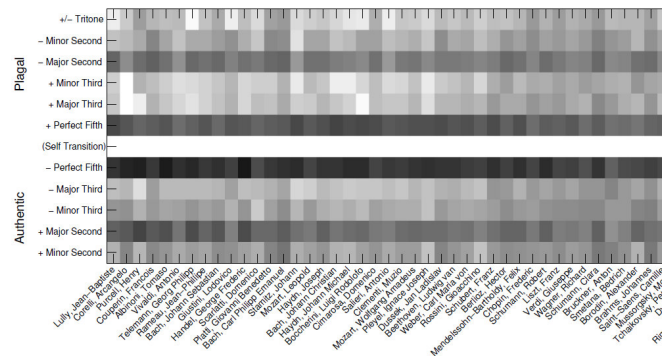
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Chord transitions: Plagal vs. Authentic



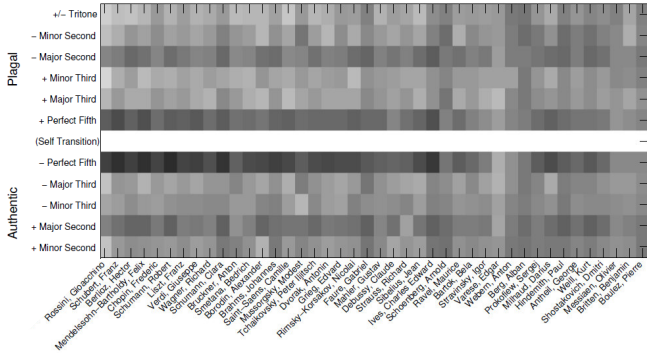
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Chord transitions: Plagal vs. Authentic



12

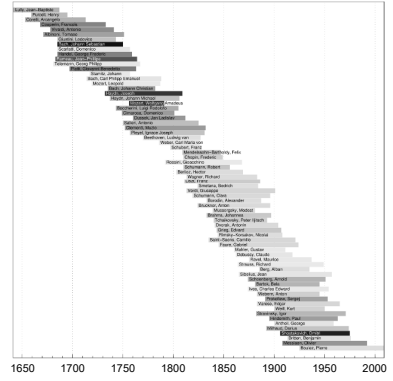
Chord transitions: Plagal vs. Authentic



13



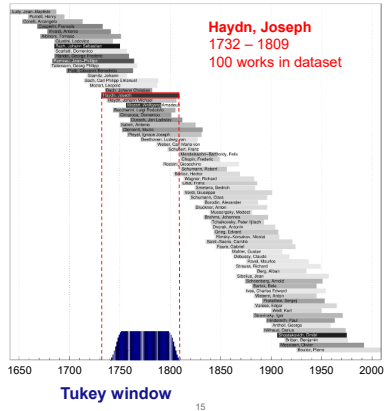
Chord transitions: Plagal vs. Authentic



14



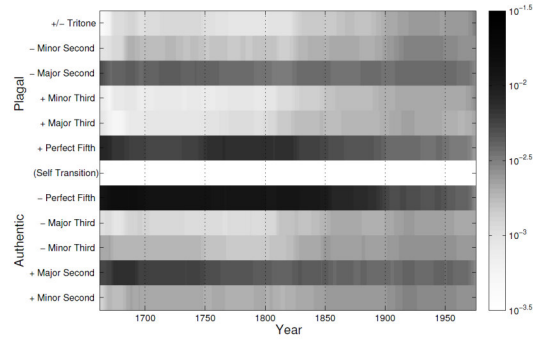
Chord transitions: Plagal vs. Authentic



15



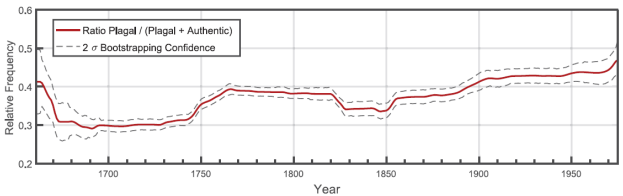
Chord transitions: Plagal vs. Authentic



16



Chord transitions: Plagal vs. Authentic



17

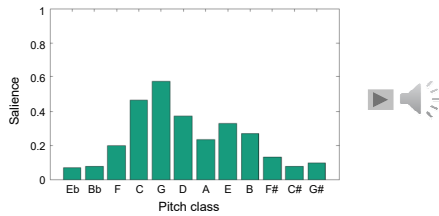


Corpus Analysis Overview

- Three example studies:
- Chord transitions in Western classical music
 - Tonal complexity in Western classical music
 - Tonal complexity in jazz solos

Tonal Complexity

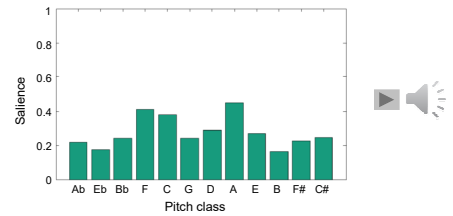
- Global chroma statistics (audio)
- 1783 – W. A. Mozart, „Linz“ symphony KV 425, 1. Adagio / Allegro



Circle of fifths →

Tonal Complexity

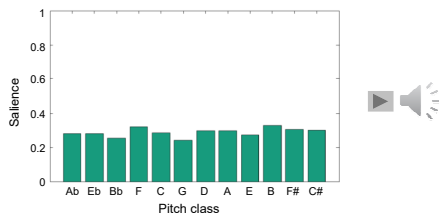
- Global chroma statistics (audio)
- 1883 – J. Brahms, Symphony No. 3, 1. Allegro con brio (F major)



Circle of fifths →

Tonal Complexity

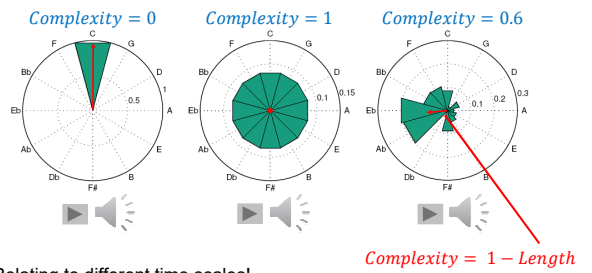
- Global chroma statistics (audio)
- 1940 – A. Webern, Variations for Orchestra op. 30



Circle of fifths →

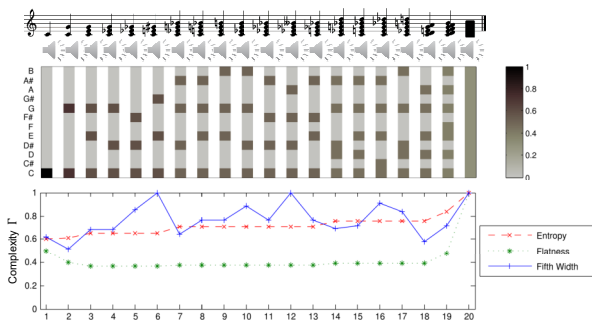
Tonal Complexity

- Realization of complexity measure Γ
- Distribution over Circle of Fifths



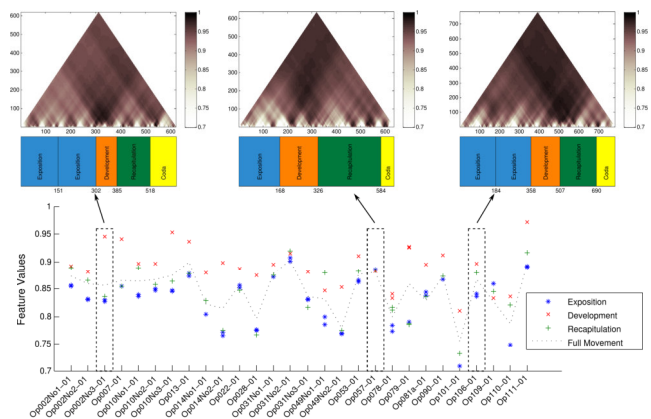
- Relating to different time scales!

Tonal Complexity – Chords



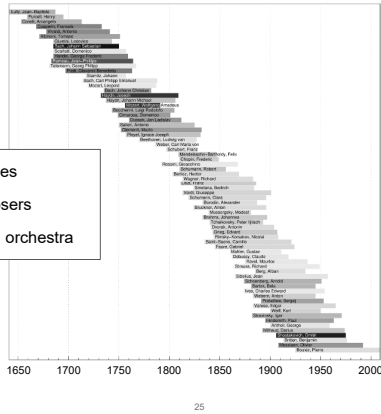
[5] Weiss / Müller, Quantifying and Visualizing Tonal Complexity, Proc. Conference on Interdisciplinary Musicology 2014

Tonal Complexity – Beethoven's Sonatas



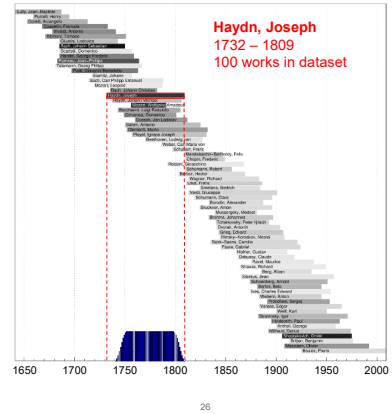
Analyzing Composer Styles

- 2000 pieces
- 70 composers
- piano and orchestra

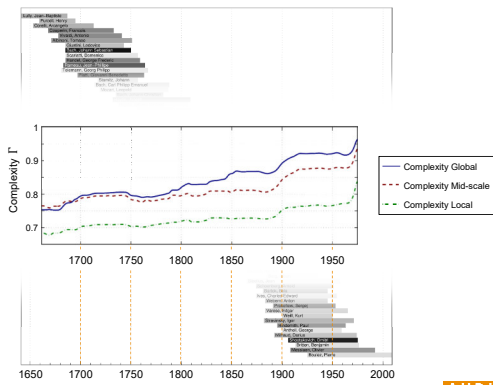


Analyzing Composer Styles

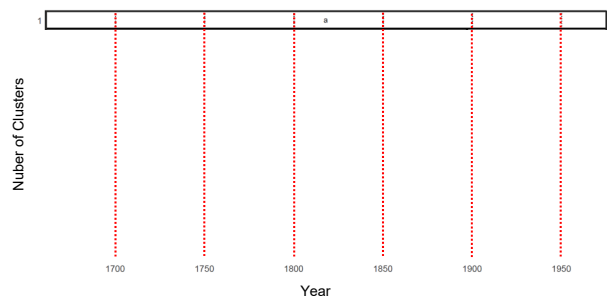
Haydn, Joseph
1732 – 1809
100 works in dataset



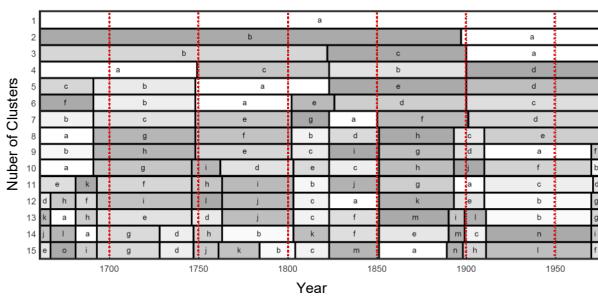
Analyzing Composer Styles



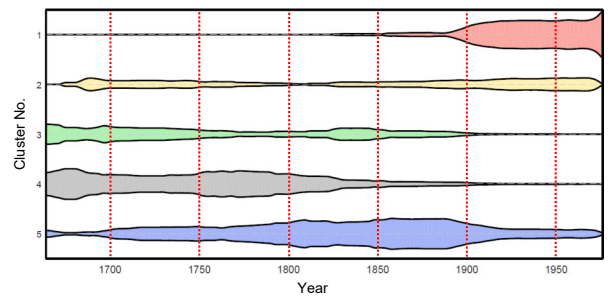
Clustering Composition Years



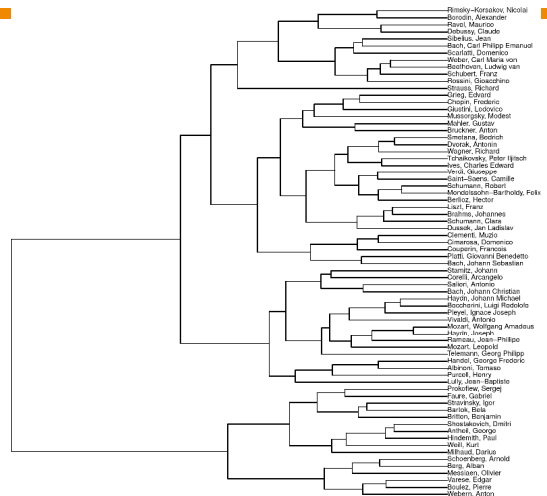
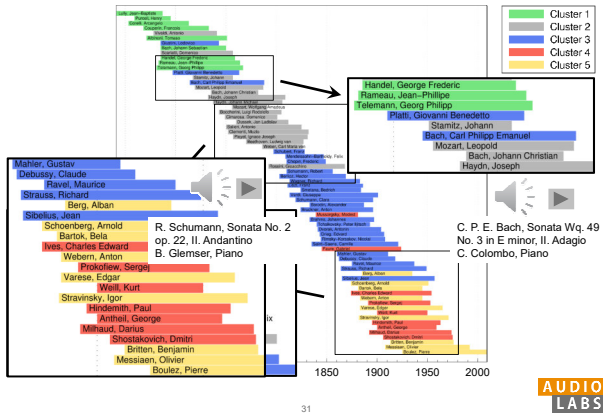
Clustering Composition Years



Clustering Individual Pieces



Clustering Composers



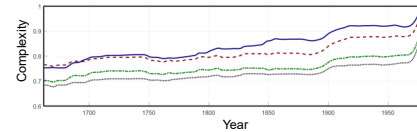
Corpus Analysis Overview

Three example studies:

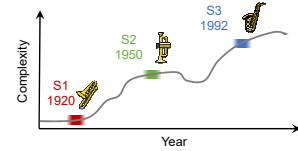
- Chord transitions in Western classical music
- Tonal complexity in Western classical music
- Tonal complexity in jazz solos

Tonal Complexity: Jazz Solos

- Motivation: Corpus study on Western classical music
- „Evolution curves“ – tonal complexity over 300 years:



- What about jazz?



- Example: John Coltrane, Solo in *Giant Steps*

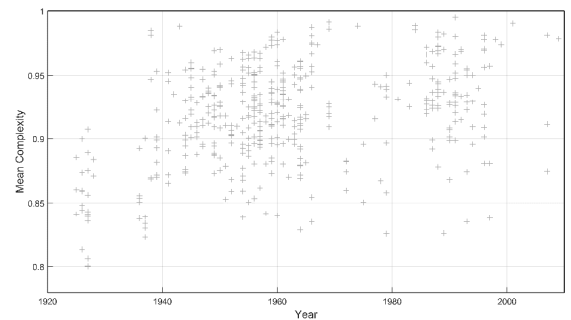
Music Scenario: Weimar Jazz Database (WJD)

- Jazz corpus comprising 456 jazz soli
- Used for our study:
 - High quality **symbolic** transcriptions of **solo melody**
 - Audio** recordings of solo parts
- Corpus analysis :
 - Evolution** of tonal complexity?



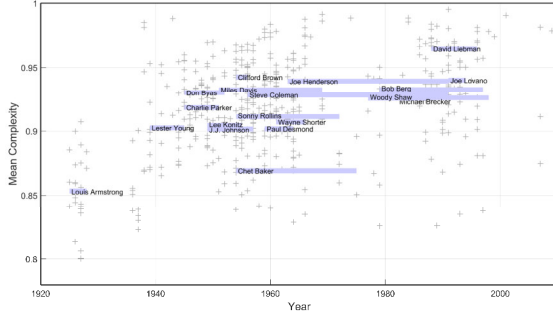
Tonal Complexity: Jazz Solos

- Compute tonal complexity from audio recordings
- Individual solos over recording year



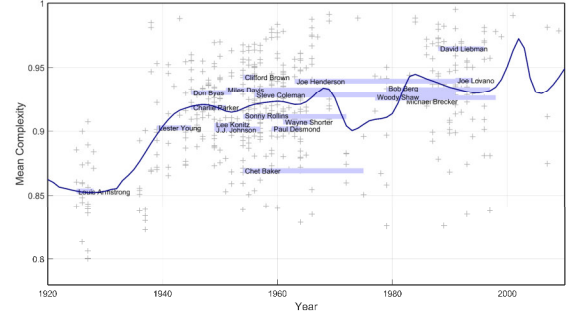
Tonal Complexity: Jazz Solos

- Compute tonal complexity from audio recordings
- Add **mean complexity** for 20 most frequent soloists



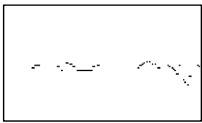
Tonal Complexity: Jazz Solos

- Compute tonal complexity from audio recordings
- Add **evolution curve** for all solos



Music Scenario: Weimar Jazz Database (WJD)

- Jazz corpus comprising 456 jazz soli
 - High quality **symbolic** transcriptions of **solo melody**
 - Audio** recordings of solo parts
- Influence of **music representation**?

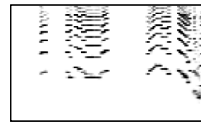


Solo F0 Overtones Percussive part Accompaniment

a) Symbolic transcription	✓	✗	✗	✗	🔊
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Solo F0 Overtones Percussive part Accompaniment

a) Symbolic transcription	✓	✗	✗	✗	🔊
b) Audio source separated melody	✓	✓	✓	✗	🔊

Music Scenario: Weimar Jazz Database (WJD)

- Jazz corpus comprising 456 jazz soli
 - High quality **symbolic** transcriptions of **solo melody**
 - Audio** recordings of solo parts
- Influence of **music representation**?



Solo F0 Overtones Percussive part Accompaniment

a) Symbolic transcription	✓	✗	✗	✗	🔊
b) Audio source separated melody	✓	✓	✓	✗	🔊
c) Audio harmonic component	✓	✓	✗	✓	🔊

Music Scenario: Weimar Jazz Database (WJD)

- Jazz corpus comprising 456 jazz soli
 - High quality **symbolic** transcriptions of **solo melody**
 - Audio** recordings of solo parts
- Influence of **music representation**?

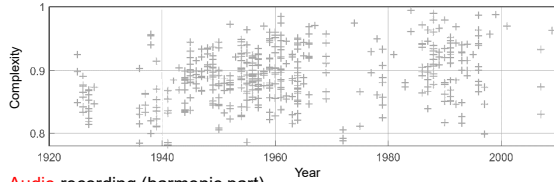


Solo F0 Overtones Percussive part Accompaniment

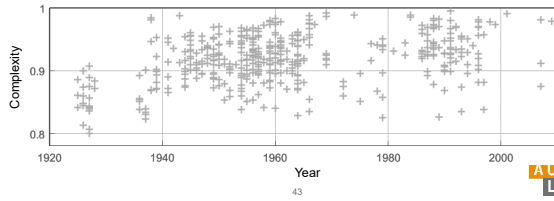
a) Symbolic transcription	✓	✗	✗	✗	🔊
b) Audio source separated melody	✓	✓	✓	✗	🔊
c) Audio harmonic component	✓	✓	✗	✓	🔊
d) Audio full mix	✓	✓	✓	✓	🔊

Tonal Complexity: Jazz Solos

- Symbolic transcription

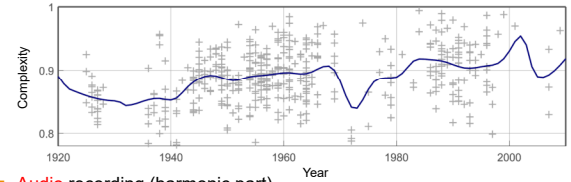


- Audio recording (harmonic part)

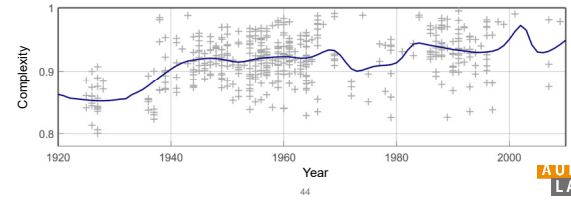


Tonal Complexity: Jazz Solos

- Symbolic transcription

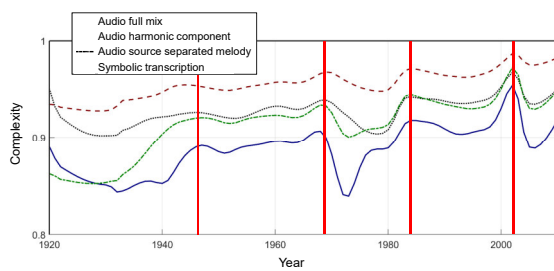


- Audio recording (harmonic part)



Corpus Analysis: Music Representations

- Compare all four representation types:



- Evolution curves have different ranges, but same general trends
- Corpus analysis can also be performed on audio recordings