A Feature History of Jazz Solos

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Introduction

• Idea: Tracing temporal developments in jazz improvisations using computational and statistical methods.

• Is there an alternative or complementary view on jazz history, beyond the subject?

• Goals:
  – Uncover hidden, previously unknown traits and trends.
  – Challenge common knowledge.
  – Confirm what is already known.
**Related Work**

Background
Central Aims

1. Devising a database of high-quality monophonic jazz solo transcriptions (Weimar Jazz Database, currently 456 solos).
2. Development of analysis tools (MeloSpySuite, MeloSpyGUI):
   • Feature extraction & visualisation,
   • Pattern search & mining,
   • Data import & export.
3. Research ...

Website: http://jazzomat.hfm-weimar.de/

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„Melodisch-rhythmische Gestaltung von Jazzimprovisationen. Rechnerbasierte Musikanalyse einstimmiger Jazzsoli“
Jazzomat Research Project

Research areas & applications:

1. Jazz research, jazz history, stylometry.
2. Psychology of creative processes.
3. Computational & statistical musicology, Music Information Retrieval (MIR).

Team: Prof. Dr. Martin Pfleiderer, Dr.-Ing. Jakob Abeßer, Dr. Klaus Frieler, Wolf-Georg Zaddach, MA, Benjamin Burkhart, MA, Friederike Bartel, BA.

TRANSCRIPTIONS: SONIC VISUALISER
Weimar Jazz Database

- Performance-based transcriptions with annotations.
- Basic model: Event lists of onset, pitch, duration, & annotations
  \[ e_n = (t_n, p_n, d_n, a_n). \]
- Annotations \( a_n \):
  - Metadata (manual)
  - Harmonic context (manual)
  - Beats (manual)
  - Metrical context (semi-automatic)
  - Phrases (manual)
  - Midlevel-units (manual)
  - Frequency modulations (manual)
  - Intensities (automatic)
Weimar Jazz Database

- 456 solos from 78 performers.
- 200,809 tone events.
- Top: Coltrane (20), Davis (19), Parker (17), Rollins (13), Liebman (11), Brecker (10), Shorter (10), S. Coleman (10).
- Styles: Traditional (32), swing (66), bebop (56), cool (54), hardbop (76), postbop (147), free (5 = Ornette Coleman).
- Instruments: ts (158), tp (101), as (80), tb (26), ss (23), other (68).
- Time range: 1925 – 2009
Distribution of solos by year

Bigband Gap

Golden Era

Fusion Gap
Solos were selected to cover a broad range of jazz styles.
Clear focus on American jazz.
Number of solos by performer represents “importance” but also preferences of the curators.
Holes in the temporal distribution.
All of the following depends crucially on the “representativeness” of the data.
Representativeness is a ill-defined concept with many possible solutions (“representative of SOMETHING”).
Solos not specifically selected for the following analysis.
MeloSpyGUI

• Tools for symbolic, monophonic data melodies.
  – Import/export/conversion (melconv)
  – Feature extraction (melfeature)
  – Pattern search and partition (melpat)
• Bundled with Weimar Jazz Database and a version of the Essen Folk Song Collection.
• MeloSpySuite: Extended options and batch processing.
• Free download and documentation:
  http://jazzomat.hfm-weimar.de/download
  Ad Block: JazzTube coming soon!
Method
Method

• For each solo in the WJD, about 150 (single number) features from different dimensions were extracted:
  – Rhythm,
  – interval,
  – pitch,
  – midlevel units,
  – tone formation (“Tonbildung”),
  – recording year.
Method

- All features tested for correlations with recording year (Spearman’s rank correlation).
- Linear regression fits for visualization.
- Selected features with correlation > .25.
- Due to redundancies, not all significant features reported here.
RESULTS
General Trends

Solos became longer ($\rho = 0.534$, $p < .001$)
Rhythm

• Duration were categorized based on two different references:
  – rel: Duration of annotated beat.
  – abs: Duration of “standard beat”, 500 ms (120 bpm).

• Five classes: Very Short, Short, Medium, Long, Very Long (~16th, 8th, quarter, half, whole note)
Rhythms become more uniform ($\rho = -0.304, p < .001$)
Rhythm

Fast notes on the run ($\rho = 0.266$, $p < .001$)
Pitch & Interval

- Pitch was measured in raw MIDI pitch, pitch intervals, and extended chordal diatonic pitch class.
- MIDI pitch: Numbers from 0-127, middle C = 60
- Pitch intervals: Difference between consecutive pitches.
- Extended chordal diatonic pitch class:
  - Dependent on chordal context
  - 1-7: Diatonic scale (minor or major)
  - Specials, e.g. B = minor third over major chord, T = #11, L = maj 7 over chord with minor 7th
Pitch: Ambitus

Expanding ranges ($\rho = 0.596, p < .001$)
Pitch: Variability

Tonally more flexible and complex ($\rho = 0.563$, $p < .001$)
Pitch: Chordal Fifths

Fifths on the decline ($\rho = -0.389$, $p < .001$)
Pitch: Tonal Trends

Getting tonally more complex over time.
Interval: Maximal Size

Wider intervals ($\rho = 0.347$, $p < .001$)
More diverse interval combinations ($\rho = 0.433, p < .001$)
Tone Formation

• Three aspects:
  – Articulation,
  – F0-modulation,
  – Intensities.

• Tone characteristics except articulation measured by transcription-informed source separation.

• Articulation: Ratio of duration to inter-onset interval.
TONE: STABILITY

Tones become more stable ($\rho = -0.276, p < .001$)
Tone: Articulation

Articulation becomes more diverse ($\rho = 0.51$, $p < .001$)
Tone: Intonation

Intonation becomes more “precise” ($\rho = -0.159$, $p = .001$)
Midlevel Analysis (MLA)

- Qualitative annotation with “playing ideas” (Frieler et al., 2016).
- 9 main types of midlevel units (MLU): line, lick, melody, rhythm, expressive, theme, quote, fragment, void
MLA: TRENDS

Getting more expressive and fluid over time.
Discussion
Summary

• Solos became longer.
• Rhythms became more uniform.
• Fast notes on the run.
• Expanding ambitus.
• Increasing exhaustion of pitch space.
• Fifths on the decline.
• Tonally more complex over time.

• Wider intervals.
• More diverse interval combinations.
• Tones become more stable.
• Articulation becomes more diverse.
• Intonation becomes more “precise”.
• More expressive and fluid over time.
Summary of Summary

• General trends to higher
  – complexity,
  – virtuosity,
  – expressivity.
• Possibility spaces are explored and used.
• Growing technical “sophistication” due to academization of jazz?
• Similar developments in classical music, but also in pop music: “Natural” evolution of (Western) music styles?
Outlook

- More detailed picture with more data.
- Subclass differentiation.
- Balanced and more representative sample.
- More and refined features (if that’s possible).
- Identification of change points (disruptive developments) and distinct stylistic phases.
- Pattern archeology (“Dig That Lick Project”).
- Combination with other sources of data (e.g., social networks).
Thanks!