What’s a word in harmony?

Can Statistical Language Models be used for the Analysis of Harmonic Progressions?
What’s this about?

› Find a symbolic harmony feature whose type sparseness resembles that of types in natural language.

› Results Sneak Preview

› Single chords don’t do the job.

› Longer chord sequences resemble words in language more closely.

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... - sparseness in the language sense: most words (types) appear very rarely
Motivation: Music IR

example 1:
“find similar song given chord transcriptions” (Query By Example)

latent semantic analysis

example 2:
“extract chords from complex audio”

Chords sequential (like words)

HMM with chords as states

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here are two examples which illustrate what we think the new knowledge can be used for ...
example 3:

“extract chords from complex audio”

- Chords sequential (like words)
- NLP methods work so well ...
- HMM with chords as states
example 3:

“extract chords from complex audio”

Chords sequential (like words)

NLP methods work so well...

HMM with chords as states

Alternative to chord as basic unit?
- Community Corpus: (1) chord “lead sheets” shared by users of the commercial software “Band in a Box”, (2) checked by relistening via the program.
- Automatic Corpus: (1) chords automatically extracted from MIDI.
**Choice of harmonic feature**

- compare word distribution to **chord sequence** distribution
- 8 kinds of chord sequences

- from the chord data we construct 8 different kinds of harmonic feature:
  - chord sequences
  - different lengths (ranging from a single chord to sequences of ...)
  - another parameter is: consider harmonic rhythm or not (by considering duration info or not)

- Let me quickly show you some examples for such chord sequence types ....
- chord sequences overlap
- explain for example setting “without duration information”, “chord sequence length 3”
- representation as chords with relative root distances in semitones
- sequences obtained by a sliding window
- benefit: key-independent, would be the same in a different key
Sequence extraction example

with duration information

without duration information

chord change

chord sequence length 3

chord sequence length 4

C  Dm  Bb  C  F  C

maj  →  min  →  maj  →  maj  →  maj  →  maj

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Sequence extraction example

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what we base our comparison on is the Frequency Spectrum:
- this one: text corpus example
- “most words appear only once (frequency class $V_{m}$)"
- smooth shape, can be modeled by a parametric model (next slide)
The frequency spectrum from a corpus can be modelled by so-called finite Zipf-Mandelbrot model of the frequency spectrum.

\[ g(\pi) = \begin{cases} 
    C \cdot \pi^{-\alpha} & A \leq \pi \leq B \\
    0 & \text{otherwise}
\end{cases} \]

\( g(\pi) \) is a normalising factor.

- following a power law
- wondering: if we did the same for chord sequences...

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Best-fitting Harmonic Elements

- settings closest to text corpus
- length 3 (metric duration)
- length 4 (no duration)

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Chord Sequence Distribution

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– one of the “winning” chord sequence configurations: “duration information”, “chord sequence length 3”
Interpretation of Results

- Single chords don’t do the job.
- Longer chord sequences resemble words in language more closely.
- Even more so if considering durations.

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Future Work

- different harmonic elements
- root progression
- degree (with respect to key)
- variable length chord progressions (determine using collocation measure)
- different language elements
- letter sequences
- other languages? Chinese?

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Thanks

... looking forward to your suggestions!

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