Analysing Musical Pieces Using harmony-analyser.org Tools

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DATESO 2017, Rančířov, Czech Republic

Music Information Retrieval

MIR / Audio Conferences and Journals

- ISMIR (Int. Society for Music Information Retrieval)
- CMMR (Int. Symposium on Computer Music Interdisciplinary Research) Springer
- MCM (Mathematics and Computation in Music) Springer
- SMC (Sound and Music Computing)
- DAFx (Int. Conference on Digital Audio Effects) B
- WASPAA (Workshop on Applications of Signal Proc. to Audio and Acoustics) IEEE
- ICASSP (Int. Conf. on Acoustics, Speech and Signal Processing) IEEE B
- WOCMAT (Int. Workshop on Computer Music and Audio Technology)
- ACMC (Australian Computer Music Conference) C
- ICMC (Int. Computer Music Conference)
- ICNMC (Int. Conf. On New Music Concepts)

- Journal of Mathematics and Music (Taylor Francis Online) IF: 0.320
- Computer Music Journal (MIT Press) IF: 0.279
- EURASIP Journal on Audio, Speech, and Music Processing Springer IF: 0.797
- Transactions on Audio, Speech and Language Processing (IEEE/ACM) IEEE acm IF: 1.225

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- ISMIR (Int. Society for Music Information Retrieval)
- CMMR (Int. Symposium on Computer Music Interdisciplinary Research) Springer
- MCM (Mathematics and Computation in Music) Springer — MATHEMATICS + MUSIC
- SMC (Sound and Music Computing)
- DAFx (Int. Conference on Digital Audio Effects) B — AUDIO
- WASPAA (Workshop on Applications of Signal Proc. to Audio and Acoustics) IEEE
- ICASSP (Int. Conf. on Acoustics, Speech and Signal Processing) IEEE B
- WOCMAT (Int. Workshop on Computer Music and Audio Technology) — COMPUTER MUSIC
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Multimedia / IR Conferences and Journals

- CBMI (Content-Based Multimedia Indexing) IEEE
- ACMMM (ACM Multimedia) A+
- ICMR (Int. Conf. on Multimedia Retrieval) B
- ECIR (Europan Conf. on Information Retrieval) Springer B
- AIRS (Asia I.R. Societies) Springer B
- SPIRE (Int. Symp. on String Processing an I.R.) Springer C
- SIGIR (Int. Conf. on Research and Dev. In I.R.) A+ B
- SIGAPP SAC / IR Track B
- ICME (Int. Conf on Multimedia and Expo) IEEE B
- ISM (Int. Symp. on Multimedia) IEEE C

- Computers in Entertainment (ACM) IF: 0.780
- Transactions on Multimedia (IEEE) IEEE IF: 2.536
- Multimedia Tools And Aplications (Springer) Springer IF: 1.331

Best MIR Universities

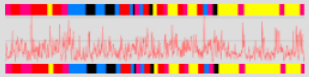
upf. Universitat Pompeu Fabra Barcelona

Queen Mary University of London

harmony-analyser.org

harmony-analyser.org | Repository | Releases | Screenshots | Documentation | Publications | Contact

harmony-analyser



harmony-analyser is a set of visual tools for music harmony analysis of WAV/MIDI input, powered by JHarmonyAnalyser library

The difference we bring is the approach based on music theory, chord and chroma distances. JHarmonyAnalyser uses recent music theory models to extract musical meaning and distances between chords and chroma vectors. We aim to develop open-source music player, which is musician / musicologist-friendly and aid recent music information retrieval tasks.

harmony-analyser tools and JHarmonyAnalyser library are licenced under the GNU GPL License.

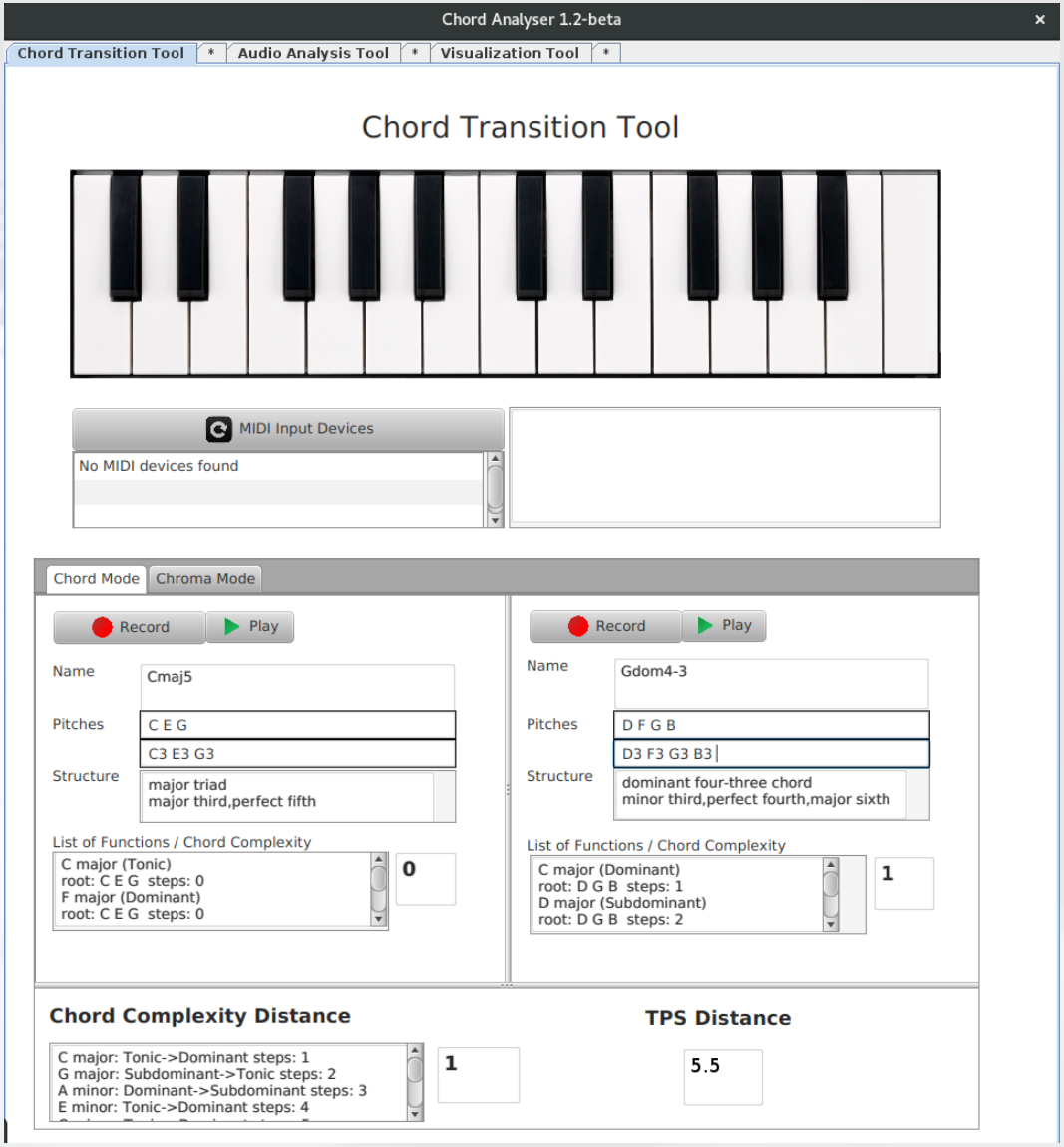
Tools are compatible with GPL Licensed Vamp plugins which can be used for additional analysis.

To contribute, please follow our guideline in GitHub repository.

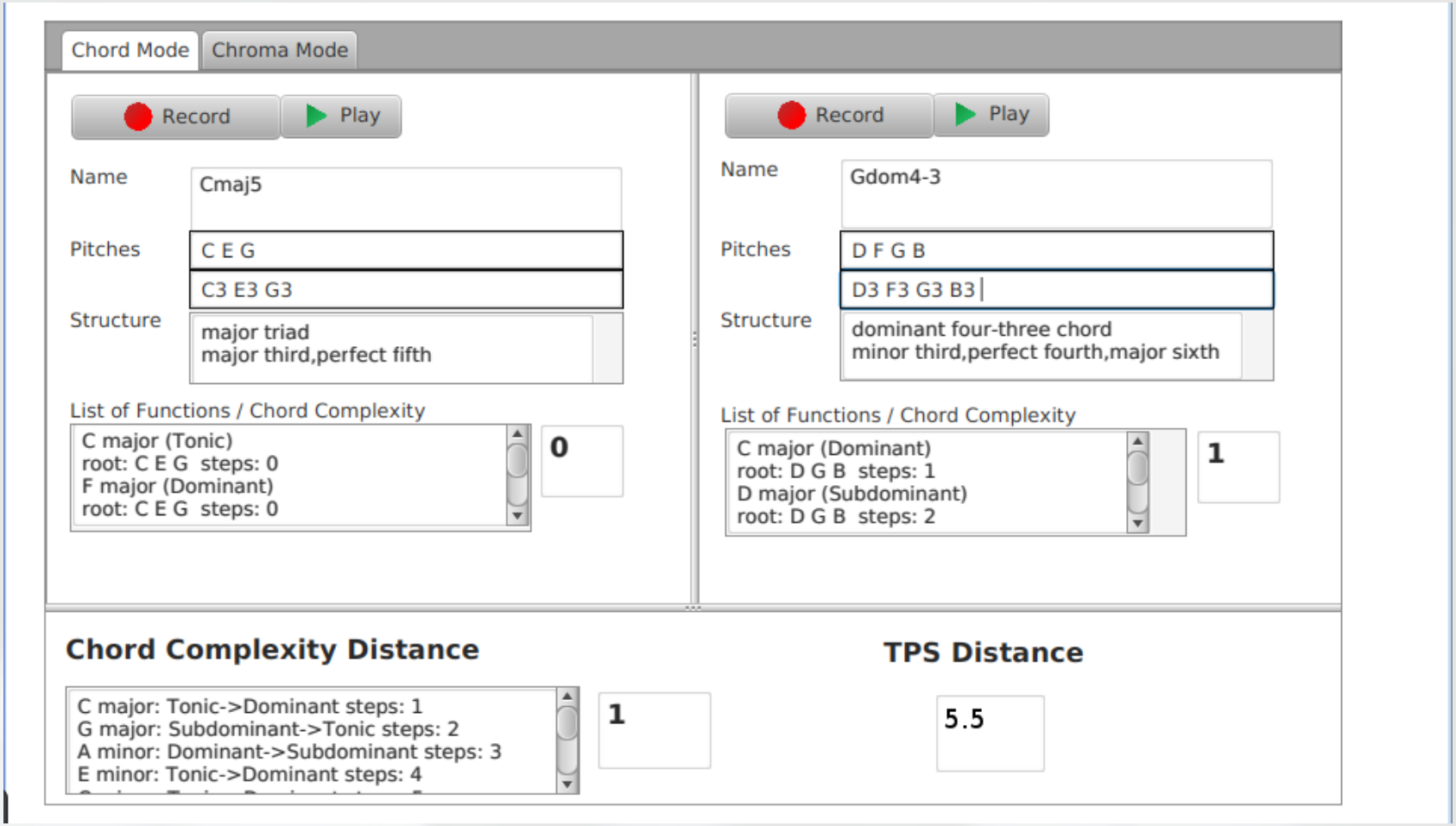
Releases

Please choose from the releases below:

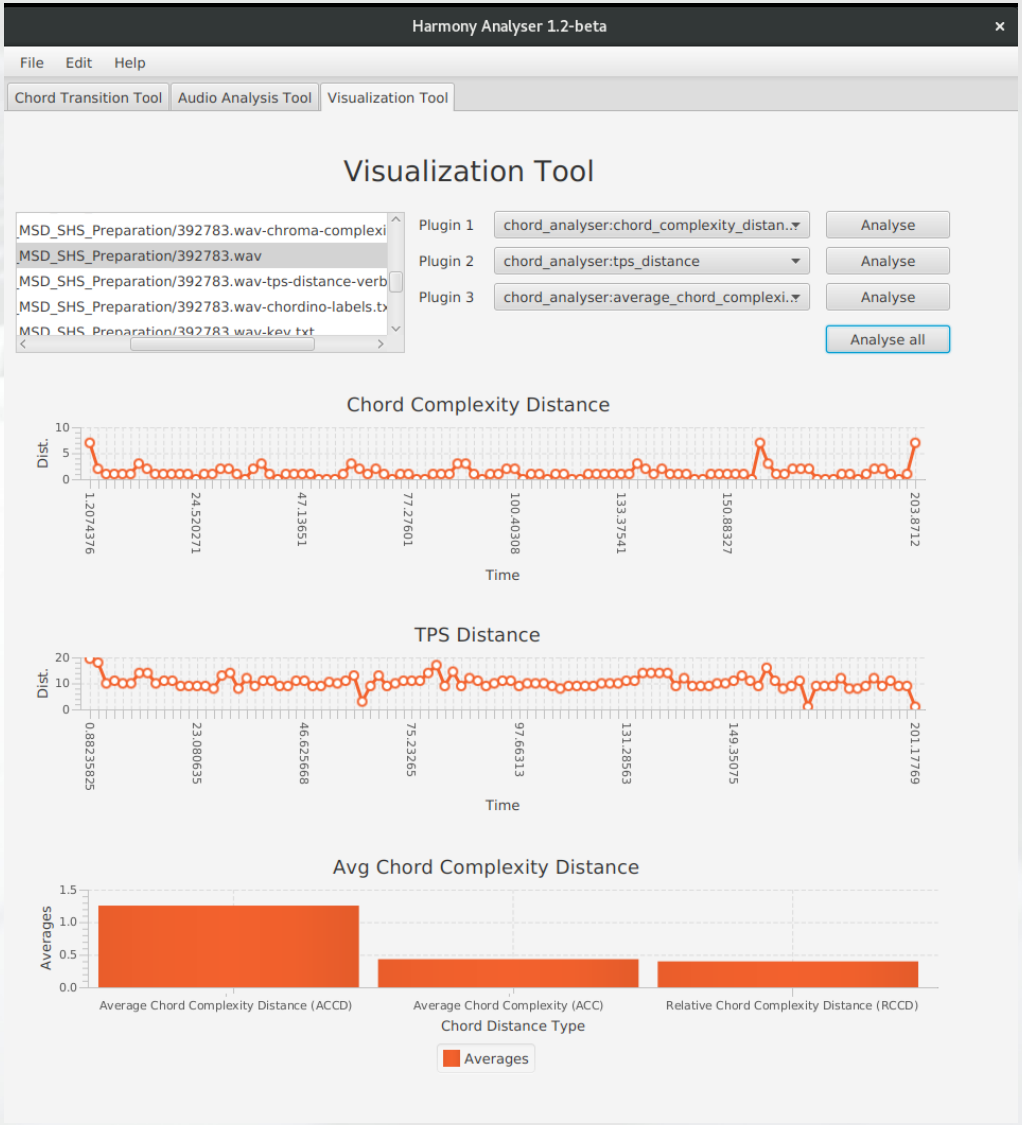
harmony-analyser.org



harmony-analyser.org



harmony-analyser.org

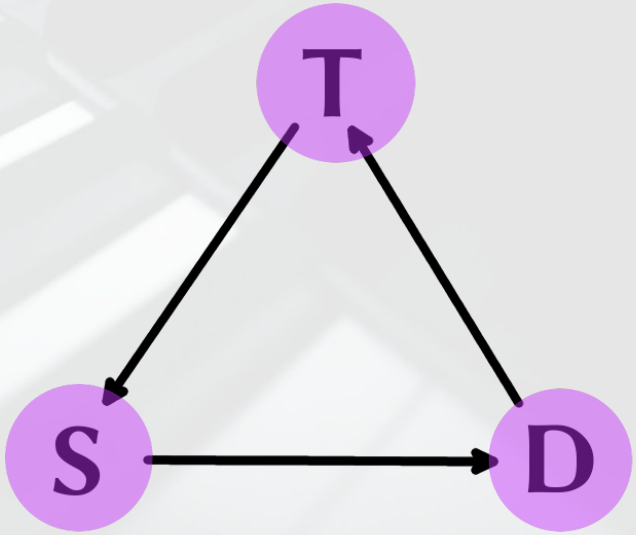


Harmony descriptor - Chord Distances

„Most important in music is its harmony.“

Ilja Zeljenka, Slovak Composer

- Tonic
- Subdominant
- Dominant

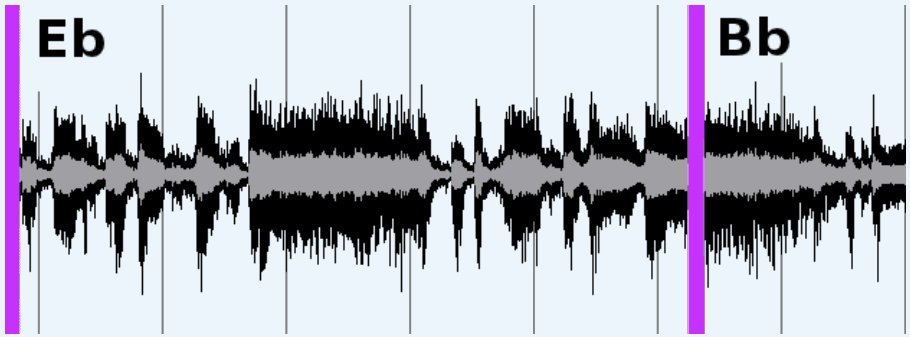


DEMO 1: Simple harmony movement

Folk song: Slovenské mamičky

Basic harmonic functions

T – D – T – D



DEMO 2: Complex harmony movement

Hiromi: 010101 (Binary System)

Modifications of basic harmonic functions

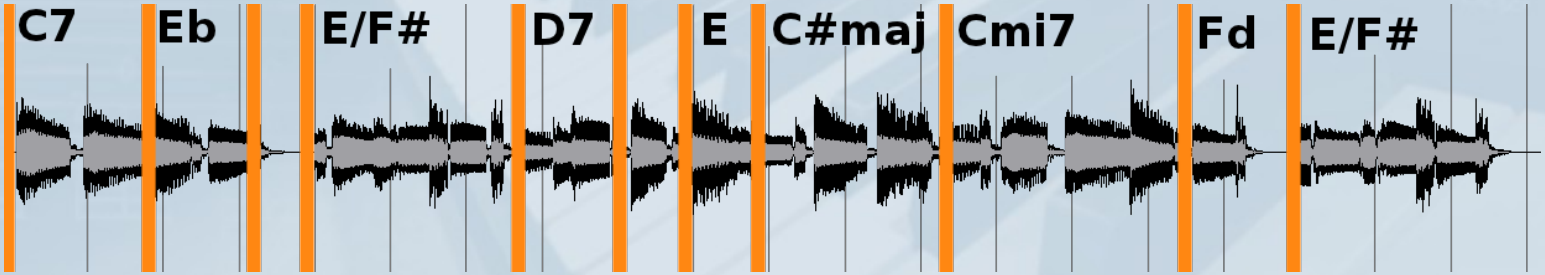
$T_7 - D_p - D_7$

$S_p - D_p - S_7$

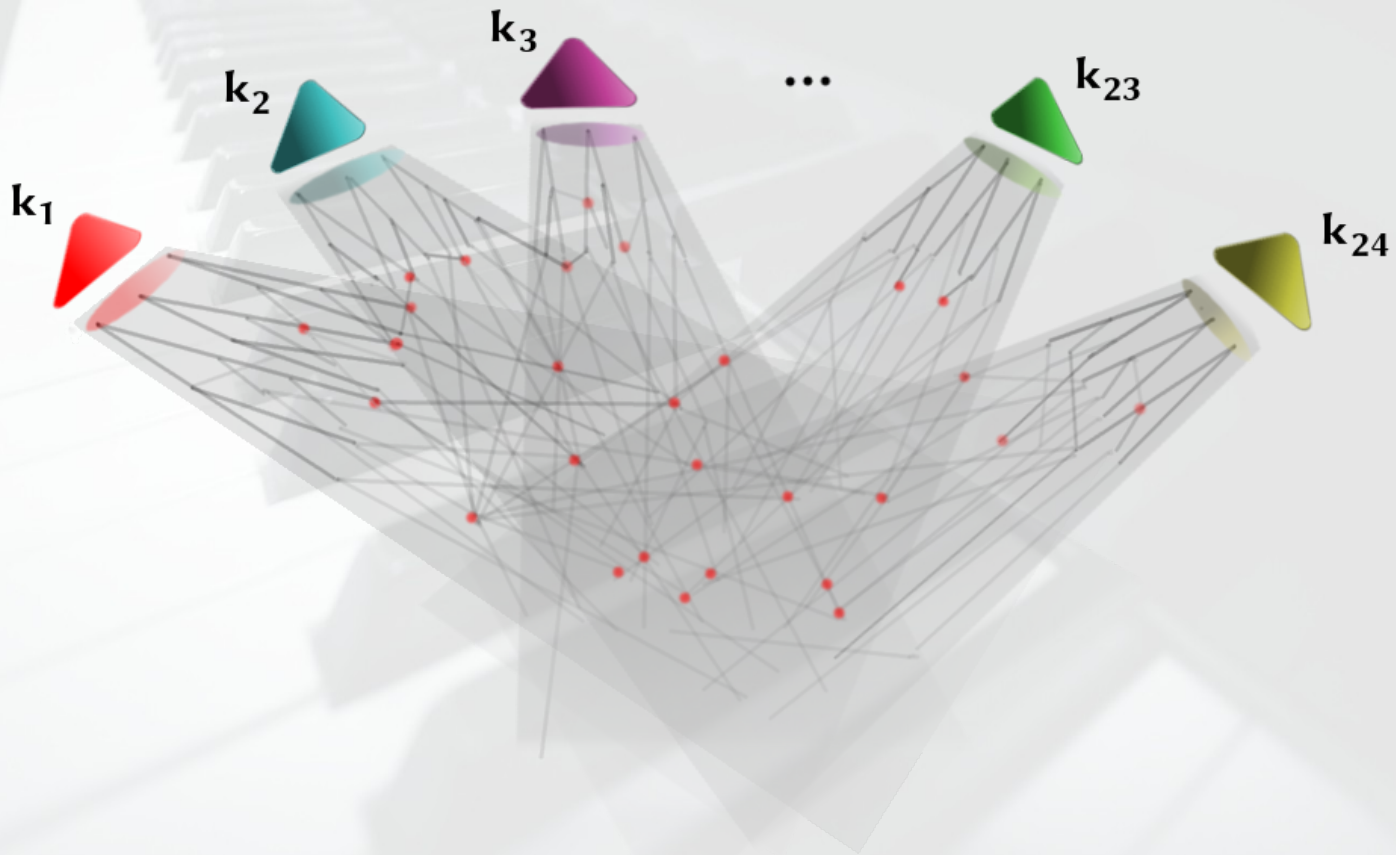
$S_p - D_{mi}$

$D_p - T_p - S_p - D_p$

$T_p - S_{dim} - D_p$



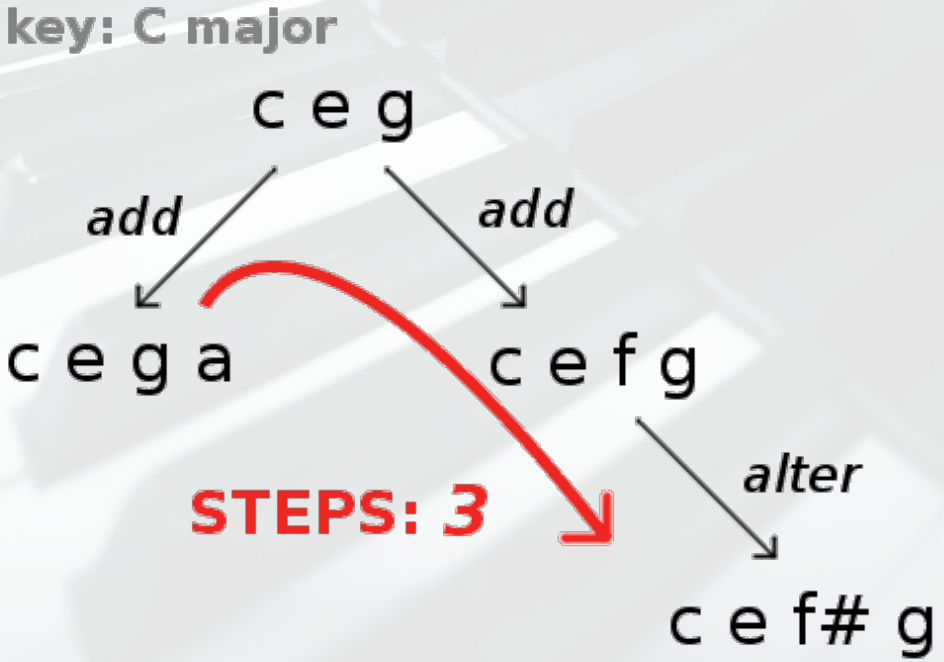
Harmony descriptor: Chord Distances



Harmony descriptor: Chord Distances

- Our novel concept: Chord Complexity Distance

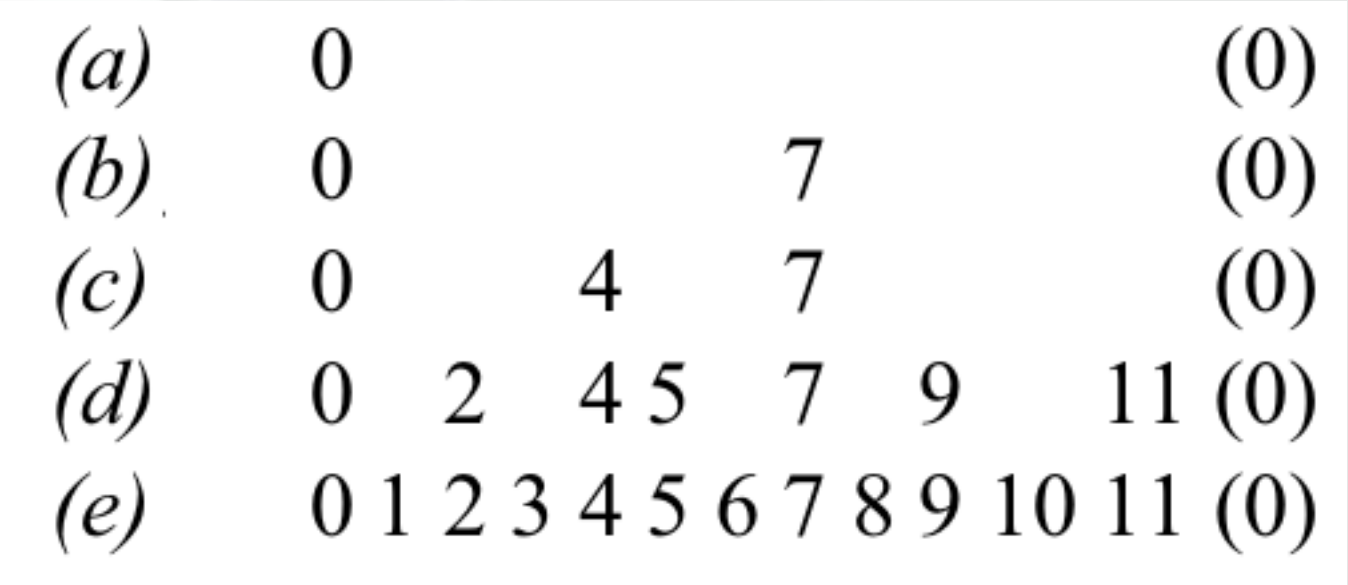
  (a variation of Edit Distance)



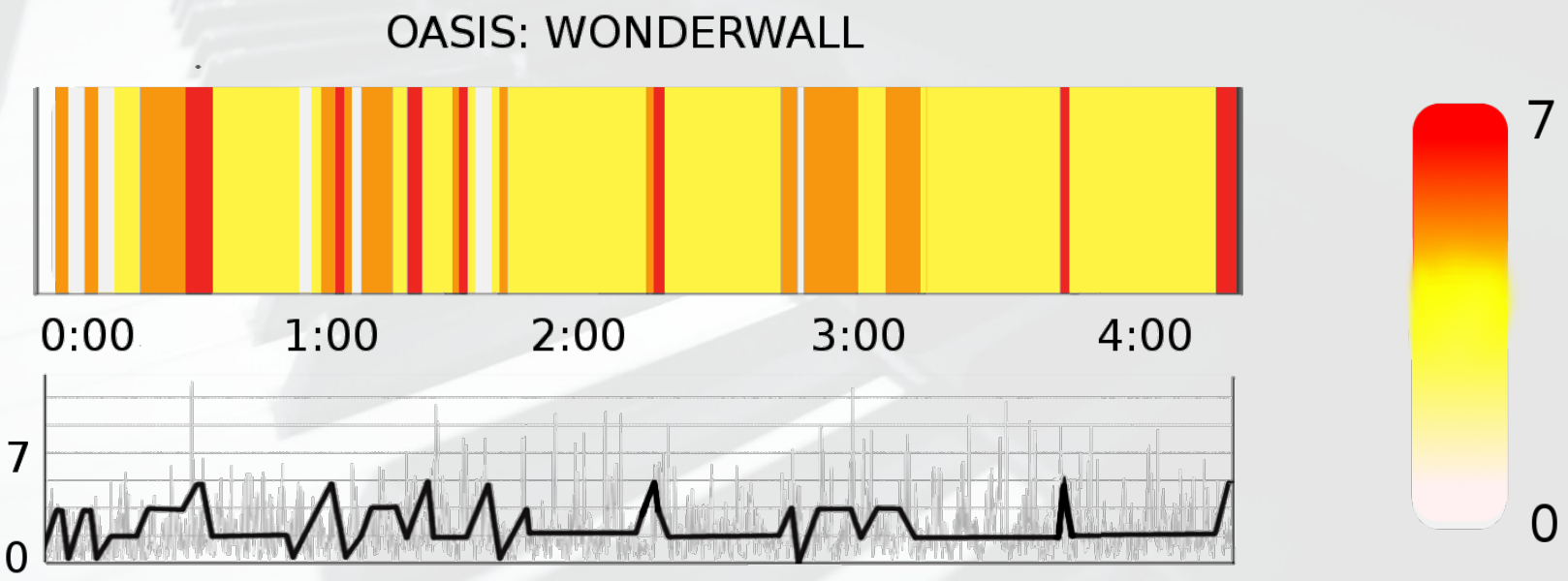
Chord Distances

- Tonal Pitch Space (Fred Lerdahl)

  TPS of C major chord in a C major key



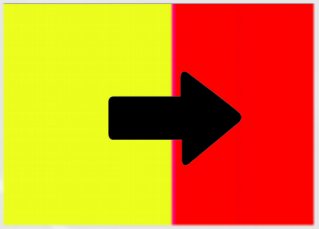
Chord Distances in a Time Series



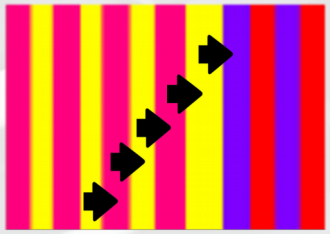
Experimental: Chroma Distances

- Idea: If chord distances work, why chroma distances shouldn‘t

Chord distance



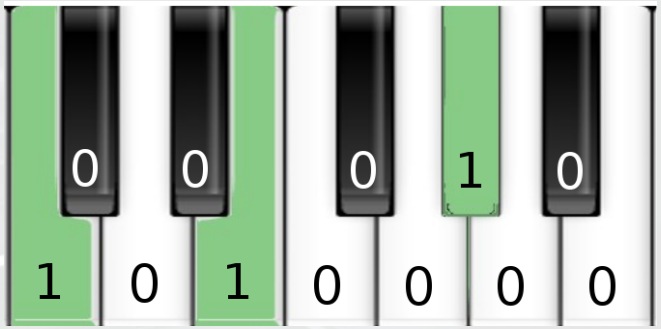
Chroma distances



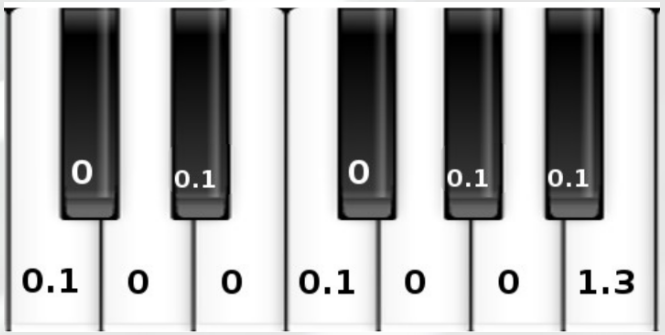
Experimental: Chroma Distances

- Idea: If chord distances work, why chroma distances shouldn‘t

Chord vector



Chroma Vector



Experimental: Chroma Distances

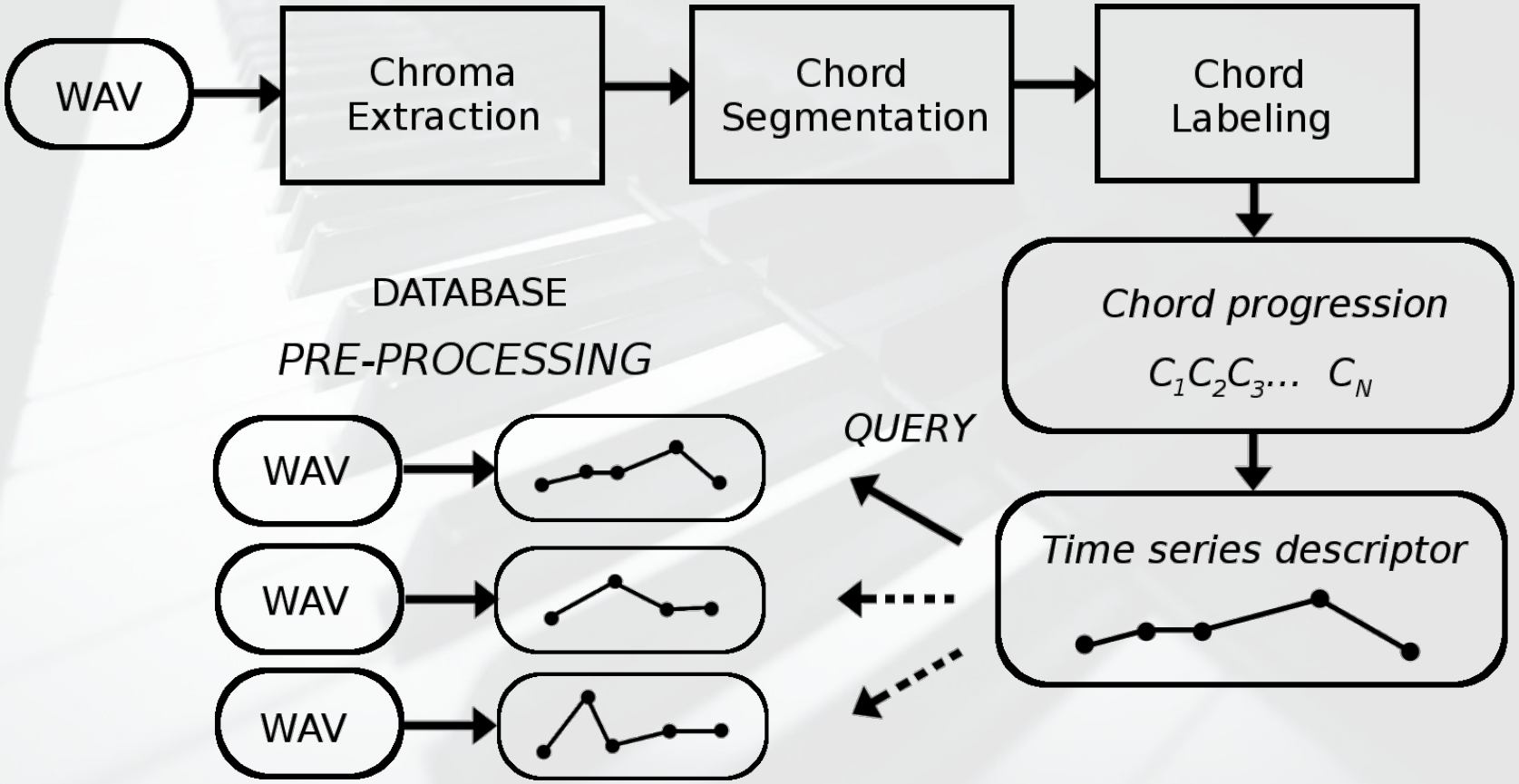
SimpleDifference sd(x,y) for chroma vectors x and y:

$$sd(x,y) = \sum_{i=1}^{12} |x_i - y_i|$$

ComplexityDifference cd(x,y) for chroma vectors x and y:

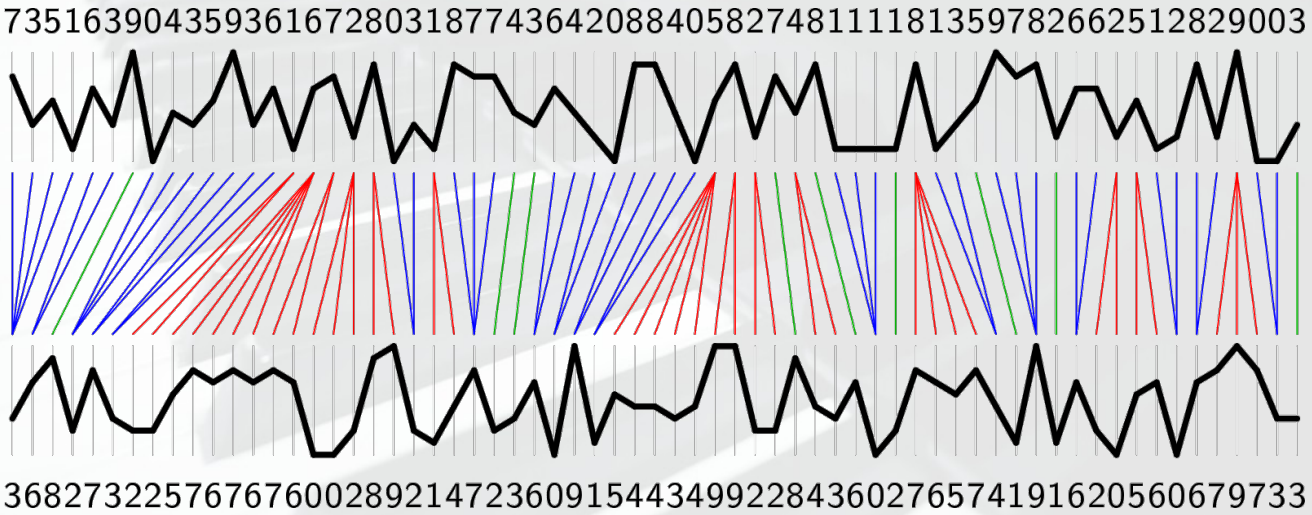
$$cd(x,y) = \sum_{i=1}^{12} |w(x)_i x_i - w(y)_i y_i|$$

Chord Distances in a Time Series



Results with our approach

- Cover Song Identification



Picture: courtesy of co-author Martin Rusek, IT4Innovations National Supercomputing centre, Ostrava

Evaluation of Chord and Chroma Distances and DTW method on Cover Song Identification, CISIM 2017

Results with our approach

Raw chroma vectors	ChromaCD	ChordCD
13.963	21.538	26.688

Comparison of mean average rank score on covers80 dataset.

Raw chroma vectors	ChromaCD	ChordCD
321.033	341.092	402.829

Comparison of mean average rank score on SecondHandSongs dataset.

Results with our approach

Raw chroma vectors	ChromaCD	ChordCD
13.963	21.538	26.688

Comparison of mean average rank score on covers80 dataset.

Raw chroma vectors	ChromaCD	ChordCD
321.033	341.092	402.829

Comparison of mean average rank score on SecondHandSongs dataset.

- ChordCD: 25ms matrix computation
- Raw Chroma: ~50s

Summary: harmony-analyser.org (JHarmonyAnalyser)

- Basic model of tones, chords, keys, …
- Feature extraction (Chroma vectors
- Implementation of chord distance models (Tonal Pitch Space, Chord Complexity, …)
- Experimental chroma distances
- Extensible plugins

Conclusion and Future work

- Proposal to use chord distances for MIR
- New Chord Complexity Distance concept
- harmony-analyser.org = Java library and ready-made tools, Open-Source project
- Results to prove that this concept has a potential to improve recent MIR tasks
  - Genre detection
  - Cover Song Identification
- … and one step towards the applications useful for musicologists
- Future work:
  - More chord distances
  - Dynamic Time Warping + chord distances

Thank you for your attention

Harmonic complexity – useful harmony descriptor

- BONUS: Demo: Ela Fitzgerald, Summertime harmony analysis (to be viewed along with music)

Harmonic complexity – useful harmony descriptor

Chord: **F A C Eb**

Complexity:

Σ: **0**

Harmonic complexity – useful harmony descriptor

Chord: **Bb Db F**

Complexity: **3**

Σ: **3**

Harmonic complexity – useful harmony descriptor

Chord: **Eb F G A**

Complexity: **4**

Σ: **7**

Harmonic complexity – useful harmony descriptor

Chord: **Bb Db F**

Complexity: **4**

Σ: **11**

Harmonic complexity – useful harmony descriptor

Chord: **Eb F G A**

Complexity: **4**

Σ: **15**

Harmonic complexity – useful harmony descriptor

Chord: **Bb Db F**

Complexity: **4**

Σ: **19**

Harmonic complexity – useful harmony descriptor

Chord: **Eb F G A**

Complexity: **4**

Σ: **23**

Harmonic complexity – useful harmony descriptor

Chord: **Bb Db F**

Complexity: **4**

Σ: **27**

Harmonic complexity – useful harmony descriptor

Chord: **Gb Bb Db E**

Complexity: **3**

Σ: **30**

Harmonic complexity – useful harmony descriptor

Chord: **F Ab B Eb**

Complexity: **4**

Σ: **34**

Harmonic complexity – useful harmony descriptor

Chord: **Bb D F Ab**

Complexity: **3**

Σ: **37**

Harmonic complexity – useful harmony descriptor

Chord: **Eb Gb Bb**

Complexity: **3**

Σ: **40**

Harmonic complexity – useful harmony descriptor

Chord: **Eb Gb B**

Complexity: **1**

Σ: **41**

Harmonic complexity – useful harmony descriptor

Chord: **Eb Gb Bb C**

Complexity: **1**

Σ: **42**

Harmonic complexity – useful harmony descriptor

Chord: **E F# G# B**

Complexity: **4**

Σ: **46**

Harmonic complexity – useful harmony descriptor

Chord: **C Eb G**

Complexity: **5**

Σ: **51**

Harmonic complexity – useful harmony descriptor

Chord: **Db F Ab C**

Complexity: **1**

Σ: **52**

Harmonic complexity – useful harmony descriptor

Chord: **C Eb Gb Bb**

Complexity: **2**

Σ: **54**

Harmonic complexity – useful harmony descriptor

Chord: **F A C Eb**

Complexity: **3**

Σ: **57**

Harmonic complexity – useful harmony descriptor

Chord: **Bb Db F**

Complexity: **3**

Σ: **60**

Harmonic complexity – useful harmony descriptor

Σ: ***60***

Transitions: **19**

Average Transition Complexity:

3.16