

Analysing Musical Pieces Using harmony-analyser.org Tools

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Music Information Retrieval

MUSICOLOGY

MUSIC INFORMATION RETRIEVAL

INFORMATICS

MUSIC THEORY

MATHEMATICS

MUSIC ACOUSTIC

PHYSICS

Music Information Retrieval

MUSIC(OLOGY)

INFORMATICS

MUSIC COGNITION

MUSIC INFORMATION RETRIEVAL

OPTICAL MUSIC (SCORE) RECOGNITION

MUSIC TECHNOLOGY

MUSIC SYNTHESIS

COMPUTER MUSIC

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MUSIC(OLOGY)

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MUSIC TECHNOLOGY

MUSIC SYNTHESIS

COMPUTER MUSIC

MIR / Musicology / Signal Processing Conferences

- 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)

MIR / Musicology / Signal Processing Conferences

- ISMIR (Int. Society for Music Information Retrieval)

ALL COMPUTER + MUSIC FIELDS

- 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) 

AUDIO

- WASPAA (Workshop on Applications of Signal Proc. to Audio and Acoustics) 

- ICASSP (Int. Conf. on Acoustics, Speech and Signal Processing)  IEEE 

- WOCMAT (Int. Workshop on Computer Music and Audio Technology)

COMPUTER MUSIC

- ACMC (Australian Computer Music Conference) 

- ICMC (Int. Computer Music Conference)

- ICNMC (Int. Conf. On New Music Concepts)

MIR / Musicology / Signal Processing Journals

- Journal of Math. and Music (Taylor Francis Online) **IF: 0.320**
- Computer Music Journal (MIT Press) **IF: 0.279**
- Journal of Interdisciplinary Music Studies (SIM)
- Journal of New Music Research (Taylor Francis Online) **IF: 0.771**
- Journal on Audio, Speech, and Music Processing (EURASIP)  Springer **IF: 0.797**
- Journal on Advances in Signal Processing (EURASIP)  Springer **IF: 0.928**
- Signal Processing (Elsevier, EURASIP) **IF: 2.063**
- The Journal of the Acoustical Society of America (ASA) **IF: 0.560**
- Transactions on Audio, Speech and Language Processing (IEEE/ACM)  **IEEE IF: 1.225**
- Transactions on Signal Processing (IEEE)  **IEEE IF: 2.624**
- Journal of the Audio Engineering Society (AES) **IF: 1.130**
- Journal of Popular Music Studies (IASPM)
- Transactions on ISMIR (ISMIR) **IF: 0.270**

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- Journal of Popular Music Studies (IASPM)
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ALL COMPUTER + MUSIC FIELDS

Multimedia / IR Conferences

- CBMI (Content-Based Multimedia Indexing)  **IEEE**
- ACMMM (ACM Multimedia)  **A+**
- ICMR (Int. Conf. on Multimedia Retrieval)  **B**
- ECIR (Europen 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+**
- SIGAPP SAC / IR Track  **B**
- ICME (Int. Conf on Multimedia and Expo)  **IEEE** **B**
- ISM (Int. Symp. on Multimedia)  **IEEE** **C**

Multimedia / IR Journals

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

Best MIR Universities

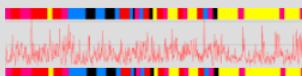


Universitat
Pompeu Fabra
Barcelona



Queen Mary
University of London

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:

Chord Analyser 1.2-beta

Chord Transition Tool



MIDI Input Devices

No MIDI devices found

Chord Mode Chroma Mode

Record Play

Name: Cmaj5

Pitches: C E G
C3 E3 G3

Structure: major triad
major third,perfect fifth

List of Functions / Chord Complexity

C major (Tonic)
root: C E G steps: 0

F major (Dominant)
root: C E G steps: 0

0

Name: Gdom4-3

Pitches: D F G B
D3 F3 G3 B3 |

Structure: dominant four-three chord
minor third,perfect fourth,major sixth

List of Functions / Chord Complexity

C major (Dominant)
root: D G B steps: 1

D major (Subdominant)
root: D G B steps: 2

1

Chord Complexity Distance

C major: Tonic->Dominant steps: 1
G major: Subdominant->Tonic steps: 2
A minor: Dominant->Subdominant steps: 3
E minor: Tonic->Dominant steps: 4

1

TPS Distance

5.5

The screenshot shows the Chord Transition Tool interface. At the top, there's a digital piano keyboard. Below it is a section for MIDI input devices, which currently shows "No MIDI devices found". The main area is divided into two columns. The left column is for "Cmaj5" and the right column is for "Gdom4-3". Each column has sections for Name, Pitches, Structure, and a List of Functions / Chord Complexity. Below these are "Chord Complexity Distance" and "TPS Distance" sections. The "Chord Complexity Distance" section for Cmaj5 shows values 0 and 1. The "TPS Distance" section shows a value of 5.5.

Chord Mode Chroma Mode

Record Play

Name	Cmaj5
Pitches	C E G C3 E3 G3
Structure	major triad major third,perfect fifth

List of Functions / Chord Complexity

C major (Tonic) root: C E G steps: 0	0
F major (Dominant) root: C E G steps: 0	0

Record Play

Name	Gdom4-3
Pitches	D F G B D3 F3 G3 B3
Structure	dominant four-three chord minor third,perfect fourth,major sixth

List of Functions / Chord Complexity

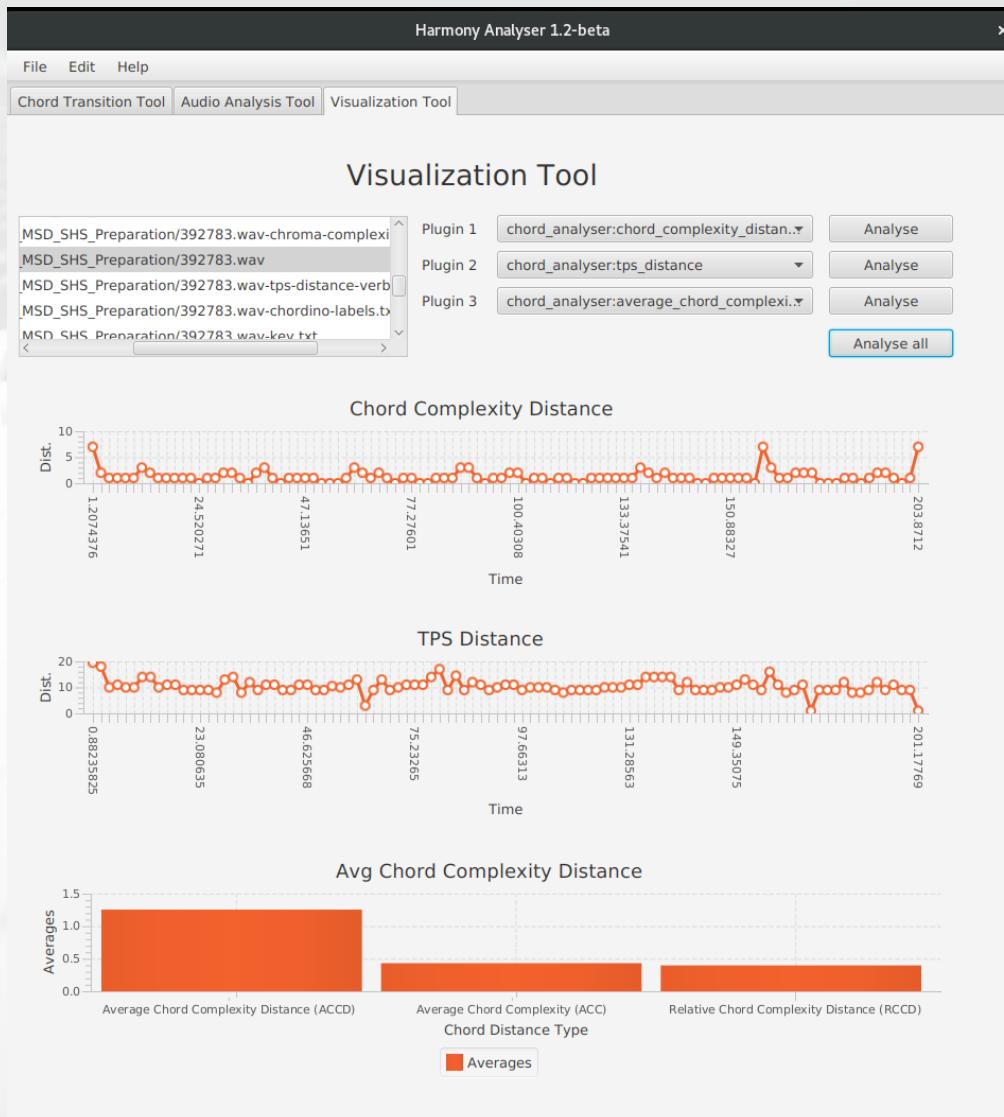
C major (Dominant) root: D G B steps: 1	1
D major (Subdominant) root: D G B steps: 2	1

Chord Complexity Distance

C major: Tonic->Dominant steps: 1 G major: Subdominant->Tonic steps: 2 A minor: Dominant->Subdominant steps: 3 E minor: Tonic->Dominant steps: 4	1
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TPS Distance

5.5

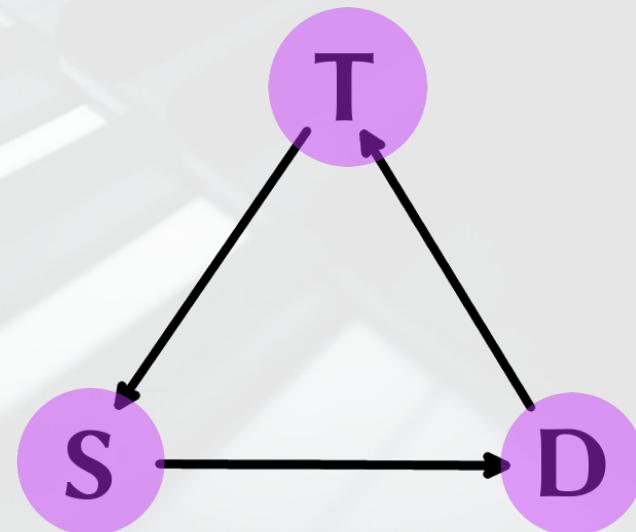


Harmony descriptor - Chord Distances

„Most important in music is its harmony.“

Ilja Zeljenka, Slovak Composer

- Tonic
- Subdominant
- Dominant



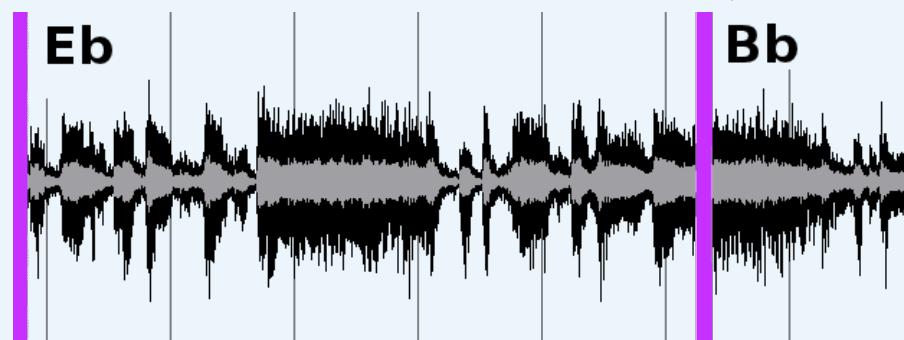
DEMO 1: Simple harmony movement

Folk song: Slovenské mamičky



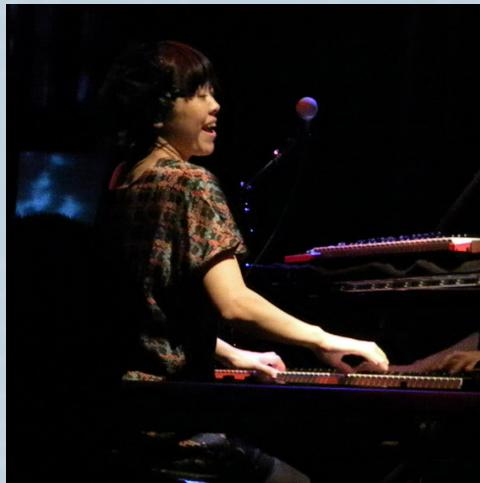
Basic harmonic functions

T – D – T – D



DEMO 2: Complex harmony movement

Hiromi: 010101 (Binary System)



Modifications of basic harmonic functions

$D_p - T_p - S_p - D_p$

$T_7 - D_p - D_7$

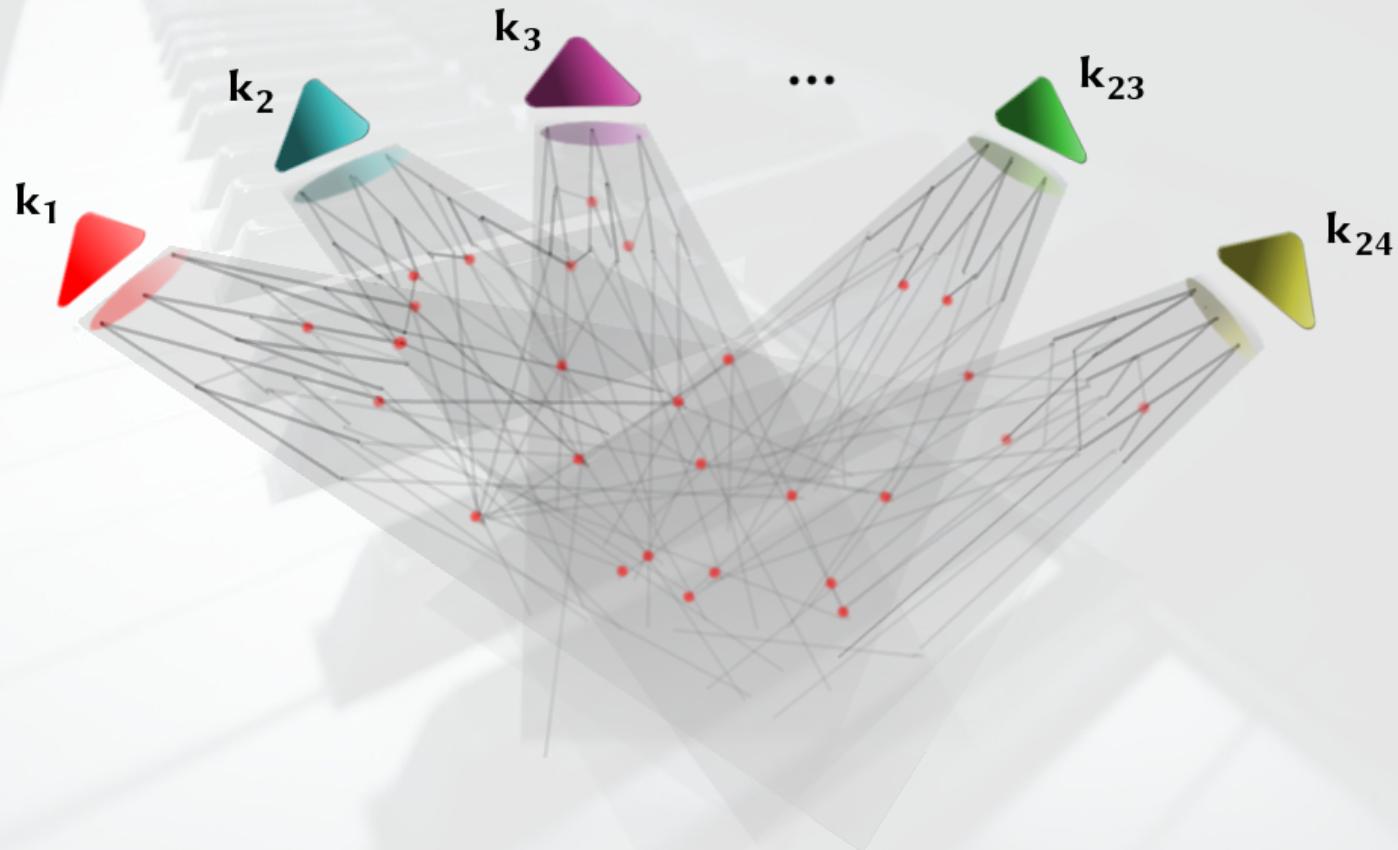
$S_p - D_{mi}$

$T_p - S_{dim} - D_p$

$S_p - D_p - S_7$

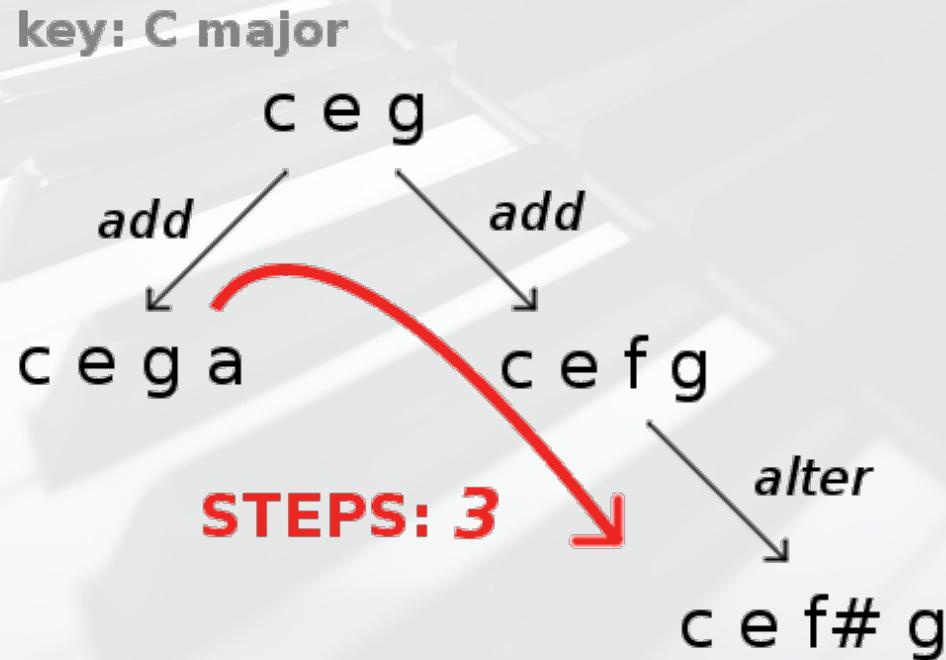


Harmony descriptor: Chord Distances



Harmony descriptor: Chord Distances

- Our novel concept: Chord Complexity Distance
(a variation of Edit Distance)



Chord Distances

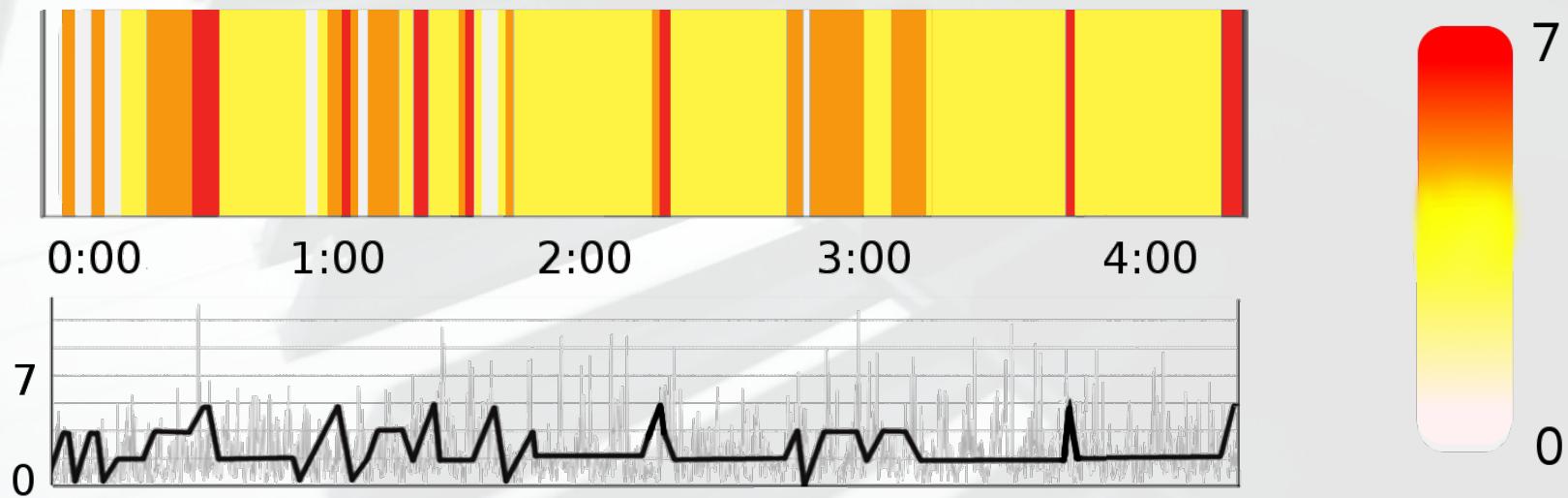
- Tonal Pitch Space (Fred Lerdahl)

TPS of C major chord in a C major key

(a)	0								(0)				
(b)	0				7				(0)				
(c)	0	4		7					(0)				
(d)	0	2	4	5	7	9	11	(0)					
(e)	0	1	2	3	4	5	6	7	8	9	10	11	(0)

Chord Distances in a Time Series

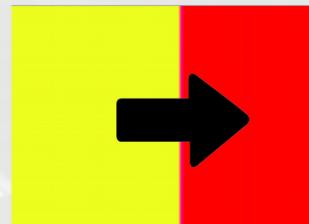
OASIS: WONDERWALL



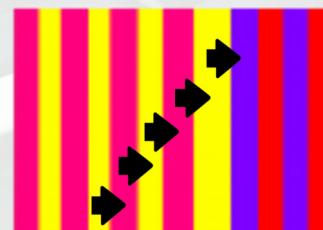
Experimental: Chroma Distances

- Idea: If chord distances work, why chroma distances shouldn't

Chord distance

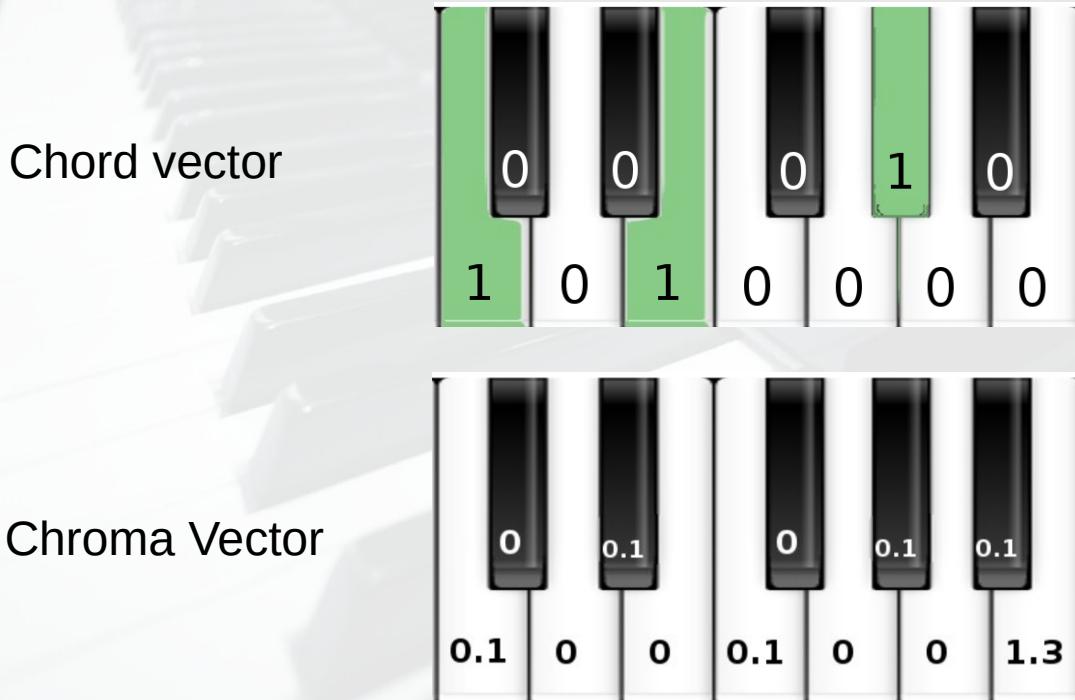


Chroma distances



Experimental: Chroma Distances

- Idea: If chord distances work, why chroma distances shouldn't



Experimental: Chroma Distances

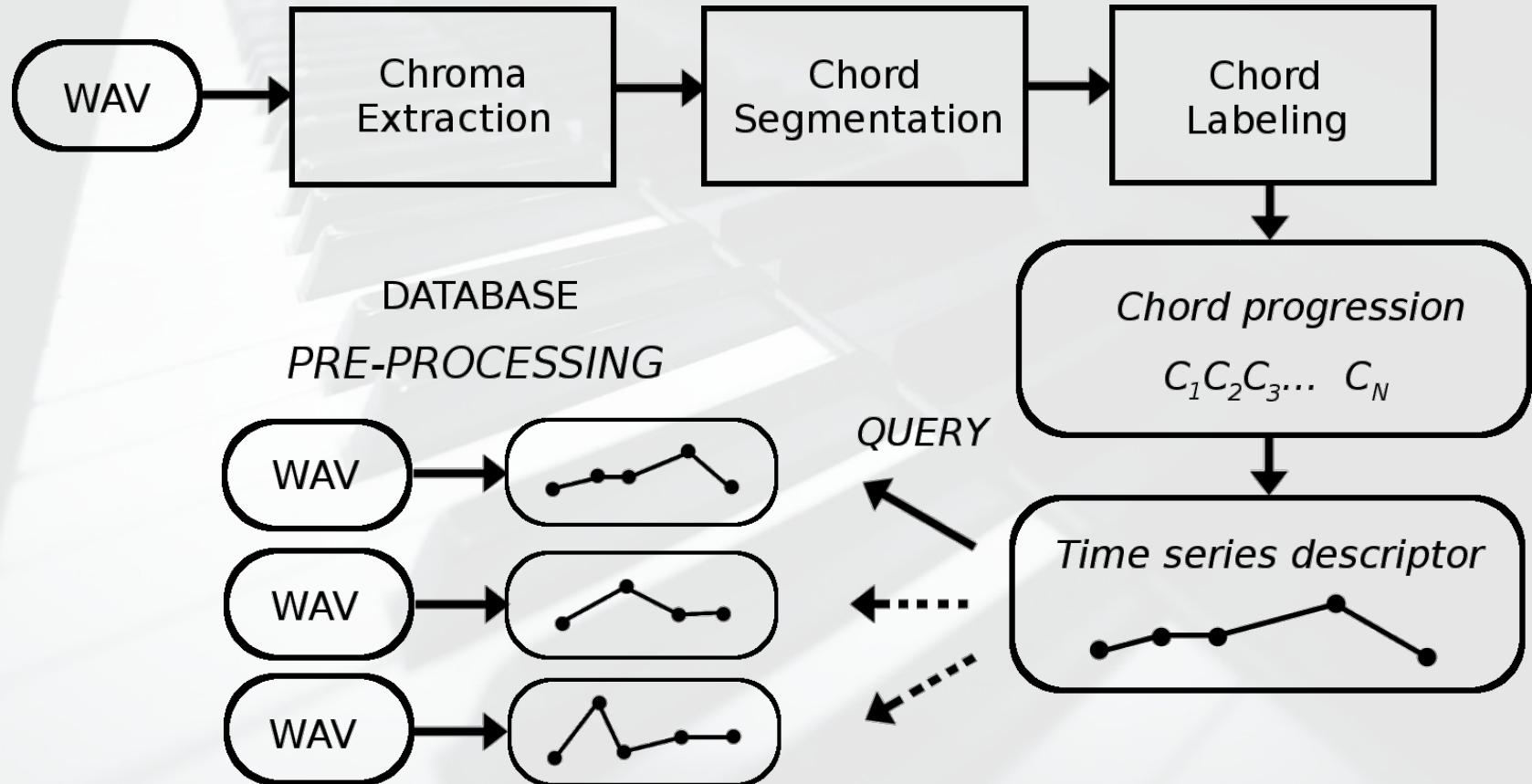
SimpleDifference $sd(x,y)$ for chroma vectors x and y :

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

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

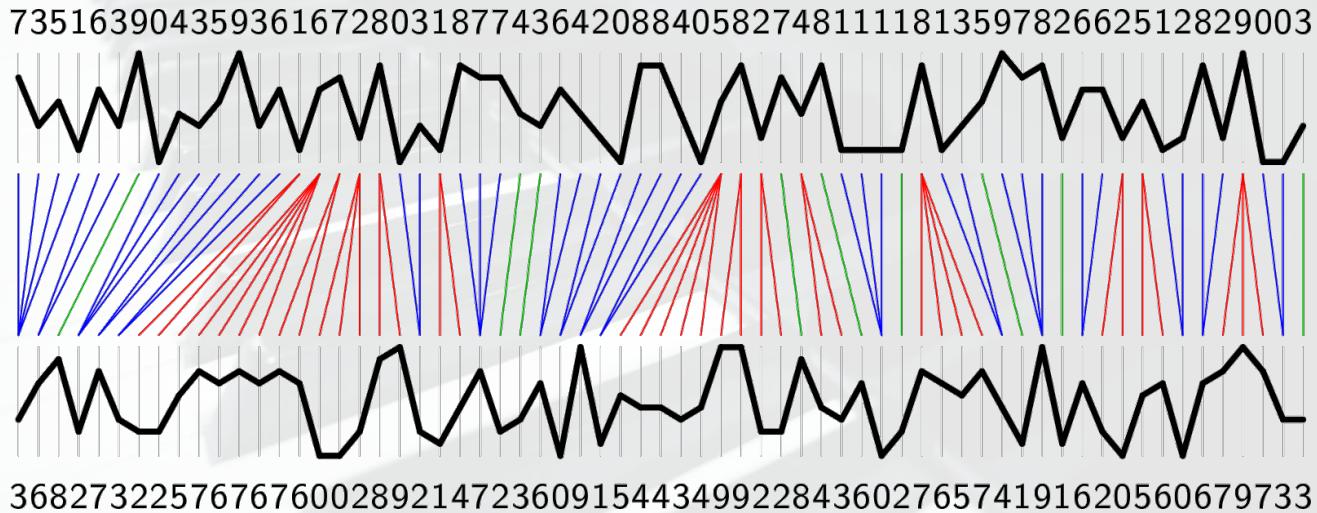
$$cd(x,y) = \sum_{i=1}^{12} |w(x)_i x_i - w(y)_i y_i|$$

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.

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

- 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

