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Generic Multimedia Indexing and Retrieval Approaches

Music information retrieval and cross link to 3D object retrieval

Remco Veltkamp
Goportis, 18,19 March 2013

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Music information retrieval and cross link to 3D object retrieval

Generic Multimedia Indexing and Retrieval Approaches

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Roadmap

- Modeling saliency
- Segmentation and similarity
- Interoperability
- Cross links

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COgnition Guided Interoperability beTween Collections of musical Heritage

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- Cognitive Itch, Brain Itch, Auditory Itch
- Earworm, Ohrwurm
- Musical Hook
- Involuntary Musical Imagery
- Sticky Tunes, Sticky Songs
- Music Memes
- Humbugs
- Song In My Head, Tune In My Head, Head Song
- Obsessive Musical Thought

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- Tune Wedgies
- Aneurhythms
- Repetunitis
- Chiclete De Ouvido ("Ear Chewing Gum")
- Music Virus, Sound Virus or Viral Music
- Stuck Tune Syndrome, Stuck Song Syndrome, Last Song Syndrome
- Melodymania
- Humsickness
- Haunting Melody

■ Kylie Minogue: Can't Get You Outta My Head

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COgnition Guided Interoperability beTween Collections of musical Heritage

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- Cognition:
 - Locate the hooks in songs (cognitive itch)
 - Better searching, better thumbnails
- Computer science:
 - Audio segmentation and feature extraction
 - Matching and searching
- Cultural heritage:
 - folks songs (Liederbank, Meertens Institute)
 - popular songs (early radio broadcasting, Sound&Vision)

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Research Question: Hooks

- Which are candidate 'hooks' of a melody, fragment of melody most people remember
- Design of an annotation framework

MI + S&V Music → ITCH Tool → Hook Model

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Finding the Elusive Hooks

- Which thumbnail is harder to recognize for others, do you think?

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Finding the Elusive Hooks

- Do you know this song?

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Finding the Elusive Hooks

- Do you know this song?
- Verify: is this a correct continuation?

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Analysis of Response

- Average response time per location in song
- Correct and wrong answers

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Research Question: Similarity

- How to map the cognitively relevant features into computational models?
- Invention of similarity measures

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Research Question: Segmentation

- How to segment pieces into candidate hooks?

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Dependency Model for Segmentation

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Graphical Dependency Model

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JSD-based segmentation

- Jensen-Shannon Divergence
- Training set of 100 folk songs to find:
 - Best feature set
 - Feature combination scheme

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Initial Segmentation Performance

- Comparison to Local Boundary Detection Model

model	recall	precision	F1
LBDM ($k = 0.5$)	0.16	0.20	0.18
divergence-based algorithm	0.55	0.83	0.65

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Structural segmentation based on repeated harmonies

- Structural segmentation is a fundamental problem in music research
- Music can be divided into *parts*, where a *part* refers to a single or all instances of a musical section
- By *structure* we refer to a set of non-overlapping segments that corresponds to musical parts

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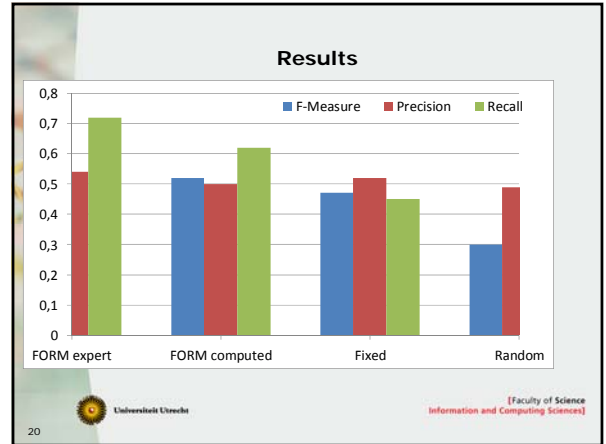
Structural segmentation

- chord is represented as a single symbol consisting of a *root* and a *quality* (major/minor)
- Within a suffix tree, all subtrees below the root share a *common prefix*, we cluster the repetitions by subtree
- Chord sequence is segmented at every position where a *repeated pattern starts* and a *subtree label changes*

C F F C D m D m D m G C F F C

A B B A

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Structural segmentation

- Grammar of tonal harmony
 - define grammar
 - sequence of chord labels
 - create parse trees
 - compare trees


$$\begin{aligned}
 4 \text{ Ton}_{Maj} &\rightarrow I_{Maj} | I_{Maj} IV_{Maj} I_{Maj} \\
 5 \text{ Ton}_{Min} &\rightarrow IV_{Min} | I_{Min} IV_{Min} I_{Min} \\
 6 \text{ Dom}_{m} &\rightarrow V_{m} | V_{m} \\
 7 \text{ Sub}_{Maj} &\rightarrow IV_{Maj} | IV_{Maj} \dots \\
 8 \text{ Sub}_{Min} &\rightarrow IV_{Min} | IV_{Min} \dots
 \end{aligned}$$

$\epsilon \in \{\emptyset, m, 7, 0\}$

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Sidestep: chordify

- Chordify is free web-service that automatically transcribes music into chords from YouTube, SoundCloud or uploaded music files
- Combines top-down symbolic music analysis with bottom-up audio feature extraction
- Creates a list of chord candidates at each beat-synchronised frame
- Merges chord candidates on strong metrical positions
- Estimates global key and possible modulations
- Selects chords based on how well they fit the rules of tonal harmony
- The chords are aligned to the music, showing the user which chords to play
- Try it yourself: <http://www.chordify.net>


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Sidestep: chordify

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Research Question: Interoperability

- How to build interoperable search infrastructure
 - Integration of search results

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Sound & Vision Collection

- Pre-1984 recordings: 350,000 songs
- 50,000 (mono, stereo LP's, 45, 78 rpm) records

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Sound & Vision Collection

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Meertens Collection

- Liederenbank/Dutch Song Database: 150,000 songs

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Meertens Collection

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Baseline measurement

- Working definition of hook
- State of the art in segmentation
- Search for overlap, 160 records being digitized
- Is there interference (mutual influence) between Folk and Popular Music?

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Liederencourant

Nijmegen, ± October 1925

Liederencourant, Firma Rombouts, Roosendaal

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Een laffe moord te Rotterdam.

Woorden van M. M. Ed. Hevedorp.

Metode: Jantje aan de telefoon.

Wat men nu hoort,
't is weer een moord,
Opgelegd in de havenstad.
Een klein jong kint,
Klein en tinnel.
Dat oit gem' kraad gewan had.
Wie is hiervan de dader?
Nou verdent hiervan de Vader.
Rafrein voor elk couplet.
Dat er menschen zijn op aarde,
Ja nou lat en see gemoen.
Die moordenaar.
't is een barbaar.
Verloos kin' naar Siberie heen.
En andere moeter sij utrieken.
Met paerden hem van elkaar.
Zoo moeten sij hem utrieken,
Die laffe moordenaar.
Hoe of het kan,
Dat hij alle man,
Zou lief en satig popje.
Zou lat en rein.
't Mecht niet nou sijn
Haar meute met haer kintje.
Haar goetie tegen de zuren.
Moordenaar gij mit 't beuren.
Nu denkt hij wel
Ginde in sijn oot
Aan sijn lief dochterje klein.
Zij was een pop.
Bang hem maar op
Of maakt hem mit gekakt sijn.
Waarom moest dit gebeuren,
Velen salen er om treuren.

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Search for overlap

Nederlandse Liederbank

zoek (16) 16 woorden 30 sorteer op | jaar

U zoekt: alle liederen op deze methode

5 resultaten

beginregel	afsluiting	wijzeaanwijzing	mus.
achter 't Ethel broe		standaardmuziek methode strofeschema	mp.3 scen
Wat men nu hoort / 't is weer een moord Bal, M.M. Een laffe moord te [...] LBI Moormann K064 (1925) [nr. 13]	Jantje aan de telefoon		scen
Wat men nu hoort / 't is weer een moord Bal, M.M. (Hevedorp) Een laffe moord te [...] LBI ML Websters 319 (1925+) [oec. 1925] [nr. 13]	Jantje aan de telefoon		scen
Zig Praetorius, waar is Pius, / Ik zie haer al in [...] Jantje aan de telefoon	[wijzeaanwijding: ontbreekt]		scen
Wat men nu hoort / 't is weer een moord Bal (Hevedorp), M. M. Een laffe moord te [...] LBI KB Websters 06108 (1932 ca.) [nr. 1]	Jantje aan de telefoon		scen

Search for overlap

Duo Hofmann
78 rpm record "Jantje aan de telefoon"

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Interoperability

- An important part of Dutch musical heritage is not available for scholars nor for the general public:
 - Willy Derby
 - Lou Bandy
 - Louis Pisuise
 - Kees Pruis
 - Louis Davids
 - Duo Hofmann

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Interoperability Pilot Project

COGITH
Demo

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From cognition to emotion

- General emotional models

Plutchik's Wheel of emotion

Russel's Valence-Arousal

Ekman's basic emotions

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GEMS (The Geneva Emotional Music Scales)

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Emotify

<https://apps.facebook.com/emotify/>

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From Music to 3D Models

- SHADES: Shape Descriptors
- Salient parts:

Gal et al. [Faculty of Science
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From Music to 3D Models

- SHADES: Shape Descriptors
- Segmentation game: how does segmentation of players comply?

Kalogerak et al. [Faculty of Science
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Take Home Message

- Na Na Na, Na Nananana, Na Na Na

and also:

- Games With A Purpose:
 - Modeling saliency (hook)
 - Segmentation, similarity
- Interoperability
- Musical collection librarians: please contact me!

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- <http://www.liederenbank.nl>
- <http://www.chordify.net>
- <https://apps.facebook.com/emotify/>
- R.C.Veltkamp@uu.nl



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