



HELSINGIN YLIOPISTO
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Automated content-based music comparison and retrieval

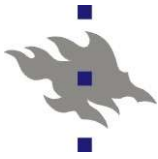
Kjell Lemström

Talk given at Nordic Music Library Conference
Sibelius Academy, Helsinki, 15.6.2005

C-BRAHMS GROUP

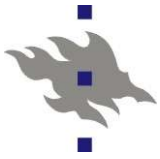
Department of Computer Science





MIR Research Community

- is multidisciplinary:
 - musicologists, psychologists, music psychologists, library and information retrieval scientists, computer scientist, ...
- studies various problems:
 - automatic genre classification, automatic pitch detection, text-based music retrieval, content-based music retrieval, optical music recognition, music indexing, automatic playlist generation, ...
- applies various scientific frameworks:
 - information retrieval, digital signal processing, stringology, computational geometry, ...
- is a young but fast growing discipline: www.ismir.net



Available MIR Applications

Text-based music retrieval:

- Sheet music collections:

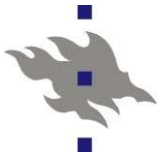
www.loc.gov

- Searching metadata by mp3 files:

www.musicbrainz.org

- Searching mp3 files by metadata:

www.alltheweb.com



Real-life MIR Application Available Currently

Content-based music retrieval (CBMR) / classification on audio:

- Automatic genre classification

- easy to humans: 0.25 sec: 40 %, 3 sec: 70%

- difficult to computers: 61 % (random: 10 %)

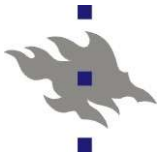
GenreGram demo (Thanks to George Tzanetakis, University of Victoria)

- Query by audio example:

- easy to computers (not so easy to humans)

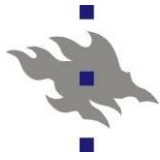
Philips, Shazam demo (Thanks to Avery Wang, Shazam)

(www.shazam.com)



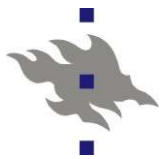
Motivation to CBMR on Symbolic Music

- Possible to query by melodies of polyphonic music
- Query By Humming (QBH) /
What You Hum Is What You Get (WYHIWYG)
 - downloading ringing tones and mp3 files
 - controlling personal music databases
- Automatic playlist generation
- Copyright infringement inspections

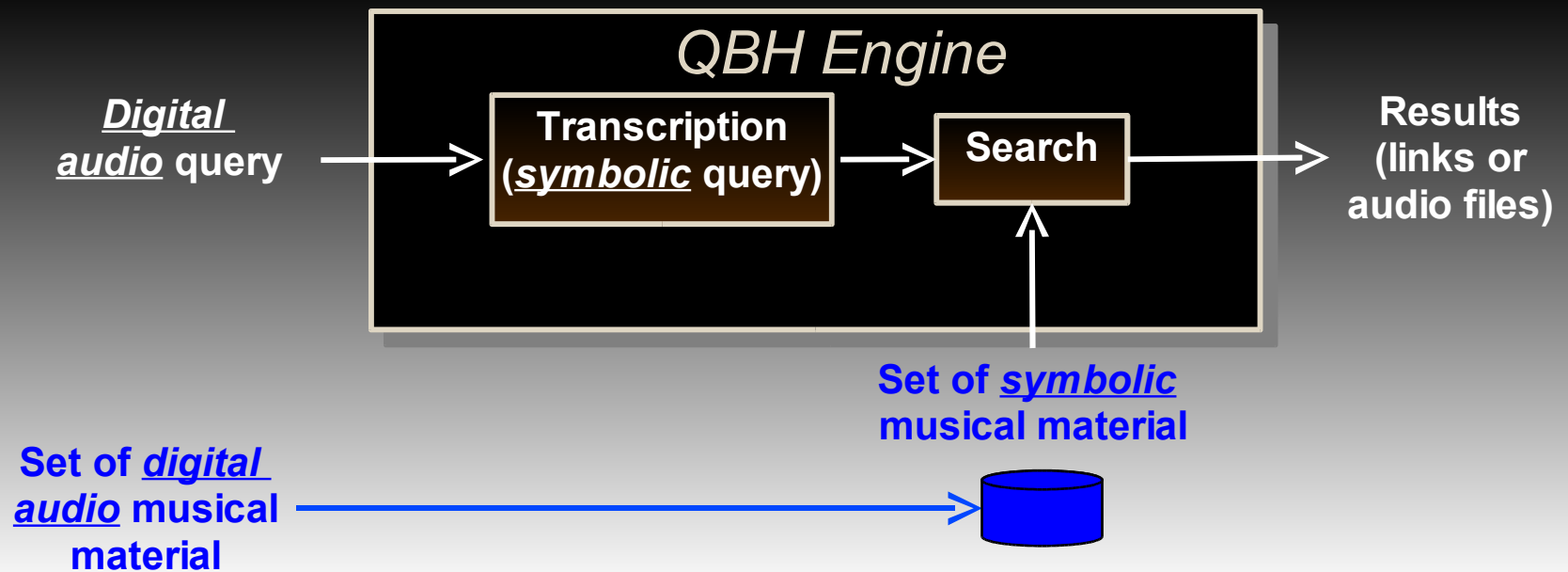


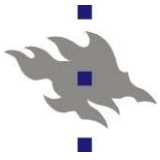
Some Chronological Landmarks of CBMR on Symbolic Music

- Dictionary of music themes (incipits)
Barlow and Morganstern, 1948
- Early computer assisted methods
e.g., Lincoln, 1970
- QBH / WYHIWYG systems (<http://mirsystems.info>)
MELDEX, McNab et al., 1996
www.nzdl.org/fast-cgi-bin/music/musiclibrary
The PHILIPS system demo (Thanks to Steffen Pauws, Philips)
C-BRAHMS demo



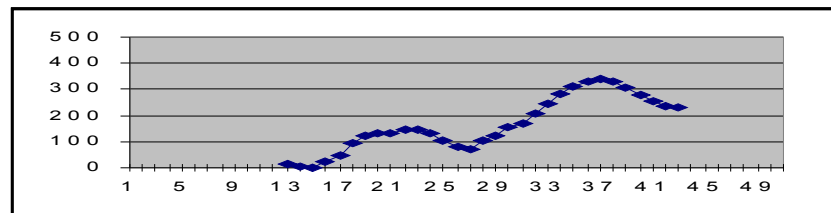
The Building Blocks of a QBH System





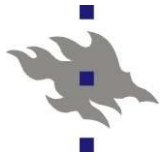
Problems Encountered in QBH System Design: The AudioToSymbolic Frontend

- Automatic pitch detection is a complex problem:



2 notes with vibrato

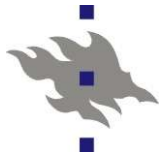
- Detecting note onsets
 - Ignoring vibrato
 - Deciding the pitch
 - "Calibrating" the musical key
- The complexity arises when several sound sources present
(Automatic music transcription to generate databases)



Problems Encountered in QBH System Design

The Query Phase

- Dealing with errors/noise in query
- Dealing with noise/decorations in database
- Dealing with polyphonic music:
 - voice separation or "distributed matching"
- Time/pitch quantization
- Transposition/tempo invariance

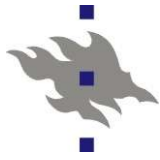


Problems Encountered in QBH System Design Database Generation/Design

- Generation error prone: OMR, MIDI, automatic transcription

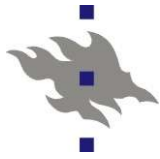
www.cs.tut.fi/~klap/iiro/ demo (Thanks to Anssi Klapuri, University of Tampere)

- Dealing with very large databases:
 - to have interactive queries, indexing required
 - but this is very difficult because of the various sources of inaccuracies



Problems Encountered in QBH System Design Providing Results

- How to find the relevant matches (relevance feedback?)
- Queries on symbolic format; to provide audio result an alignment between audio and symbolic representation is required



Easy Reading Suggestions

- Kjell Lemström: In Search of a Lost Melody. Computer Assisted Music: Identification and Retrieval. Finnish Music Quarterly, (3-4), 40-45, 2000.
www.musicfinland.com/fmq/articles/lost_melody.html
- J. Stephen Downie: Music information retrieval. Annual Review of Information Science and Technology 37 (Chapter 7). http://music-ir.org/downie_mir_arist37.pdf
- More to read at http://music-ir.org/research_home.html