Online Music Recognition and Search
Ontology-driven Music Retrieval & Annotation Sharing Service

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Online Music
Recognition
and Search

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Rhodes

OMRAS
Context

Original project:

- ran from 1999 to 2003;
- King's College London and Univ. Massachusetts;
- indexing of musical data and efficient search algorithms;
- search and recognition *primarily* of whole tracks;
- operate on mid-level representation generatable from MIDI *and* audio.

Current project (OMRAS II):

- runs 2007–2010;
- Goldsmiths and Queen Mary, London (and friends);
- indexing of musical data and efficient search algorithms;
- more than MIDI!
- aim to build system usable by non-technical experts.

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Challenges

- large databases: $\sim 10^6$ tracks;
- large, possibly unclean metadata;
- large datasets: each track ~ 10MB data;
    - not all that data is *relevant*;
    - different tasks have different relevance criteria.
- accessible system: interfaces for
    - MIR experts;
    - Musicological experts;
    - End-users ("consumers").
- inexact matching.

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Metadata

Metadata is expressed today in searchable RDF:

- example: "What links *Simple Exercice* to Paul Verlaine?"

```
"Simple Exercice" a mo:Record;
  foaf:maker "Both"

"Both" a mo:MusicGroup;
  foaf:based_near http://dbpedia.org/resource/Moselle

http://dbpedia.org/resource/Metz p:department
    http://dbpedia.org/resource/Moselle

http://dbpedia.org/resource/Paul_Verlaine a foaf:Person;
  p:birthPlace http://dbpedia.org/resource/Metz
```

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Metadata

We can also publish our experimental results in RDF

- scalable;
- distributed;
- automatically interpretable (sort of);
- discoverable?

```
http://dbtune.org/jamendo/track/241
  mo:similar_to http://dbtune.org/jamendo/track/185;
  mo:similar_to http://dbtune.org/jamendo/track/472;
  ...
```
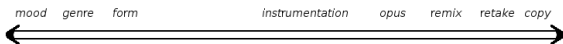
Raimond, Y. and Sutton, C. *A Music-Related Web of Data*, IEEE Multimedia, submitted

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Similarity
Similarity in Music

- given a track or fragment of a track, retrieve similar tracks from a database.
- what does 'similar' mean?

Music Similarity Scale (after D. Byrd)

mood genre form   instrumentation   opus remix retake copy

Similarity judgments we understand (well-posed):

- apocrypha / copy / fingerprint;
- opus / cover;
- remix;

… with respect to a database

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Approximate search for *sequences* of feature vectors.

- features typically 12–20 numerical values per frame;
- sequences typically 10–30 frames;
- effective dimensionality 120–600.

Locality-Sensitive Hashing:

- indexing technique
- deals with 'curse of dimensionality';
- allows sublinear-time retrieval of neighbours within threshold of query;
- probabilistic algorithm.

Slaney, M. and Casey, M. *Locality-Sensitive Hashing for Finding Nearest Neighbors*, IEEE Sig. Prog. Magazine 25(2), 2008

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Retrieval

Approximate search for *sequences* of feature vectors.

Feature-Space Modelling:

$$\frac{x^2 d}{M\sigma^2} \sim \chi_d^2$$

gives track-based threshold on *minimum* query-target distance

$$x_{\text{thresh}} = \frac{2M\sigma^2}{d} \left(\frac{d\Gamma(\frac{d}{2})(-\ln(1-f))}{2N} \right)^{\frac{2}{d}}$$

Casey, M., Rhodes, C. and Slaney, M. *Analysis of Minimum Distances in High-Dimensional Musical Spaces*, IEEE Trans. Audio, Speech and Language Processing, in press.

Approximate search for *sequences* of feature vectors.

Results:

- Database of ~ 2000 Chopin Mazurka performances;
- Identify performances of the same *opus*.
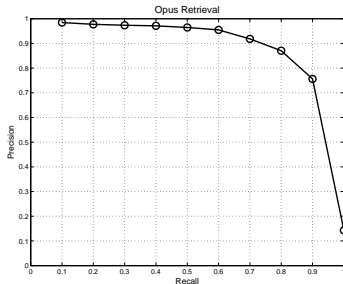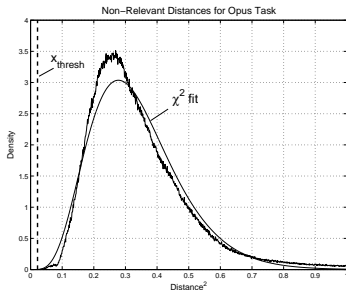
1. Search database for all 30-second sequences of *chroma* contained in query track;

2. User interface browsing Chopin Mazurkas, starting from query sample taken from Concert Artists recording by Joyce Hatto.

Magas, M., Casey, M., Rhodes, C. *mHashup: fast visual music discovery via locality sensitive hashing*, SIGGRAPH 2008.

Cook, N. and Sapp, C. *Purely coincidental? Joyce Hatto and Chopin's Mazurkas*. CHARM 2007.

`http://mazurka.org.uk/fiorentino/`

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Resources

Resources:

- Goldsmiths deployment: 52,000 tracks in database:
  - features for each audio file;
  - metadata;
  - infrastructure bits and pieces.
- "technology preview release":
  - $O(N)$ search;
  - `http://omras2.doc.gold.ac.uk/software/audiodb/`
  - `http://omras2.doc.gold.ac.uk/audiodb/`
  - $O(N^{\frac{1}{c^2}})$ LSH release "soon".
- `http://www.omras2.org/`