MIR research for broadcast monitoring at (6) bmat

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OFICINA BMAT

GESTION CLIENTES DE BMAT

BMAT

- Funded in 2005 as a spin-off of UPF
- Based in Barcelona, offices worldwide
- Currently ~120 employees
- Working with more than
 100 CMOs worldwide









































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- Summarized representation of audio. Discriminative. Fast to process.
- **Robust** to strong audio degradations





Music detection

- Three classes: no-music, background music, music
- **Sound event detection** (classic deep learning problem)





Cover identification

- Robust to musical transformations: arrangements, singer...
- Harder scalability than in the case of audio fingerprinting

Example of state-of-the-art algorithm (Serra, 2008):





Customers and services

- **Customers:** CMOs, labels & publishers, broadcasters...
- Services
 - **Fingerprinting:** Monitoring of thousands of channels vs. large catalog
 - **Music detection:** Detect unidentified music. Know if music is in foreground or in background.
 - Cover identification: only with limited catalog (thousands of tracks)









- Research

- From PhD to industry
- BMAT use-case
- Challenges, considerations...



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How the customer explainened it. How the project leader understood it. How the analyst designed it.







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Contribution of the researcher



great improvement of aerodynamics





Contribution of the researcher



What the customer

really wanted.

great

of





Contribution of the researcher **Forgot user** needs!



improvement aerodynamics

What the customer

really wanted.

great

of



Research From PhD to industry BMAT use-case

- Challenges, considerations...



BMAT use-case

- Business-to-business service: big clients



- Clients have **access to large auditable reports** of results: they can listen all matches, so they can assess your quality easily
- Clients have access to all historical results: importance reproducibility
- A lot of copyrights money (>1000M€) depends on these results: clients are sensitive to changes (even to improvements)



BMAT use-case

- Different clients are **sensitive** to different kind of errors Q
- On-going 24/7 service: the show must go on. Legacy 24/7
- Large-scale service: millions of identifications per day, hundreds of thousands of hours of audio analyzed per day. Super high computational impact of algorithm changes!
- Many different contexts: radio, TV, venues, digital platforms... technologically challenging. Generalization is hard.



- Research

- From PhD to industry
- BMAT use-case
- Challenges, considerations...













More computation → More accuracy

So, we can **improve accuracy** in two ways:

- With **MIR** ideas about the acoustic fingerprint itself
- With **HPC** ideas about the way matching is computed (indexing, nearest-neighbor search...)

The implementation really matters to improve costs and accuracy.



Some research challenges

- Robustness against **mix of degradations** in challenging catalog. E.g:

Identify all tracks in a DJ mix session of **techno** music, **time-scaled**, recorded with a **microphone** in a **noisy** ambient. We identify vs. a **large catalog of techno**, but we still we lack **some tracks**, and our customer wants **no false positives**.

- Identification of short samples of music, played in the very very background with speech/noises on top
- False positives when we lack content



Music detection

Common machine learning challenges:

- How to annotate data?
- How much data?
- Which approach? classification, segmentation, regression...
- Which classes?
- How to evaluate? Which evaluation metrics?





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Music detection

Different use-cases require different evaluation metrics

(apart from F-measure and accuracy)









Music detection

Generic music detection challenges

- Barely-audible **background** music
- Music-like **SFX**: bells, sirens...
- Some **genres**: rap, experimental music (SFX-like), opera...
- Computation time: **small networks** better







Cover identification

Main challenge: **scalability** to large catalogs

- Methods that work well, scale linearly
- Other methods are based on nearest-neighbor search (better scalability), but their accuracy is significantly lower









Cover identification

Other research challenges:



- "Creative" covers detection (e.g. electric to acoustic version)
- Cover identification in **streaming** (window-wise analysis)



Cover identification of songs without many **discriminative** elements (e.g. frequent chord progressions)



Degraded audio: microphone recordings, ambient noise, etc.



Conclusion

- At BMAT we do broadcast monitoring to achieve a fair copyrights distribution
- We use:
 - \circ audio fingerprinting
 - music detection
 - cover identification
- Research at BMAT requires being pragmatic
- Implementation and scalability matters
- If you need challenges, we can show you a few





