

Automatically Describing Music on a Map

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Outline

- Aims
- Music Maps
 - Creation, visualization, limitations
- *Music Description Map (MDM)*
- Demonstration in nepTune interface
- Future Work
- Conclusions



Aims

- Automatically infer natural language descriptors for music
 - By means of **audio analysis** and
 - **web retrieval**
- Labeling of Music Map regions with music related terms
- Bridging the Semantic Gap for music



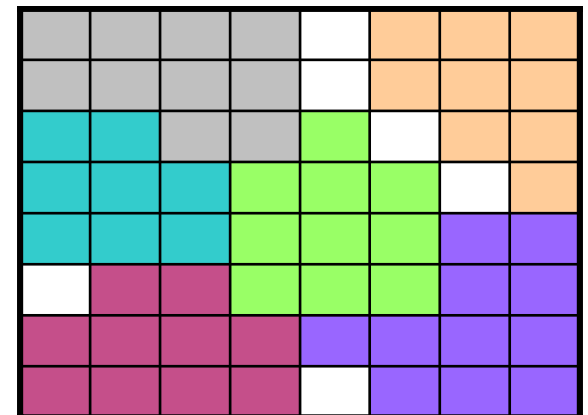
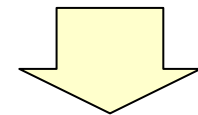
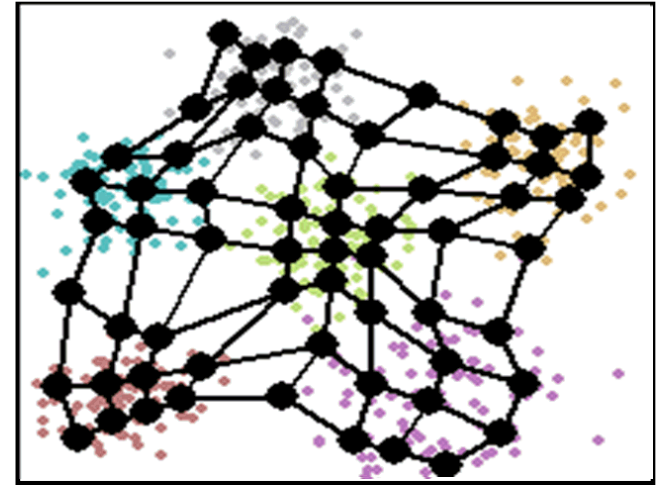
Music Maps – Creation

Audio Signal Analysis

Audio Similarity Measure
→ Similarity Space

Clustering via SOM

High-dimensional data is
projected to plane

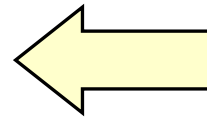
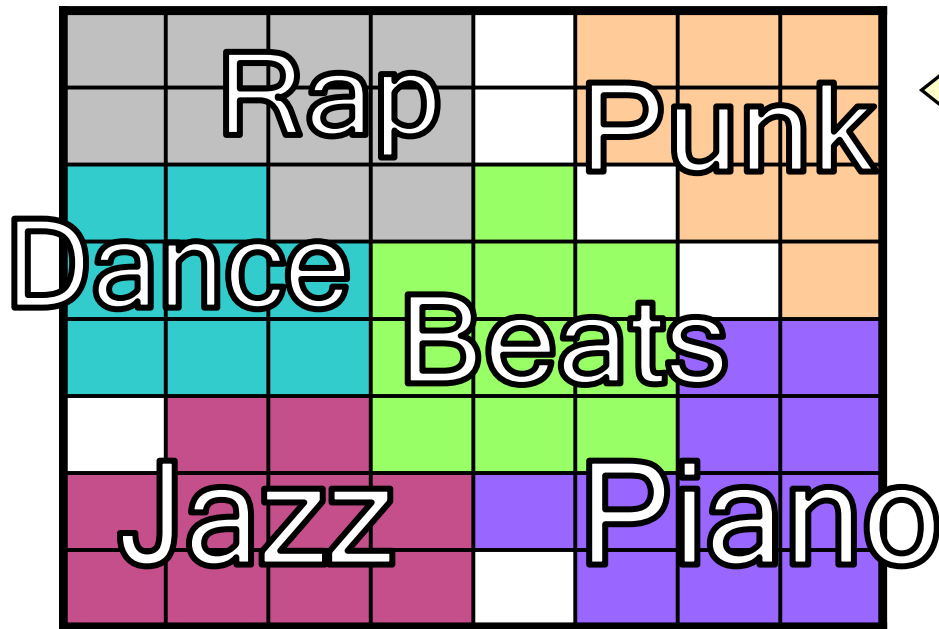


Music Maps – An example

Pop (43) Hip-Hop (25) Jazz (19) Dance (9) Metal	Hip-Hop (18) Pop (9) Dance (5) Jazz	Jazz (6) Hip-Hop (5) Dance (4) Pop (3) Metal	Hip-Hop (15) Jazz (12) Pop (12) Dance (5) Punk	Jazz (20) Pop (13) Hip-Hop (6) Dance (4)	Pop (15) Jazz (13) Dance (5) Hip-Hop (5)	Jazz (32) Dance (14) Pop (9) Hip-Hop (6) Metal	Jazz (46) Dance (6) Hip-Hop (2) Pop (2) Classical Metal	Jazz (70) Pop (5) Dance (3) Classical (2) Metal (2) Hip-Hop	Jazz (49) Classical (6) Dance (2) Pop (2)	Jazz (49) Classical (35)	Classical (182) Jazz (66) Metal (3)
Hip-Hop (12) Pop (10) Dance (4) Jazz (3)	Dance (2) Hip-Hop (2) Pop (2)	Hip-Hop (5)	Dance (2) Hip-Hop (2) Hip-Hop (2) Metal Pop	Dance (5) Jazz (2) Pop	Jazz (5) Hip-Hop (4) Dance (2) Pop	Dance (2) Jazz Pop	Jazz (7) Dance	Jazz (4) Dance Metal	Jazz	Jazz (2) Metal (2)	Jazz
Hip-Hop (14) Dance (12) Pop (11) Jazz (8) Metal	Hip-Hop (7) Dance (2) Jazz Pop	Hip-Hop (7) Dance (3) Pop (3)	Dance (4) Hip-Hop Metal Pop	Dance (7) Hip-Hop (3) Pop (3) Jazz (2)	Hip-Hop (4) Pop (2)	Pop (3) Dance (2) Hip-Hop	Jazz	Hip-Hop Jazz	Jazz (3)		Metal
Pop (26) Hip-Hop (11) Dance (10) Jazz (4) Metal (2) Punk	Hip-Hop (6) Dance (5)	Hip-Hop (3) Dance (2) Jazz Pop	Dance (3) Jazz (2) Pop (2) Hip-Hop Metal Punk	Dance (5) Pop (2)	Hip-Hop (6) Dance Jazz Pop	Hip-Hop (3) Jazz (2) Metal Pop	Metal (2)	Dance (2) Hip-Hop Jazz			Punk
Pop (19) Dance (12) Hip-Hop (10) Jazz (5) Punk	Pop (3) Hip-Hop (2) Dance Metal	Dance (5) Hip-Hop (3) Pop	Dance (2) Pop (2) Jazz	Dance (3) Hip-Hop (3) Punk	Dance (4) Pop (4) Hip-Hop (2) Jazz Metal Punk	Dance (4) Pop (3) Metal Punk	Dance (3) Punk (3) Metal Pop	Dance (9)		Metal Punk	Punk
Dance (20) Pop (19) Hip-Hop (11) Metal (3) Punk (3) Jazz (2)	Dance (5) Pop (3) Hip-Hop	Dance (5) Jazz (4) Hip-Hop Pop	Dance (16) Hip-Hop Jazz Pop	Dance (9) Pop (3) Hip-Hop	Hip-Hop (2) Dance Metal	Dance (4) Hip-Hop (2) Pop (2) Punk (2) Metal	Punk (6) Hip-Hop (2) Dance Metal Pop	Dance (3) Metal Pop Punk	Metal (2) Pop Punk	Dance Pop	Punk (8) Metal (4) Dance Pop
Dance (14) Pop (11) Hip-Hop (5) Metal (2) Punk (2)	Dance (3) Pop (2) Metal	Dance (2) Metal (2) Pop (2)	Dance (13) Hip-Hop Jazz	Dance (7) Pop (2) Punk	Metal Pop Punk	Metal (3) Dance (2) Pop (2) Punk (2) Hip-Hop	Dance (3) Metal Punk	Metal (3) Dance (2) Punk (2) Pop	Punk (3) Metal (2)	Metal (3) Punk (3) Dance	Metal (63) Punk (10) Dance
Dance (56) Pop (32) Hip-Hop (4) Jazz (4) Punk (4)	Dance (11) Pop (7) Punk (5) Hip-Hop (3) Metal	Dance (31) Pop (8) Metal (4) Hip-Hop (3) Hip-Hop (2) Jazz (2) Punk	Dance (21) Pop (5) Punk (4) Metal	Dance (49) Pop (8) Metal (5) Hip-Hop	Dance (30) Pop (21) Metal (12) Punk (9) Hip-Hop (2) Jazz	Metal (25) Pop (23) Punk (15) Dance (8) Hip-Hop (2)	Metal (25) Punk (16) Pop (11) Dance (10) Hip-Hop (2)	Metal (34) Punk (28) Pop (4) Dance (2)	Metal (39) Punk (29) Pop (4)	Metal (33) Punk (21) Dance Pop	Metal (127) Punk (115) Dance Hip-Hop Pop

MDM – Overview

Automatic extraction of descriptors



$$G_{w,j} = \frac{F_{w,j}^2}{\sum_i F_{w,i}}$$

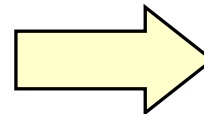
SOM labeling



Music vocabulary



artist names (ID3)



Google Web Images Video News Maps more »
"daft punk" music style Search Advanced Search Preferences

Web Results 1 - 10 of about 1,100,000 for "daft punk" music style. (0.18 seconds)

[Daft Punk MP3 Downloads - Daft Punk Music Downloads - Daft Punk ...](#)
Daft Punk MP3 Downloads - MP3.com offers legal Daft Punk music downloads as ... and original music in the background, they keep a style like no other band ...
www.mp3.com/daft-punk/artists/140991/summary.html - 58k - 7 Oct 2006 - Cached - Similar pages

[Daft Punk MP3 Downloads - Daft Punk Music Downloads - Daft Punk ...](#)
Daft Punk's full-length debut is a funk-house hailstorm, giving real form to a style of straight-ahead dance music not attempted since the early fusion days ...
www.mp3.com/albums/196087/summary.html - 42k - Cached - Similar pages
[More results from www.mp3.com]

Amazon.com: Discovery: Music: Daft Punk
Amazon.com: Discovery: Music: Daft Punk by Daft Punk ... This album features a dumbly simple and cheesy style, but executed in a way that's intelligent, ...

MDM – An example

Pop (43) Hip-Hop (25) Jazz (19) Dance (9) Metal	Hip-Hop (18) Pop (9) Dance (5) Jazz	Jazz (6) Hip-Hop (5) Dance (4) Pop (3) Metal	Hip-Hop (15) Jazz (12) Pop (12) Dance (5) Punk	Jazz (20) Pop (13) Hip-Hop (6) Dance (4)	Pop (15) Jazz (13) Dance (5) Hip-Hop (5)	Jazz (32) Dance (14) Pop (9) Hip-Hop (6) Metal	Jazz (46) Dance (6) Hip-Hop (2) Pop (2) Classical Metal	Jazz (70) Pop (5) Dance (3) Classical (2) Metal (2) Hip-Hop	Jazz (49) Classical (6) Dance (2) Pop (2)	Jazz (49) Classical (35)	Classical (182) Jazz (66) Metal (3)
Hip-Hop (12) Pop (10) Dance (4) Jazz (3)	Dance (2) Hip-Hop (2) Pop (2)	Hip-Hop (5)	Dance (2) Hip-Hop (2) Jazz (2) Metal Pop	Dance (5) Jazz (2) Pop	Jazz (5) Hip-Hop (4) Dance (2) Pop	Dance (2) Jazz Pop	Jazz (7) Dance	Jazz (4) Dance Metal	Jazz	Jazz (2) Metal (2)	Jazz
Hip-Hop (14) Dance (12) Pop (11) Jazz (8) Metal	Hip-Hop (7) Dance (2) Jazz Pop	Hip-Hop (7) Dance (3) Pop (3)	Dance (4) Hip-Hop Metal Pop	Dance (7) Hip-Hop (3) Pop (3) Jazz (2)	Hip-Hop (4) Pop (2)	Pop (3) Dance (2) Hip-Hop	Jazz	Hip-Hop Jazz	Jazz (3)		Metal
Pop (26) Hip-Hop (11) Dance (10) Jazz (4) Metal (2) Punk	Hip-Hop (6) Dance (5)	Hip-Hop (3) Dance (2) Jazz Pop	Dance (3) Jazz (2) Pop (2) Hip-Hop Metal Punk	Dance (5) Pop (2)	Hip-Hop (6) Dance Jazz Pop	Hip-Hop (3) Jazz (2) Metal Pop	Metal (2)	Dance (2) Hip-Hop Jazz			Punk
Pop (19) Dance (12) Hip-Hop (10) Jazz (5) Punk	Pop (3) Hip-Hop (2) Dance Metal	Dance (5) Hip-Hop (3) Pop	Dance (2) Pop (2) Jazz	Dance (3) Hip-Hop (3) Punk	Dance (4) Pop (4) Hip-Hop (2) Jazz Metal Punk	Dance (4) Pop (3) Metal Punk	Dance (3) Punk (3) Metal Pop	Dance (9)		Metal Punk	Punk
Dance (20) Pop (19) Hip-Hop (11) Metal (3) Punk (3) Jazz (2)	Dance (5) Pop (3) Hip-Hop	Dance (5) Jazz (4) Hip-Hop Pop	Dance (16) Hip-Hop Jazz Pop	Dance (9) Pop (3) Hip-Hop	Hip-Hop (2) Dance Metal	Dance (4) Hip-Hop (2) Pop (2) Punk (2) Metal	Punk (6) Hip-Hop (2) Dance Metal Pop	Dance (3) Metal Pop Punk	Metal (2) Pop Punk	Dance Pop	Punk (8) Metal (4) Dance Pop
Dance (14) Pop (11) Hip-Hop (5) Metal (2) Punk (2)	Dance (3) Pop (2) Metal	Dance (2) Metal (2) Pop (2)	Dance (13) Hip-Hop Jazz	Dance (7) Pop (2) Punk	Metal Pop Punk	Metal (3) Dance (2) Pop (2) Punk (2) Hip-Hop	Dance (3) Metal Punk	Metal (3) Dance (2) Punk (2) Pop	Punk (3) Metal (2)	Metal (3) Punk (3) Dance	Metal (63) Punk (10) Dance
Dance (56) Pop (32) Hip-Hop (4) Jazz (4) Punk (4)	Dance (11) Pop (7) Punk (5) Hip-Hop (3) Metal	Dance (31) Pop (8) Metal (4) Hip-Hop (3) Jazz (2) Punk	Dance (21) Pop (5) Punk (4) Metal	Dance (49) Pop (8) Metal (5) Hip-Hop	Dance (30) Pop (21) Metal (12) Punk (9) Hip-Hop (2) Jazz	Metal (25) Pop (23) Punk (15) Dance (8) Hip-Hop (2)	Metal (25) Punk (16) Pop (11) Dance (10) Hip-Hop (2)	Metal (34) Punk (28) Pop (4) Dance (2)	Metal (39) Punk (29) Pop (4)	Metal (33) Punk (21) Dance Pop	Metal (127) Punk (115) Dance Hip-Hop Pop

MDM – Details

- Google query: „*artist*“ +music +style
- Extraction of tf of 945 music terms
- SOM-Labeling (cf. Lagus & Kaski, 1999)

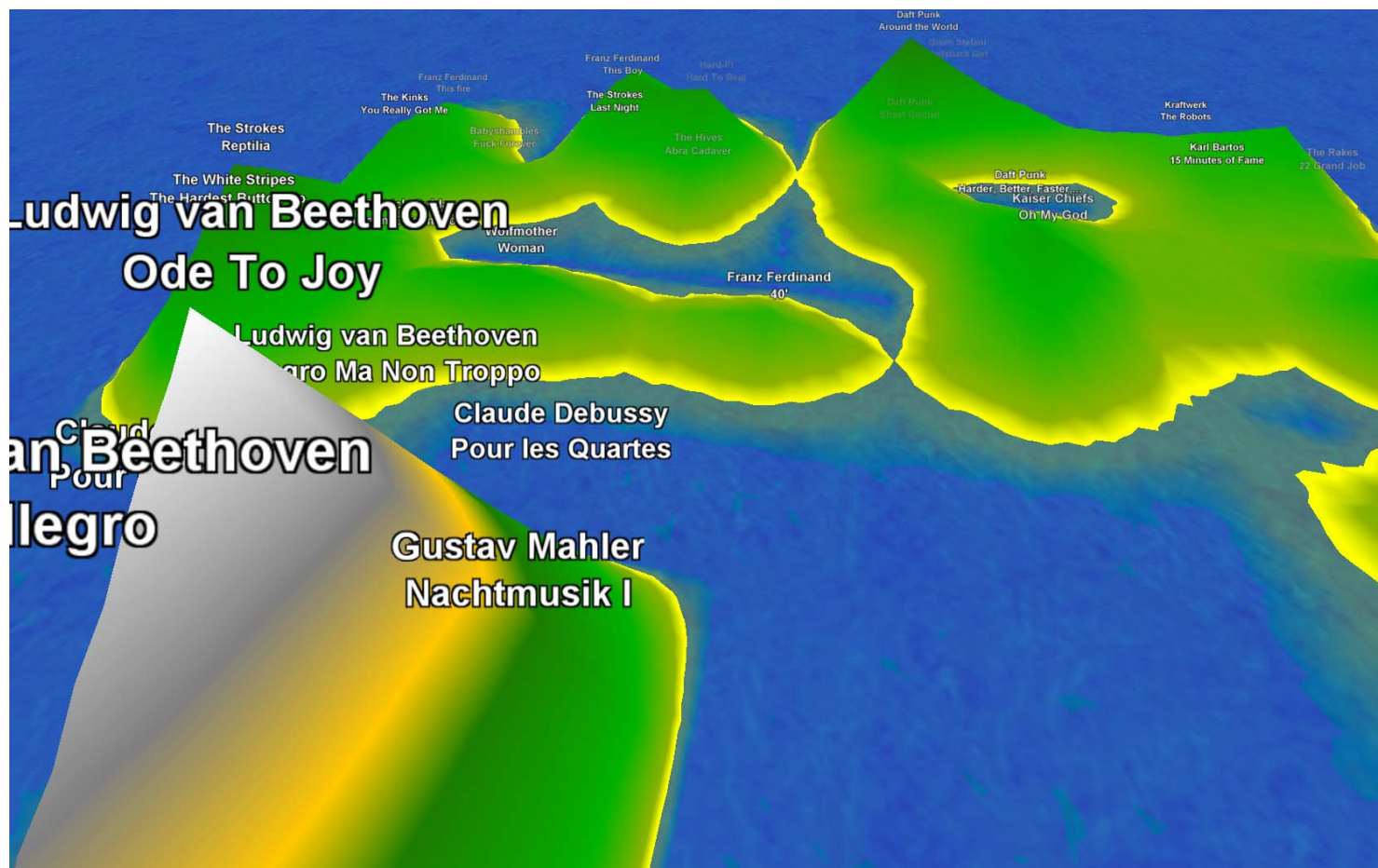
$$G_{t,u}^2 = \frac{(\sum_{k \in A_0^u} F_{t,k})^2}{\sum_{i \notin A_1^u} F_{t,i}} \quad F_{t,u} = \frac{\sum_a f_{a,u} \cdot tf_{t,a}}{\sum_v \sum_a f_{a,u} \cdot tf_{v,a}}$$

rewards terms typical to regions of clusters

- Finally: connection of similar clusters

Application Demo

Integration of MDM into nepTune



Future Work

- Finding descriptors without usage of music vocabulary
- Adapting the labeling strategy to reflect similarities in feature space
- Transformations of similarity space
- Use associations of descriptors to music pieces for e.g. search engine

Current Work – Color MDM



Conclusions

- Automatic labeling of Music Maps
 - Maps created via audio analysis
 - Descriptors extracted from the Web
- Music descriptors serve as intuitive landmarks and lead to better overview
- Top-down approach to associate music with related musical terms