



Smooth Radio

Automatic playlist generation using signal graph processing

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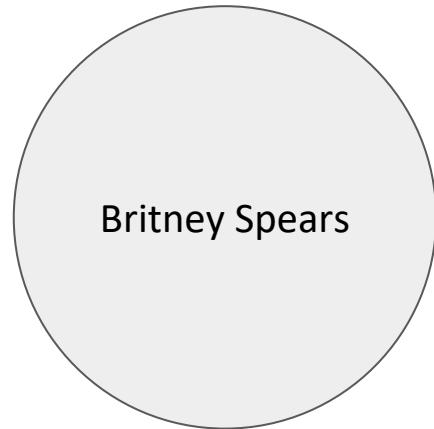
Simon Maksay



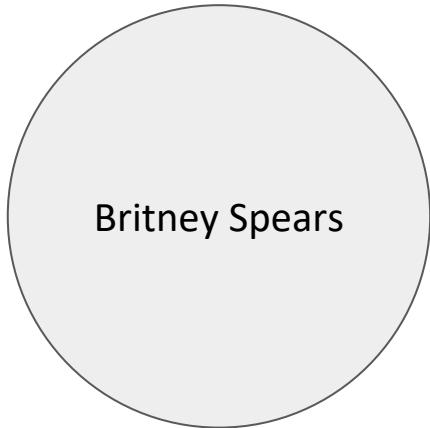
Motivation



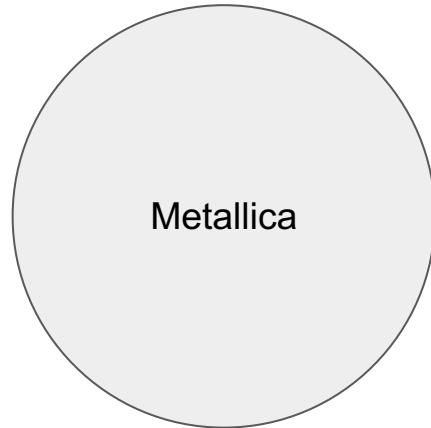
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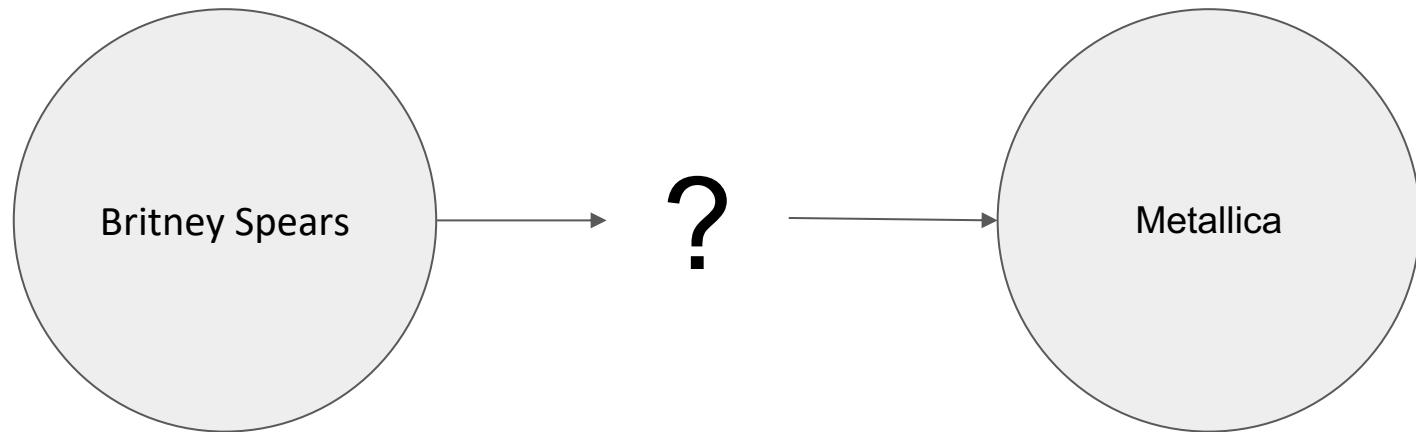


Britney Spears



Metallica

Motivation



Overview

1. Dataset
2. Features extraction
3. Graph selection
4. Shortest and smooth paths
5. Conclusion

Dataset

Free Music Archive (FMA) = 106'574 tracks

- Complete metadata such as artist, track, album, etc
- 518 audio features extracted with LibROSA
- features provided by Echonest (now Spotify)
- 163 genres



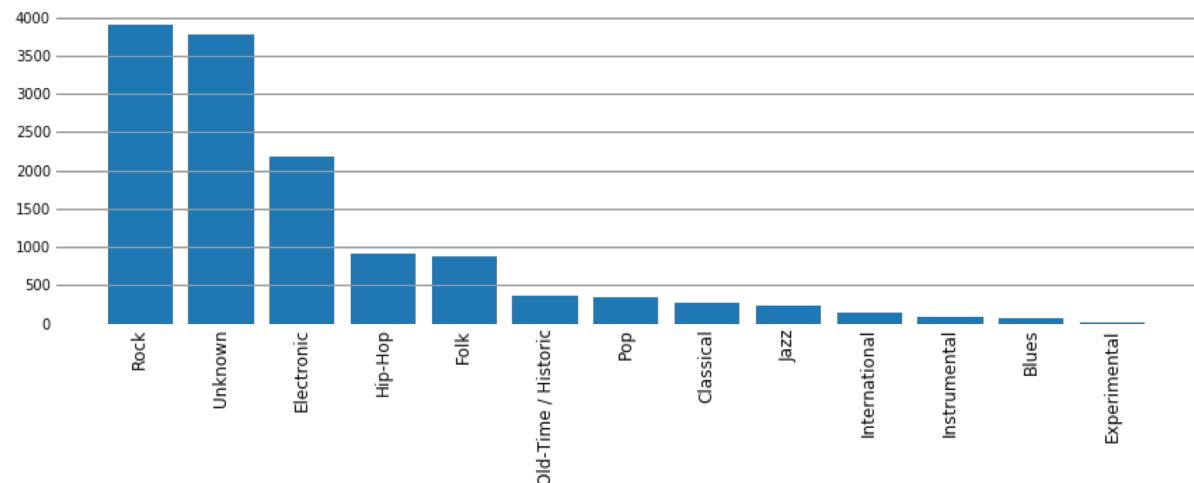
Dataset



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Echonest → 13'129 tracks
Top 8 genres → 9'055 tracks



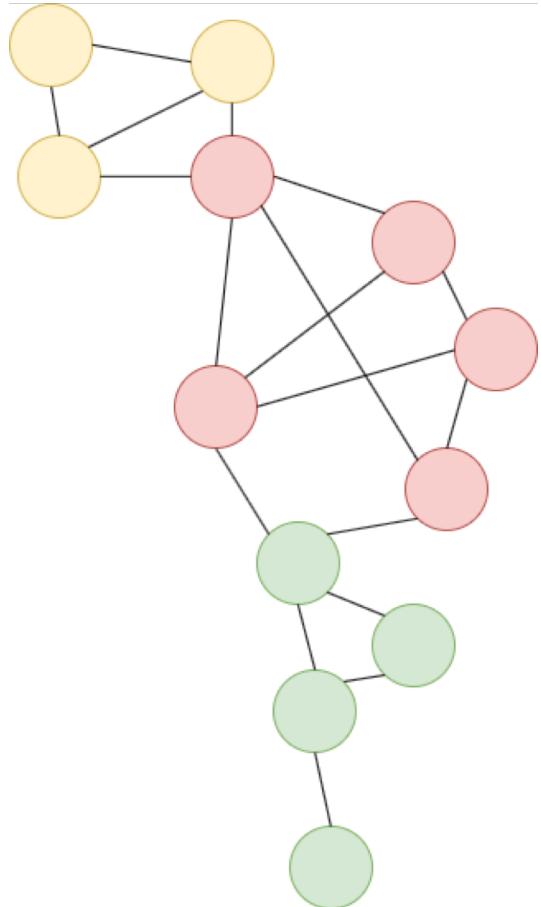
Features extraction

- 3 groups :
 - 6 Echonest audio features (acousticness, danceability, energy, instrumentalness, liveness, speechiness, tempo, valence)
 - 224 Echonest temporal features
 - 518 LibROSA features
- Normalize each feature
- Compute pairwise distances for each group
- Combine them linearly using coefficient

$$d_{total} = \alpha d_{echo.audio} + \beta d_{echo.temporal} + \gamma d_{librosa.audio} \quad \text{with} \quad \alpha + \beta + \gamma = 1$$

Graph selection

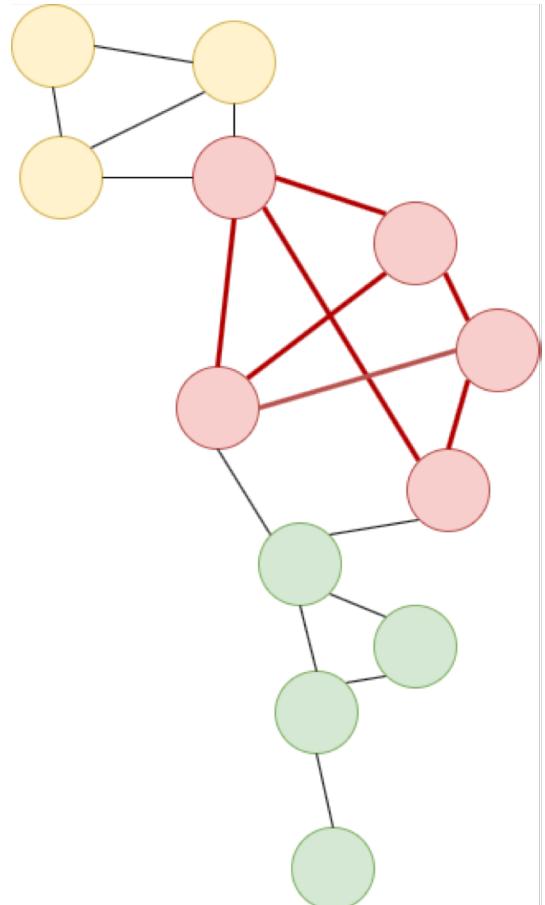
- Graph observation
- Average clustering coefficient
- Genre distinction coefficient (GDC)



Graph selection

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- Average clustering coefficient
- Genre distinction coefficient (GDC)

$$c_{in}(g) = \frac{1}{|E(G_{in})|} \sum_{i \in E(G_{in})} d_i$$

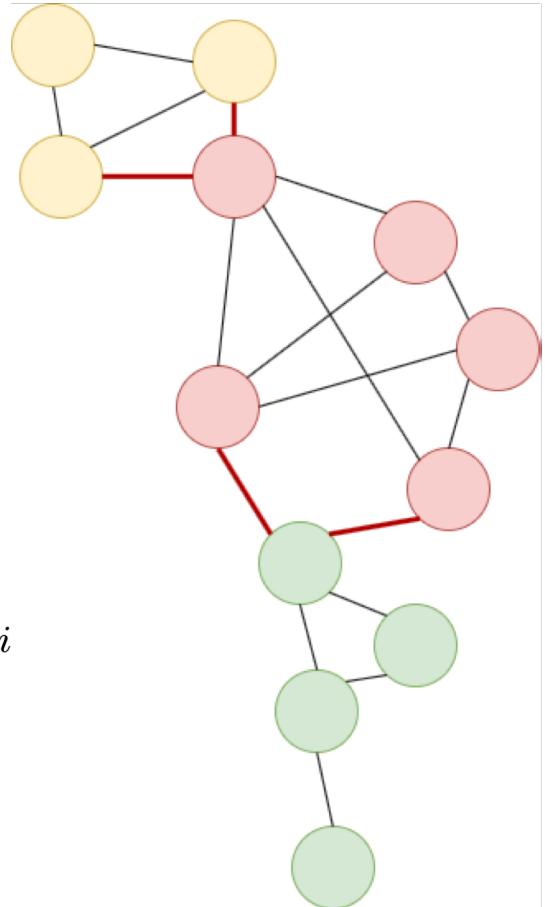


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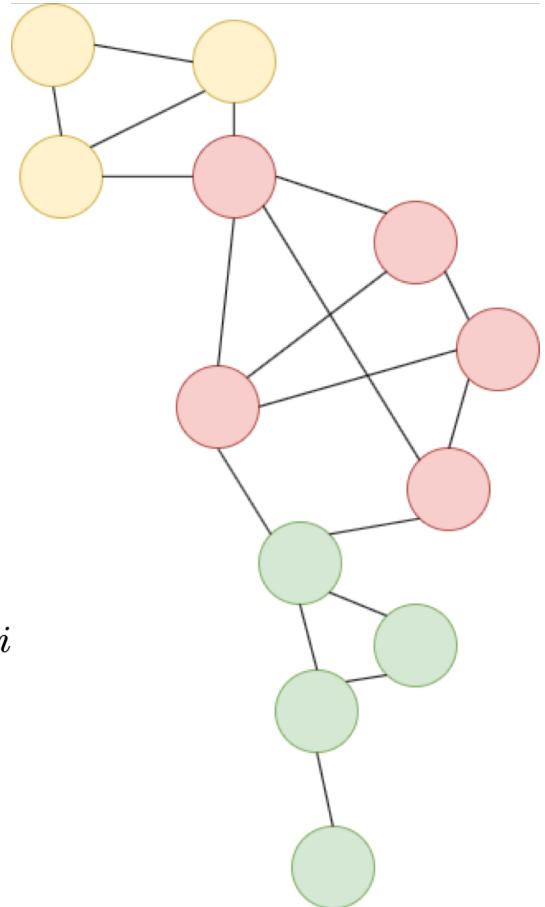
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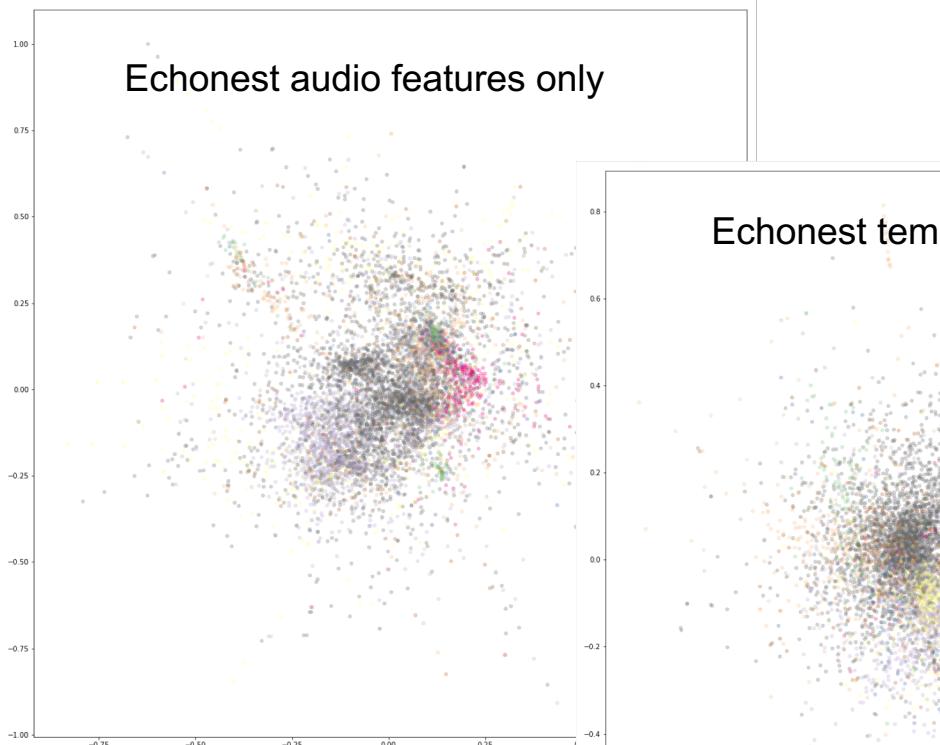
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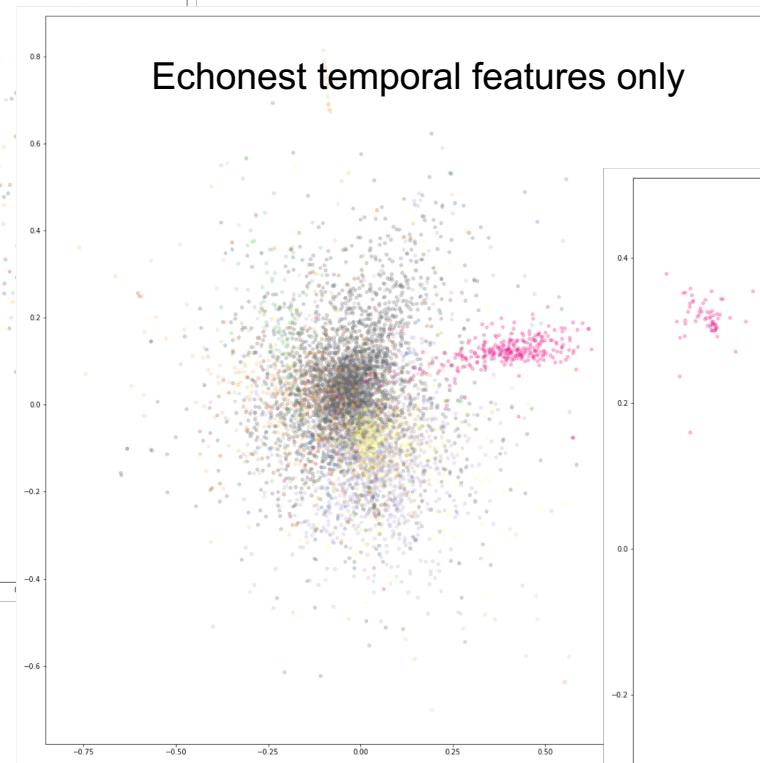
$$GDC = \sum_g \frac{c_{ext}(g)}{c_{in}(g)}$$



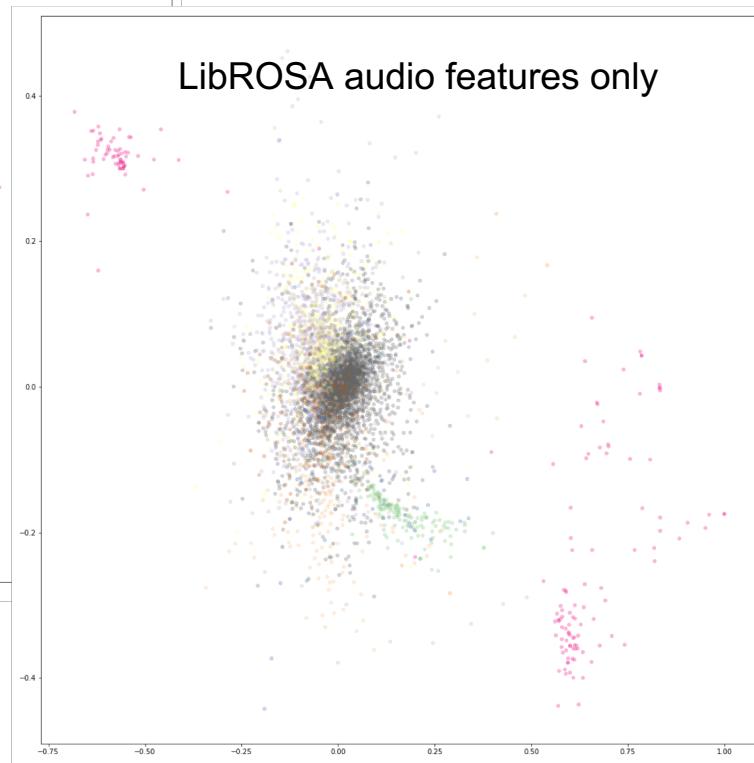
Echonest audio features only



Echonest temporal features only



LibROSA audio features only



Graph selection

Coefficient			Cosine metric		Euclidean metric	
echo. audio	echo. temporal	librosa audio	clust. coeff.	GDC	clust. coeff.	GDC
1	0	0	0.40768	8.32282	0.40943	8.20578
0	1	0	0.35337	8.30906	0.34563	8.20542
0	0	1	0.42140	8.36297	0.41509	8.22717
0.4	0.2	0.4	0.39672	8.40572	0.41190	8.23486
0.2	0.2	0.6	0.39614	8.41026	0.38778	8.23939
0.3	0.1	0.6	0.40566	8.40892	-	-
0.2	0.1	0.7	0.39988	8.40819	-	-

Graph selection

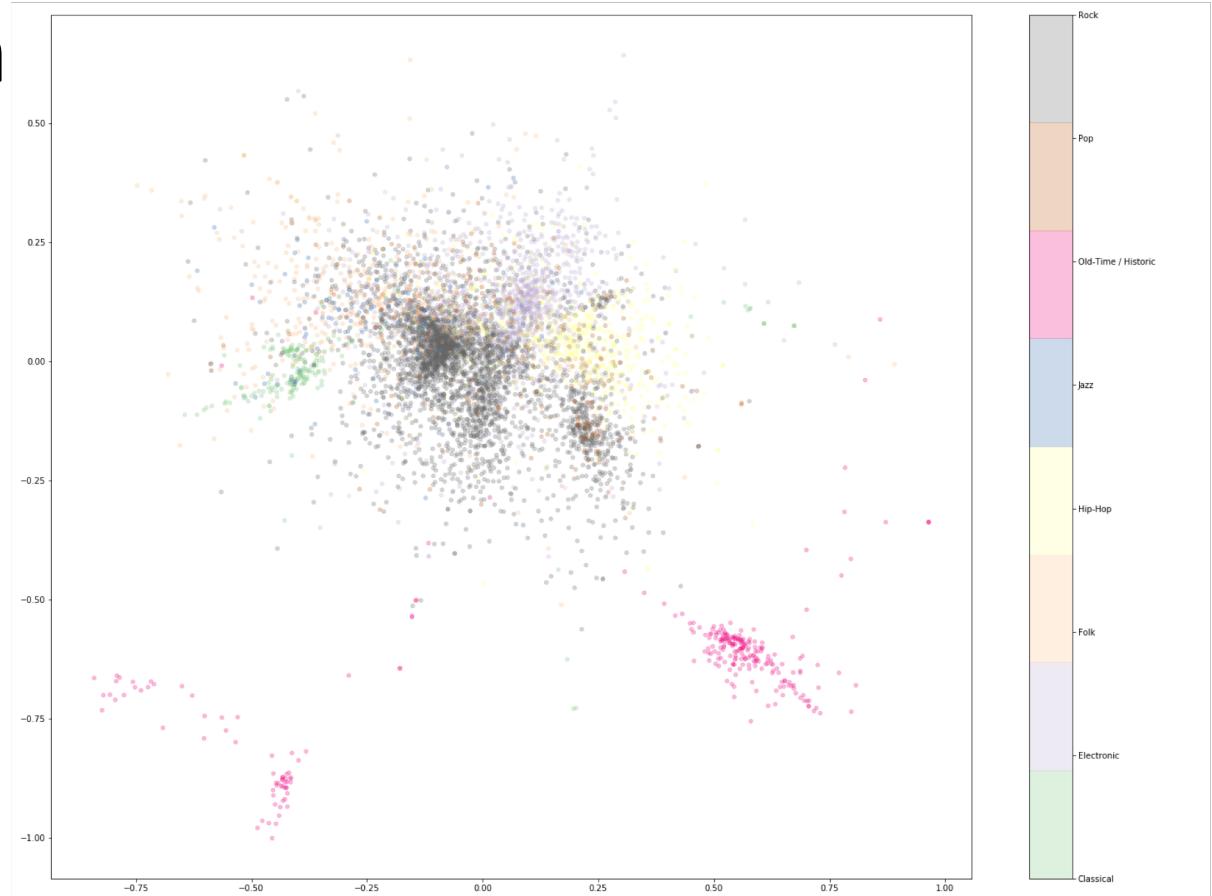
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Resulting graph

→ 7'988 tracks



Playlist creation

- Shortest path \Leftrightarrow distance

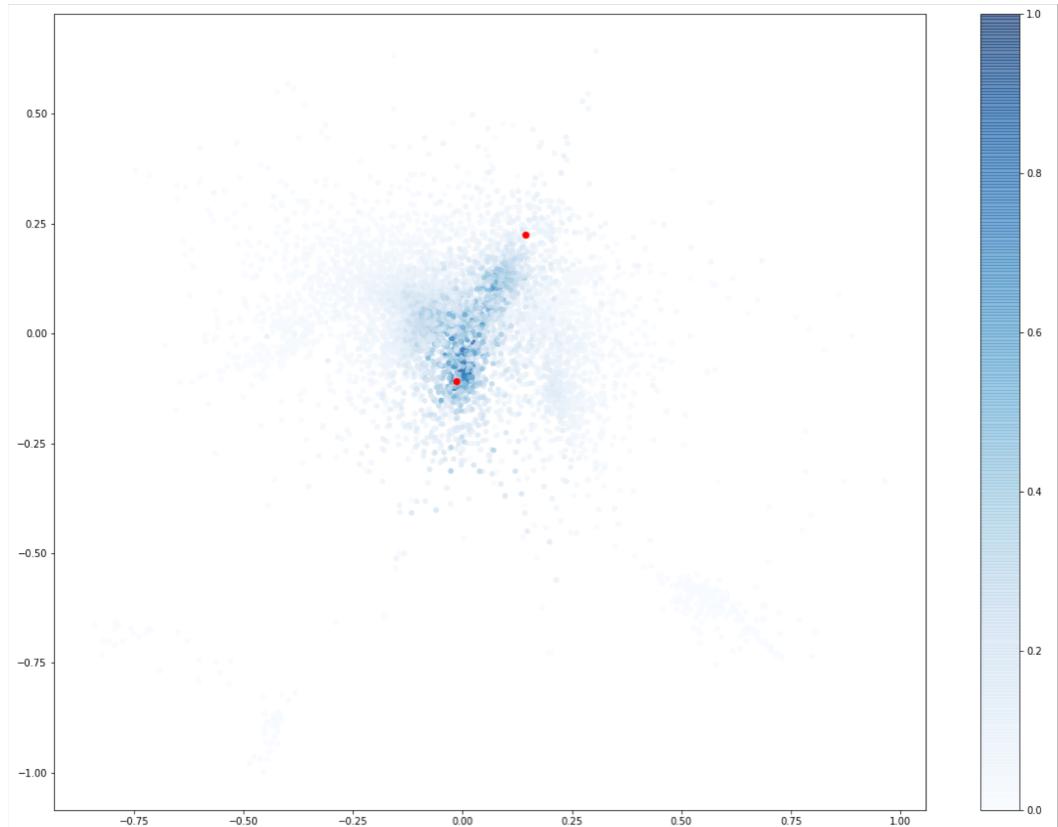
Playlist creation

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Heat filter with $t = 15$

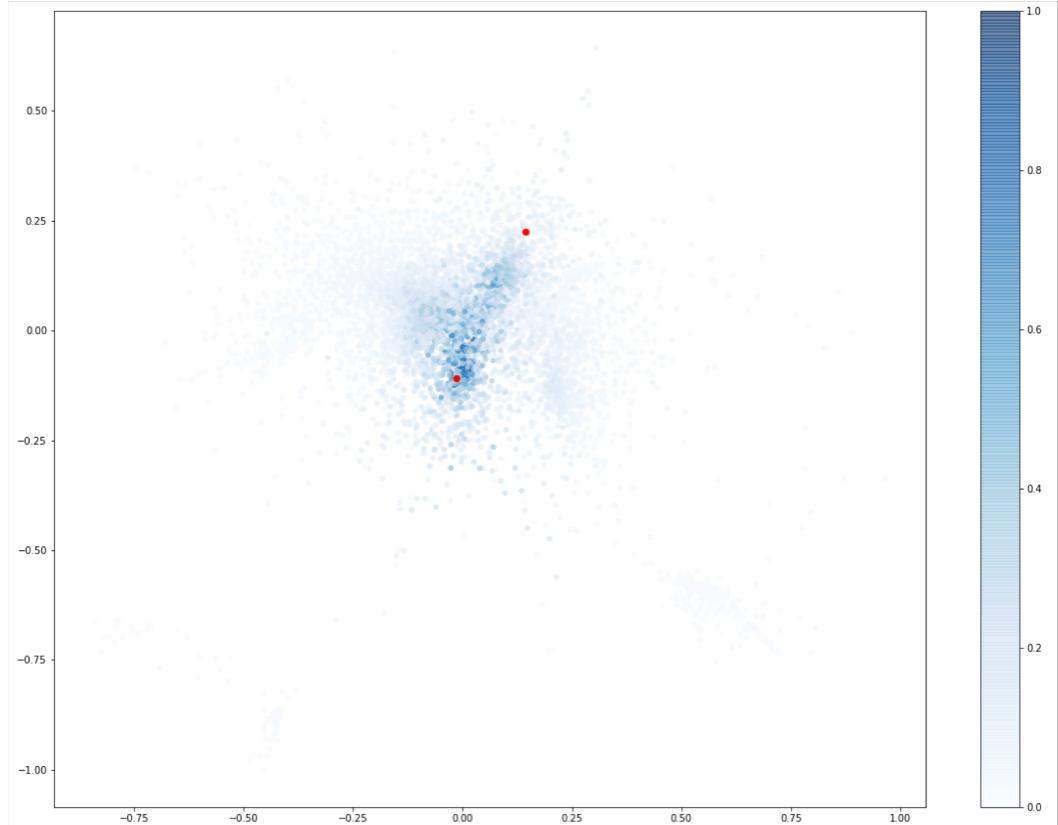


Playlist creation

- Shortest path \Leftrightarrow distance
- Smoother path \Leftrightarrow cost

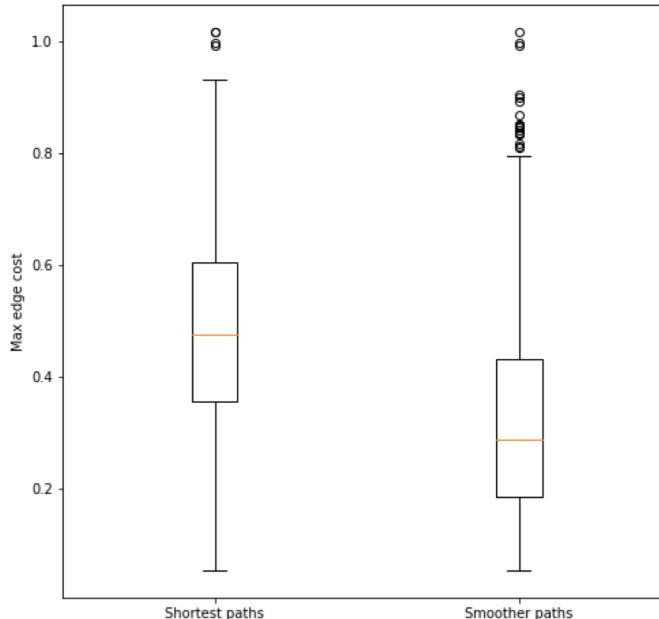
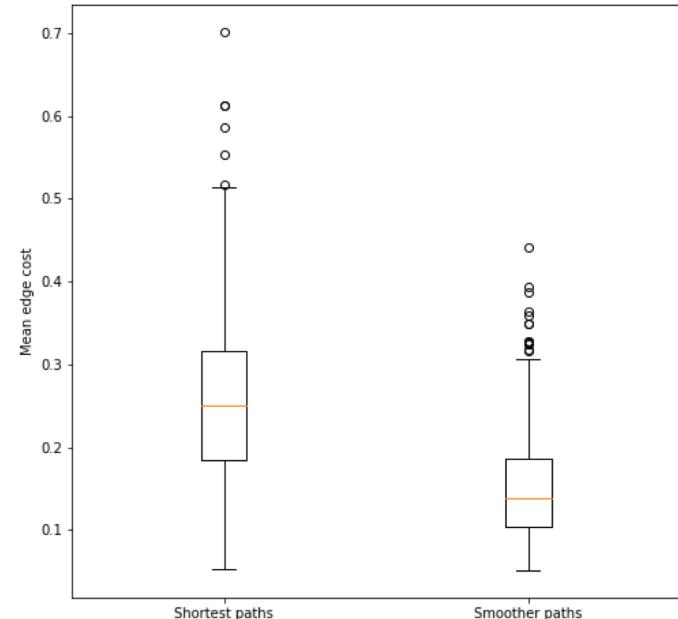
$$cost_{ij} = d_{ij} + |h_i - h_j|$$

Heat filter with $t = 15$

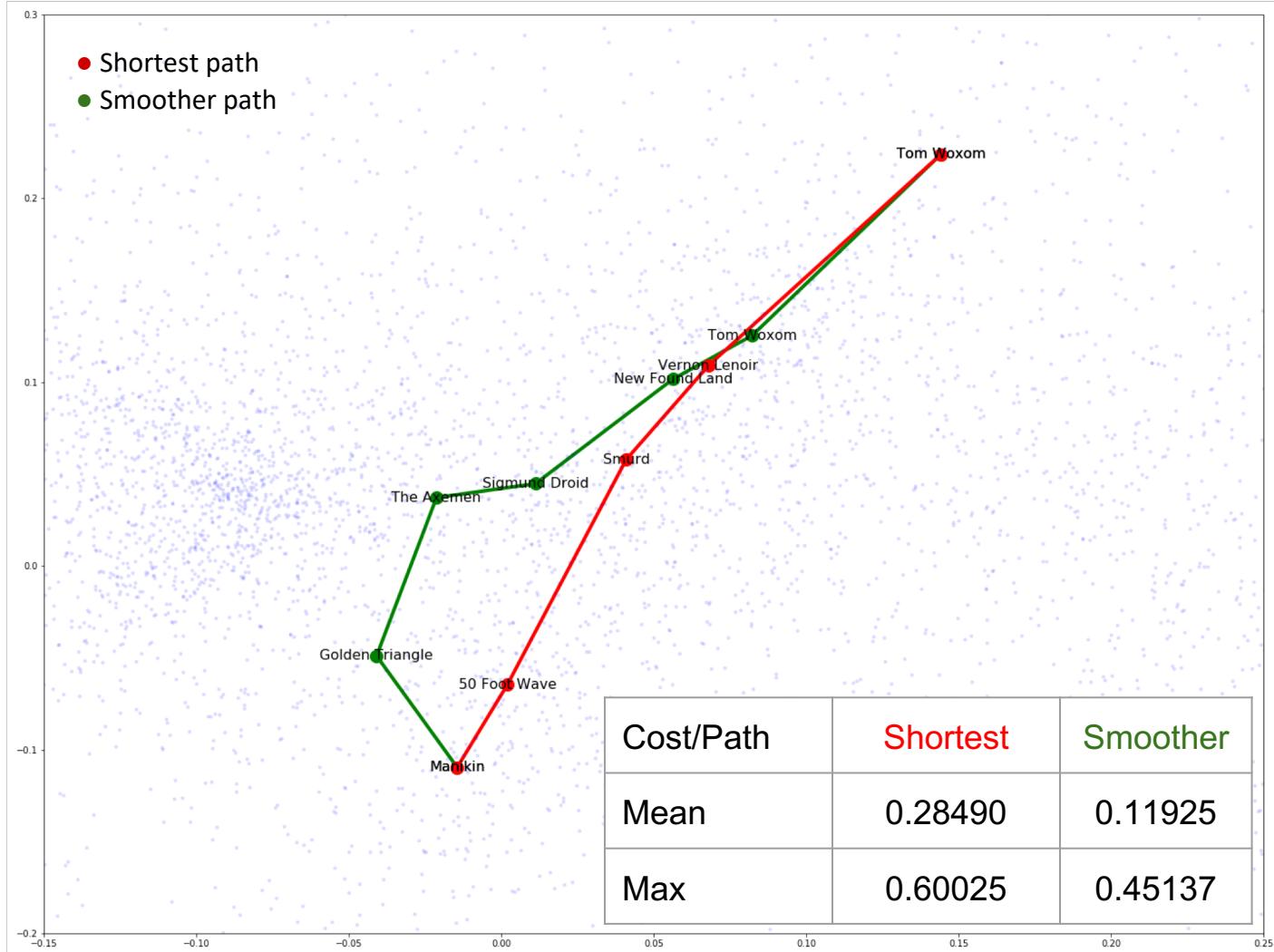


Results

Over 500 random trials :



Example



Conclusion

- Combine linearly three different features sources
- New quantitative metric of graph : GDC
- Diffuse signal on graph using heat filter
- Find smoother path by optimizing cost function that minimizes signal variation

Thank you for listening.
Any questions ?