THE DEEP HISTORY OF MUSIC PROJECT

Armand Leroi, Imperial College London
a.leroi@imperial.ac.uk
Matthias Mauch, Queen Mary University of London
m.mauch@qmul.ac.uk
Pat Savage, Tokyo University of the Arts
patsavagenz@gmail.com
Emmanouil Benetos, Queen Mary University, London
emmanouil.benetos@qmul.ac.uk
Juan Bello, New York University,
jb2843@nyu.edu
Maria Panteli, Queen Mary University, London
m.panteli@qmul.ac.uk
Joren Six, University of Ghent
joren.six@ugent.be
Tillman Weyde, City University London
T.E.Weyde@city.ac.uk

1. INTRODUCTION

Music, like language and genes, is the product of a descent–by–modification process (MacCallum et al., 2012). As such, the current distribution of music styles around the world should reflect the history of human migration and cultural diffusion (Lomax, 1968). However, where geneticists and linguists have developed sophisticated techniques for reconstructing that history, ethnomusicologists have largely abandoned large-scale comparative studies (Leroi & Swire, 2006; Savage & Brown, 2013). Here we outline a proposal to revive comparative musicology using recently digitized ethnomusicological archives and MIR technology. Our study has three objectives: (i) To determine global distribution of musical style; (ii) To investigate the relationship between patterns of musical, linguistic and genetic diversity; (iii) To construct a large open-access database containing MIR features and metadata from traditional music.

2. METHODS

2.1 Sources

Our study relies on recently digitized ethnomusicological archives (Cornelis et al., 2005; Weyde et al., 2014). We have access to the following archives (number of tracks, thousands): British Library, London (33k), Royal Central Africa Museum, Tervuren (30k), Smithsonian, Washington DC (30k), as well as some smaller archives. We are currently in discussions to obtain the holdings of the Centre de Recherche en Ethnomusicologie, Paris and Ethnologisches Museum, Dahlem, both of which contain tens of thousands of tracks. These tracks have been filtered for music that we believe was primarily composed for oral rather than mechanical transmission. We have also standardized the metadata from these diverse sources by means of a standardized geographic and cultural group ontology. In all, we estimate that our initial database will contain ≈75k useful recordings from $>$ 300 cultures.

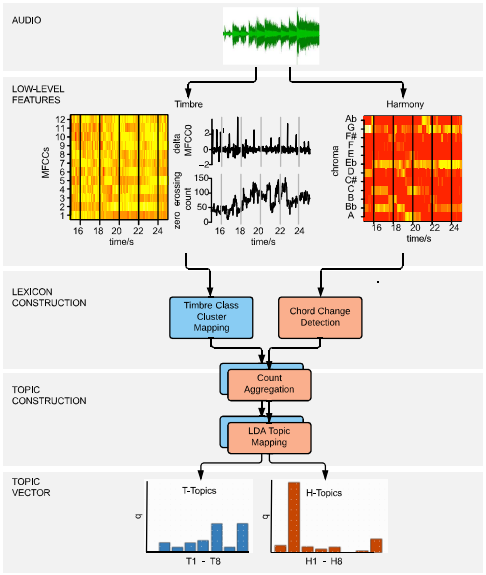

Figure 1: Data processing pipeline illustrated with a segment of Queen's *Bohemian Rhapsody*, 1975. From (Mauch et al., 2015).

2.2 MIR features

We have examined a variety MIR features, focusing on melodic, rhythmic and timbral descriptors that are not specific to Western-tradition music. To do this, we have tested existing descriptors, or modifications of them, against two sets of audio: a small set of synthesized audio designed to vary rhythm and melody systematically, and another set of cross-cultural real-world recordings (Panteli & Mauch, 2015). The rhythmic decriptors that we have tested are Onset Patterns, Fluctuation Patterns and Scale Transform; the melodic descriptors are Pitch Bihistograms, Magnitudes of the 2D Fourier Transform and Intervalgrams. For rhythm, the best performing descriptor was a modification of Onset Patterns, and for melody, the best performing descriptor was a modification of Intervalgrams.

These features were then processed further using a technique inspired by text-mining that we have successfully used in a large study of American popular music (Mauch et al., 2015), shown in Figure 1. Briefly, the features were

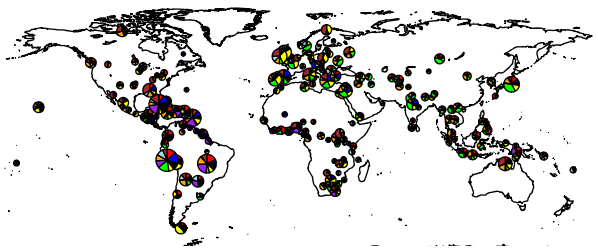

Figure 2: Global map of 7 musical styles.

discretised into "words" resulting in a rhythmic lexicon (R-lexicon), a timbral lexicon (T-lexicon) and a melodic lexicon (M-lexicon). These features were then combined into combinations of musical "words", or "Topics". Each song, then, is described by a vector of 10 R-, T- or M- Topics, making a total of 30 higher-level features.

3. RESULTS

In order to determine whether our features have any power to uncover structure in the world's music, we have been studying a subset of the Smithsonian database. Since most of the variation in music is located within, rather than among, cultures (Savage & Brown, 2014), we think that the basic unit of analysis should be Styles (c.f. Mauch et al. (2015)). To take a first look at such Styles we have carried out K-means clustering on our Topics and mapped their geographic distribution (Figure 2). These results are encouraging for they suggest that particular Styles are indeed enriched in certain parts of the world and hence that our data do capture at least some global musical structure.

4. DISCUSSION

We have only begun to analyse our data. Much remains to be done in terms of filtering our songs further and refining the basic features, Topic analysis, and clustering procedures. Once we have done that, we will proceed to examine the distribution of stylistic patterns formally via Bayesian spatial models in order to distinguish stylistic similarities due to diffusion from those that are due to convergent evolution. The resulting spatial analyses will then be combined with geographic genetic and linguistic data (e.g., Leslie et al. (2015)) in order to test causal, historical, explanations for the distribution of musical Styles.

Although we will initially focus on continent-scale musical diversity, our techniques and data can be used for studies any scale. We envision that our data will form the basis for a publicly accessible database of the world's music that will expand as new MIR features are developed and additional archives are digitized. To that end, we welcome collaboration from MIR experts, ethnomusicologists and archive-curators.

5. REFERENCES

Cornelis, O., De Caluwe, R., De Tré, G., Hallez, A., Leman, M., Matthé, T., Moelants, D., & Gansemans, J. (2005). Digitisation of the ethnomusicological sound archive of the royal museum for central africa (belgium). *IASA JOURNAL*, (26), 35–43.

Leroi, A. M. & Swire, J. (2006). The recovery of the past. *World of Music*, *48*.

Leslie, S., Winney, B., Hellenthal, G., Davison, D., Boumertit, A., Day, T., Hutnik, K., Royrvik, E. C., Cunliffe, B., Lawson, D. J., Falush, D., Freeman, C., Pirinen, M., Myers, S., Robinson, M., Donnelly, P., Bodmer, W., Control, W. T. C., & Genetics, I. M. S. (2015). The fine-scale genetic structure of the British population. *Nature*, *519*(7543), 309+.

Lomax, A. (1968). *Folk song style and culture*. Washington, D. C.: American Association for the Advancement of Science.

MacCallum, R. M., Mauch, M., Burt, A., & Leroi, A. M. (2012). Evolution of music by public choice. *Proceedings of the National Academy of Sciences*, *109*(30), 12081–12086.

Mauch, M., MacCallum, R. M., Levy, M., & Leroi, A. M. (2015). The evolution of popular music: USA 1960–2010. *Royal Society Open Science*, *2*(5), 150081+.

Panteli, M. & Mauch, M. (2015). Suitability of audio features for rhythmic and melodic description of world music styles. In *unpublished*, volume 00, (pp. 00–00).

Savage, P. & Brown, S. (2014). Mapping Music: Cluster Analysis Of Song-Type Frequencies Within And Between Cultures. *Ethnomusicology*, *58*, 133–155.

Savage, P. E. & Brown, S. (2013). Toward a new comparative musicology. *Analytical Approaches To World Music*, *2*, 148–197.

Weyde, T., Cottrell, S., Dykes, J., Benetos, E., Wolff, D., Tidhar, D., Gold, N., Abdallah, S., Plumbley, M. D., Dixon, S., Barthet, M., Mahey, M., Tovell, A., & Alencar-Brayner, A. (2014). Big data for musicology. *1st International Digital Libraries for Musicology workshop*, *00*, 00–00.