Problems and Opportunities of Applying Data- & Audio-Mining Techniques to Ethnic Music

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Abstract

Current research in music information retrieval focuses on Western music. In music from other cultures, both musical structures and thinking about music can be very different. This creates problems for both the analysis of musical features and the construction of databases. On the other hand, a well-documented digitization offers interesting opportunities for the study and spread of 'endangered' music. Here, some general problems regarding the digital indexation of ethnic music are given, illustrated with a method for describing pitch structure, comparing Western standards with African music found in the digitization of the archives of the Royal Museum of Central-Africa in Tervuren (Brussels).

Keywords: ethnic music, Africa, pitch, archiving, databases, cultural heritage

1. Introduction

At the moment most MIR applications are aimed at popular and classical music in the Western tradition. With the increasing use of digital search methods, users are guided to music that is 'searchable'. Music that occupies a more marginal position risks to be omitted from databases, or be much less accessible (e.g. because popular search fields can not be filled out or similarity measures with popular styles are very low). Thus the combination of digitization and commercialization tends to push 'vulnerable' music into oblivion. However, if we develop methods aimed at indexing non-Western music in an appropriate way, the opposite might be true. The use of music databases can bring people in contact with music they would normally never have heard of, and thus give the community a broader view on music.

Simply integrating more ethnic music, and non-western music in general, into the existing databases and indexes, can not entirely solve this problem. Musical structures can be fundamentally different and also the relative importance of structural elements in the musical experiences can be different. In the west, music theory and research traditionally focus on pitch, but in African music a fixed tuning does not exist and relative pitch (higher-lower) is more important than absolute pitch.

Another difficulty of integrating ethnic music in digital music libraries lies in the construction of the meta-data. In the description of field recordings, some information that is 'compulsory' in the description of Western music is lacking, while information that seems irrelevant in the description of Western music is very important. Names of composers are usually not known, performers could be named, but some music is seen as performed by 'the community' and the names of the participants are not considered very important. On the other hand, location and date of the recording are important as documentation for researchers. Not all recordings are well-documented, in some, even the most basic information is lacking, this while the knowledge about traditional music within the cultures is vanishing under pressure of urbanization and Westernization. This combination makes it harder and harder to identify and label the music correctly.

Finally there is also a terminology problem. Different local names for the same concept can exist, and then different researchers can use different transcriptions for these concepts. At this moment the American Folklore Society and the American Folklife Center at the Library of Congress are constructing an "Ethnographic Thesaurus", a comprehensive, controlled list of subject terms to be used in describing ethnographic and ethnological research collections (cf. http://www.etproject.org). But even a standardized list can not solve all problems. We can give the example of the 'thumb piano' (lamellophone). This instrument type is referred to with diverse names (mbira, likembe, sanza, kalimba, etc.). Someone looking for one of these search terms should also be directed to pieces in which one of the other denominations is used (Matthé et al., 2006) To make it even more complicated, one denomination does not necessarily point at a specific subtype: size, material, number of pitches and tuning can widely vary. Therefore the user should be given the means to refine his search by looking for more specific instrument characteristics, or for instruments with a similar tuning.

2. Digitization of the audio collection of the Belgian Royal Museum of Central-Africa

The ideas described in this paper are a result of work on the digitization of the ethnomusicological archives of the Royal Museum of Central-Africa (RMCA) in Tervuren (Brussels). With its 50,000 sound recordings, with a total of 3,000 hours of music, the audio archive is one of the biggest archives in world for the region of Central-Africa, an area where the cultural heritage is endangered by modernization and political instability (Cornelis et al., 2005). The goal of the project is to conserve the unique collection of sound recordings and to make the archives accessible for a broad group of users. This implies the digitization of different types of sound recordings (wax cylinders, sonofil, vinyl recordings and magnetic tapes) each with their own problems, the construction of a database structure that is suitable to describe the music (Matthé et al., 2005) and develop some tools that allow a further analysis and classification. Musicological texts describing the music and instruments of different areas, sound examples and photos from the archives and the collection of the museum are added as background information. The progress can be followed on the website http://music.africamuseum.be/.

An additional challenge is the differentiation between user groups. We can broadly distinguish three groups. The first and largest group is that of people who are just interested in African music, but don't have a good knowledge of it. These people want to find e.g 'drumming', 'trance music' or 'some song from Rwanda', which needs rather vague, general labeling. A second group consists of people from within the culture. They might have a very good knowledge of certain repertoires and functions of the music, and thus ask very specific questions like. music played by a specific performer, music from one particular village, lyrics, genres, instruments (in local terminology). The third group consists of researchers, using the database in their study. For them a fully indexed electronic database is an excellent tool to study elements like the geographical spread of certain instrument types or the relative importance of certain musical structures in different regions.

Interesting applications for the first group could be query by example, or searching by affective parameters. Latter two groups can add valuable information to the database. For this reason a forum is set up, when the database will be fully available, users will be invited to discuss on certain topics in this forum and hopefully this

will allow us to fill some gaps, come in contact with researchers how to use the database and might give ideas for the development of additional search tools and extend the database with (copies of) recordings kept at other institutions or by private persons.

3. Pitch structures in African Music

Models for pitch detection generally assume that there are certain fixed elements like 12 chromatic tones, a tonic and a dominant and octave relationships. These concepts allow describing, comparing and classifying the pitch structure in different pieces. When studying African Music we can not hold these concepts as basis of our study. This is a problem with which ethnomusicologists already have to deal with for many years in making transcriptions, usually solving it by adding additional marks for deviations from regular tuning, sometimes adding precise pitches.

The music of Central-Africa uses many different tunings and scales. In fact, melody is closely connected to the tones of Bantu languages. The music thus follows the melody of speech. Therefore it is more important to have high and low pitches as such than to have specific harmonic relations between them. Furthermore in this region instrumental sounds with a very broad, percussive spectrum are preferred, which also reduces the importance of 'correct' intervals. Nevertheless there instruments with a fixed tuning like flutes, citers, (wooden) trumpets or thumb piano's allow to study the scales used.

In order to study the scales and tunings, a system was developed that allows representing scales without reference to Western notes or scales. Instead of an a priori thinking in pitch categories, we chose to start from a continuous representation of pitch. In a first stage the music is analyzed by a melody extractor (De Mulder et al., 2004). This system was originally devised for vocal queries, and is thus optimized for monophonic music and the normal voice range. Yet, testing the model on different types of music reveals that it can give a very good image of the distribution of pitches in music with a more complex texture. The melody extractor currently used gives a frequency for every time frame of 10 ms. In order to give an image of the scale, we transform these values to cent values (taking the low A, 55Hz as 0 cents) and then make a frequency table by cent values between 1 and 6000.

The method is illustrated bye the analysis of a song "Ingendo y'inka" with ikembe (thumb piano) accompaniment recorded on 14 Jan 1973 by Jos Gansemans in the village Karengera, Cyangugu province, Rwanda. The singing is mainly in parlando style, following the pitches of the instrument. The text describes the elegance of the local cows. If we extract the most prominent peaks (table 1) we see more or less equidistant intervals, with an average size of 236 cents. The intervals betweens successive tones are somewhat larger than a

whole tone but the size is rather variable (202-286 cents), but the octave relationships are generally quite well preserved, which is also the case for the fifths. However, we see that the highest octave is much (60 cents) too small, while the lowest is 25 cents too wide. This causes a problem when we want to reduce the representation to one single octave (see Figure 1). Three tones keep a very narrow peak, indicating near perfect octave relationships, but the middle peak is clearly widened and in the left peak, the one corresponding to the extreme pitches we clearly see a combination of three smaller peaks.

Table 1: analysis of the most prominent peaks in "Ingendo y'inka", left the pitch in cents above 55 Hz, next the distance in cents between successive pitches and in the right column the size of the octave relationships.

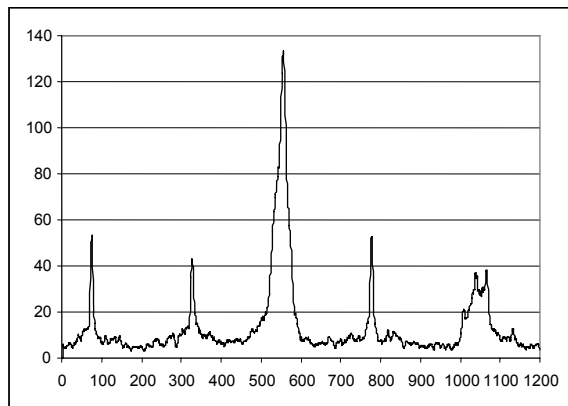| pitch	interval	octave
1042	236	1225
1278	264	1199
1542	202	1185
1744	237	1214
1981	286	1198
2267	210	1140
2477	250	
2727	231	
2958	221	
3179	228	
3407		

Figure 1: pitch analysis of "Ingendo y'inka", reduced to one octave, on the x-axis the pitch in cents (0 = a), on the y-axis the smoothed number of occurrences for every 1 cent.

This example illustrates the difference between African and Western tone systems very well. The Western system uses a chromatic scale in which interval sizes are multipliers of 100 cents and there is a strict adherence to a 1200 cents octave. In African music there is no standard tuning, in this case there is a more or less equidistant pentatonic scale, but many different scale types are found. The octave exists, but it's role is not absolute. In fact it is not unusual that players deliberate tune some of the octaves to wide or to narrow in order to create an extra rich timbre.

The graphic representation can be the basis of comparison of tone systems. This can allow to use the system for musicological applications (e.g. to map the spread of certain tone systems), but also to let a user of the database look for similar music.

4. Conclusions

Constructing MIR applications that can deal with the world's music is difficult, but necessary to protect the world's cultural heritage. It is important to bring knowledge about the music together and make it accessible to a broad audience. The fundamentally different use of pitch in African music compared to Western music illustrates the difficulty of simply applying existing methods to other bodies of music in order to index it. In this phase of the project of digitizing the archives of the RMCA we started to develop some methods that should be able to deal with all types of musical content. This was illustrated by a method of extracting the scale of a musical piece and representing it in a graphic notation that can serve as basis of comparison with scales used in other pieces, regardless of their cultural background and tone system

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