OPPORTUNITIES FOR A CULTURAL SPECIFIC APPROACH IN THE COMPUTATIONAL DESCRIPTION OF MUSIC

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ABSTRACT

The current research in Music Information Retrieval (MIR) is showing the potential that the Information Technologies can have in music related applications. A major research challenge in that direction is how to automatically describe/annotate audio recordings and how to use the resulting descriptions to discover and appreciate music in new ways. But music is a complex phenomenon and the description of an audio recording has to deal with this complexity. For example, each music culture has specificities and emphasizes different musical and communication aspects, thus the musical recordings of each culture should be described differently. At the same time these cultural specificities give us the opportunity to pay attention to musical concepts and facets that, despite being present in most world musics, are not easily noticed by listeners. In this paper we present some of the work done in the CompMusic project, including ideas and specific examples on how to take advantage of the cultural specificities of different musical repertoires. We will use examples from the art music traditions of India, Turkey and China.

1. INTRODUCTION

Due to the widespread use of the Information Technologies in the distribution and consumption of music, the topic of automatic description/annotation of audio recordings has become a research topic with many practical applications. This research is being carried out within the field that is known as Music Information Retrieval, whose main application focus has been the development of automatic recommendation systems. The research topics actively being worked on include: audio identification, beat detection, prominent melody extraction, genre identification, cover song detection, or query by humming.

As the information processing techniques become more sophisticated and they start to deal with more semantically meaningful concepts, there is a need to incorporate domain specific knowledge into the systems. Without incorporating top-down and contextual information, we will not advance much more in the automatic description of music and it will be difficult to identify new problems. Many of the new research problems emerge when we extend the "recommendation" focus and consider the broader context of discovery, which also requires developing technologies for other uses, such as education or active listening.

There is the common belief that music is a universal language, understood and shared by everyone. This is so if we stay at a superficial level, but as soon as we go deeper we realize that every music has a personality which is very much linked to its context; context that can be historical, personal, cultural, or functional. A piece of music is best understood if we take into account the context within which it has been created, and it is supported and appreciated.

In the CompMusic project [1] we work on the automatic description of music by emphasizing its cultural context. To study and emphasize this aspect we focus on music repertoires coming from strong cultural traditions that are as different as possible from the western classical music. We have started working with art music traditions of India, Turkey and China, trying to learn and take advantage of the musicological studies available. Most of the initial results have been presented in the 2nd CompMusic workshop[1].

In the next section we identify the research areas of relevance to our work within the fields of MIR and Computational Musicology. Then we present and discuss some research topics that have been identified as relevant for CompMusic, such as melodic and rhythmic description, community profiling, and discovery applications. Finally we also mention some research opportunities that could be explored in the future.

2. MUSIC INFORMATION RETRIEVAL AND COMPUTATIONAL MUSICOLOGY

The field of MIR has developed its main research focus from a particular commercial need, the one to recommend relevant audio recordings to consumers in on-line systems. Given that most of the music industry is dedicated to the distribution of western pop music, the research community tends to focus on the audio

[1] http://compmusic.upf.edu/node/130

collections that the big record labels have on this type of music. There has been a lot of progress in the automatic management of collections of audio recordings and the problems being looked at have evolved over the last decade. It started by studying low-level audio issues and it is recently working on higher-level semantic topics. Following the ISMIR conferences we can see this progress and identify the current trends [2]. Most of the research being reported is based on applying machine learning techniques to large data repositories. The community is quite conscious of the limitations of the current approaches [3] and advancements are being explored by increasing the sizes of the audio collections and the variety of the data types used.

The term Computational Musicology comes from the research tradition of musicology, field that has focused on the study of the symbolic representations of music (scores) of the classical western music tradition [4]. This research perspective takes advantage of the availability of scores in machine-readable format. Music theoretical models, like the one by Lerdahl and Jackendoff [5], are very much followed and current research focuses on the understanding and modeling of different musical facets such as melody, harmony, or structure, of western classical music. This research can be followed in the yearly journal Computing in Musicology[2]. From there it is clear that this field has been opening up, approaching other types of music, such as popular western music or different world music traditions, and it has started to use other types of data sources, such as audio recording. Thus there is an increasing research convergence between the Computational Musicology and MIR communities.

3. MELODIC DESCRIPTION

Melody is one of the fundamental music elements of most music cultures. It is a concept difficult to define and very much culture dependent. For our research approach it is good to generalize the common definitions used for western music and, using an engineering perspective, consider a melody as the time-dependent pitch variations performed in a piece. Then as we focus on particular music genres we will be more precise and adapt the definition to it.

Within computational musicology, melodic analysis has been approached from the symbolic notation [6]. In MIR, given the tradition to focus on the audio recordings, melodic analysis requires identifying the melodic pitch contours from the audio [7]. This is quite a bit harder and the current results are quite limited.

When we look into some specific music traditions the study of melody has to be rethought. For example in the case of Indian art music there are no scores comparable to the ones used in western music and it requires focusing on using audio recordings. Also other music concepts need to be studied, such as the issue of tonic [8] [9], of intonation [10], or of *rāga* [11]. From our initial results it is clear that the study and characterization of melodic motifs is fundamental to understand Indian art music.

For the case of Turkish makam music, both the Ottoman tradition and the folk traditions, the study of the microtonal characteristic is a basic issue, which has started to be approached computationally [12]. Given that scores are available in machine-readable formats [13] it is possible to study melodies using them [14] [15]. However the extensive expressive deviations that are used by performers [16] require the study of audio recordings, ideally being able to take advantage of the complementarity of the information available in the scores and the audio recordings [17]. In this music the concept of *makam* is at the core of all melodic organization.

4. RHYTHMIC DESCRIPTION

Rhythm is another fundamental element of music, and like the melody it is a difficult concept to define that is also very much culture dependent. A useful general way to define it, again from a practical engineering approach, is to say that rhythm is the arrangement of sounds and silences in time establishing patterns of strong and weak events.

Most rhythm analysis done in MIR and Computational Musicology has focused on music that has a very hierarchical metric structure, with regular pulses on each level and simple periodic relations [18].

In Turkish Makam music, just as in other related Makam traditions, the metrical description of a piece is traditionally given by a verbal sequence that defines a series of strong and weaker intonations in time, called *usul*. There has been very little work on computational approaches to model *usuls* and in CompMusic we just started to look into some of its characteristics [19].

In Indian art music rhythm is organized around the concept of *tāla* [20], the framework that organizes the rhythmic structure at multiple time-scales. Some computational work has been done on understanding *talas* but we are just starting with it [21].

There is quite a bit of world music that is unmetered [22]. The *alaps* in Indian music or the *taksims* in Turkish music are good examples of that. Some of this music has a clear pulse but most it does not. These music styles offer a very interesting ground on which to study rhythmic structures that are not based on meter.

5. COMMUNITY PROFILING

An important aspect of a culture specific approach to music analysis is to take into account the social context, thus to use the characteristics of the community that creates and supports a given musical repertoire to help describe the actual music content. We are interested in characterizing computationally the views and preferences of specific music communities. For this we study the digital footprint that on-line music communities leave.

This area is very much within the semantic web field, related to the research aiming at converting unstructured and semi-structured data into meaningful semantic information. Very little work has been done on this in

[2] http://www.ccarh.org/publications/cm/

MIR but there are some publications on the analysis of social tags and their use in recommendation systems [23].

In the context of CompMusic we have started to look into community profiling from the perspective of the different cultures we are studying. In particular we have started to develop a methodology for extracting music-related semantic information from an on-line discussion forum of Carnatic music [24].

6. MUSIC DISCOVERY

In CompMusic the main application area that we want to focus on is music discovery, with the idea of developing technologies with which to explore culture specific music audio collections. We are putting together audio collections that include different data types coming from different sources and we want to convert this data into information with which a user can interact. A part from the need to extract semantic information from the available data, the main research challenge for a discovery application is to develop culturally and musically meaningful distance measures between all the difference information entities of a given music audio collection. These distances should allow navigating and listening to songs while learning to appreciate the different aspects that characterize a musical style. Our initial work has been to develop a web application that interfaces with all the data gathered (audio, scores, plus contextual information) and all the semantic information that is automatically generated with the developed methods [25].

7. OTHER RESEARCH OPPORTUNITIES

We have outlined a few of the opportunities that the study of specific music cultures have for research in music information research. Clearly there are many more.

In the case of the music traditions of China, whose study we have not yet started, we have identified some issues that we would like to work on. One is the relationship between music and language. All Chinese languages are tonal, which means that many words are differentiated solely by tone, and each syllable in a multisyllabic word often carries its own tone. These tones are distinguished by their pitch contour and range. The tonal characteristics of the languages have clearly influenced all Chinese musics but we have not identified any academic discussion on it. We have found that the Beijing Opera [26] offers a very good ground with which to study some of these aspects.

Another interesting research topic is the relationship between music and gesture. For example the *Guqin* [27], a plucked seven-string Chinese musical instrument of the zither family, has an amazing tradition in which the performance gestures play a fundamental role in the musical expression. The cypher notation used in *Guqin* music that is more than 2000 years old, details quite well the gestures to be used in playing.

Musical emotion is another topic that is very much tied to cultural context. For example the concept of *rasa* in Indian art, first enunciated in the *Nāṭyaśāstra* [28], offers a very fruitful ground for studying emotions with a very different point of view than the one normally used in MIR.

8. CONCLUSIONS

In this article we have introduced and outlined some of the current topics that are being worked in the CompMusic project and some of the ideas that we want to develop in the near future. Most of these topics have been more extensively presented in the 2nd CompMusic workshop that took place in Istanbul in July 12th and 13th 2012, thus we refer to the proceedings of the workshop for further explanations and presentations of the initial results of this research.

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