Optimising Music Information Retrieval Systems Using Automatic Music Analysis Algorithms

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Summary of the Research Proposal

Music Information Retrieval, (at times referred as MIR), is a research topic that has been studied extensively during the last half a decade. One of its famous instances is the so-called query by humming application (see e.g. [2, 4]). Given a large database of music, the task is to find those pieces of music that contain excerpts mostly resembling (in a musical way) the hummed query.

The MIR systems can be divided into two separate categories: methods comparing input signals to audio signals stored into a database and methods comparing a transcription of input signal to symbolic representations of musical pieces. This PhD work concentrates on the latter category of the MIR systems.

The MIR methods that use symbolic data representations are mainly based on the string matching techniques. Even though these techniques are very efficient, they lack aspects that are musicologically meaningful. The main hypothesis of this work is that the MIR systems can be optimised using automatic music analysis algorithms in various phases of the retrieval process.

The MIR process can be divided into at least three separate phases: analysis of the input, comparison of the input to the database and representation of the results in a meaningful way. Each of these phases will be examined and new algorithms for optimising each phase will be presented in this work.

In the first phase of the process, a user produces a query. Especially when the query is hummed, the pitch and rhythm values of the notes could be inaccurate due to bad memory or singing skills. There are at least two different ways of solving this problem: using the more robust matching algorithms and analysing and optimising the query beforehand. Increasing the robustness of the matching algorithm leads potentially to vast amount of results, most of which are inaccurate. Therefore this work concentrates on the latter solution using the theories of musical expectancy (see e.g. [1]).

The efficiency of the second phase, matching the query, is dependent on both the matching algorithm and the size of the database. Even though the efficiency of the matching algorithms has increased considerably, there are only a few methods that aim at limiting the search space beforehand [3]. The search space can be limited using various means such as indexing the database [6, 7]. The index should consist of some meaningful excerpts of musical pieces such as repeating patterns (see e.g. [5, 10]) or extracted melodies. In this work the search space is limited using the approach introduced above.

In the third phase, the user should be allowed to browse the resulting musical space using the characteristics of the pieces, such as melodic and rhythmic information. Especially when the user wishes to browse the database without limiting query, the database should be organised in a meaningful way. One way to organise the contents of the database is to cluster it using desired similarity criteria [8, 9]. The method presented in this study allows clustering to be based on both the deep level structure and the surface level characteristics.

The PhD work described above is scheduled as follows. At this moment two of the methods described above are completed and either published [7] or submitted to peer review [9]. The study considering the optimisation of given queries is carried out during the summer and autumn 2004. The method for extracting melodic voices from polyphonic sources is carried out during

the spring 2005. The summer and autumn 2005 are reserved for developing one still undefined method and the PhD thesis will be completed by the summer 2006.

References

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