

Towards an Indexing Method to Speed-Up Music Retrieval

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ABSTRACT

Computations in most music retrieval systems strongly depend on the size of data compared. We propose to enhance performances of a music retrieval system, namely a harmonic similarity evaluation method, by first indexing relevant parts of music pieces. The indexing algorithm represents each audio piece exclusively by its major repetition, using harmonic descriptions and string matching techniques. Evaluations are performed in the context of a state-of-the-art retrieval method, namely cover songs identification, and results highlight the success of our indexing system in keeping similar results while yielding a substantial gain in computation time.

Categories and Subject Descriptors

H.3.1 [Information Storage and Retrieval]: Content Analysis and Indexing—*Indexing methods*

General Terms

Algorithms, Performance, Experimentation

1. INTRODUCTION

With the growing presence of large collections of musical content, methods for facilitating efficient browsing become more and more useful. The research field of Music Information Retrieval (MIR) aims at analysing and comparing music pieces on musical criteria, such as harmony, timbre, rhythm etc. Most MIR comparison systems are based on a common scheme to estimate similarity on audio material. One or several audio features are chosen and computed on signals segmented in small parts, or frames, thus providing feature sequences representing pieces. For instance, harmonic information is often used since it provides a good insight of the architecture of music pieces. Then, adapted algorithms, such as dynamic time warping or alignment techniques, are used to yield similarity scores between sequences. However, algorithms involved in such retrieval systems highly depend on the length of representative sequences. Harmonic sequences, for instance, are usually relatively long and induce a high computational cost to be compared. Hence, many works over the last decades focused on the detection of the most salient parts in musical sequences in order to speed-up music retrieval and analysis (see for instance [8]).

In this study, we propose to reduce the size of musical sequences by selecting relevant parts in order to index data involved in retrieval tasks. Our indexing method uses harmonic representations analysed by string matching techniques to isolate specific parts. Then, our indexing process is evaluated in the context of harmonic similarity from a data reduction step preliminary to cover song identification.

2. INDEXING PROCESS

Audio pieces are represented by sequences using *Harmonic Pitch Class Profiles* (HPCP) [1], frequently used to describe harmonic information. The aim of the indexing step is to extract a specific part in each audio piece, namely the *major repetition*, that can roughly be described as the longest repeated part perceived in a piece. In western popular music, for instance, this repetition classically consists in the concatenation of a verse and a chorus. The motivation of such a selection is to reduce the audio representation to a summarized, less redundant version, that remains relevant to characterize properly the music piece. To isolate relevant parts, each harmonic sequence is analysed using string matching techniques by considering each HPCP feature as a symbol. We consider the polynomial algorithm proposed by Karman et al. [2], that mainly relies on a local alignment algorithm [5] to detect approximate repetitions. In order to evaluate the alignment score of approximate repetitions, the latter technique requires scores for substituting each feature by another one and gap penalties. These scores are determined according to the *Optimal Transposition Index* (OTI) method [4], which ensures a higher robustness to musical variations. The Pearson correlation coefficient is used as a similarity measure for OTI evaluations. For a detailed description of the indexing process, please refer to [3].

3. HARMONIC SIMILARITY

The above process is evaluated as an indexing step for music retrieval, more specifically on harmonic content. One way to evaluate harmonic similarity retrieval systems is to identify cover songs, i.e., every new recording, performance, or rendition of a previously recorded musical piece. In cover songs datasets, music pieces are divided into several classes, each one containing all the different covers of a track. Harmonic baselines of cover songs of a same piece are likely to remain very similar, even in presence of strong musical variations. For our experiments, we focus on a robust cover song identification method, proposed by Serra et al. [4], and we compare its performances with and without the major repetition indexing step.

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Table of Contents Research And Development In Information Retrieval

1. Understanding the eBook Research And Development In Information Retrieval
 - The Rise of Digital Reading Research And Development In Information Retrieval
 - Advantages of eBooks Over Traditional Books
2. Identifying Research And Development In Information Retrieval
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Research And Development In Information Retrieval
 - User-Friendly Interface
4. Exploring eBook Recommendations from Research And Development In Information Retrieval
 - Personalized Recommendations
 - Research And Development In Information Retrieval User Reviews and Ratings
 - Research And Development In Information Retrieval and Bestseller Lists
5. Accessing Research And Development In Information Retrieval Free and Paid eBooks
 - Research And Development In Information Retrieval Public Domain eBooks

- Research And Development In Information Retrieval eBook Subscription Services
- Research And Development In Information Retrieval Budget-Friendly Options
- 6. Navigating Research And Development In Information Retrieval eBook Formats
 - ePub, PDF, MOBI, and More
 - Research And Development In Information Retrieval Compatibility with Devices
 - Research And Development In Information Retrieval Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Research And Development In Information Retrieval
 - Highlighting and Note-Taking Research And Development In Information Retrieval
 - Interactive Elements Research And Development In Information Retrieval
- 8. Staying Engaged with Research And Development In Information Retrieval
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Research And Development In Information Retrieval
- 9. Balancing eBooks and Physical Books Research And Development In Information Retrieval
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Research And Development In Information Retrieval
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Research And Development In Information Retrieval
 - Setting Reading Goals Research And Development In Information Retrieval
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Research And Development In Information Retrieval
 - Fact-Checking eBook Content of Research And Development In Information Retrieval
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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