Preface

INTRODUCTION

As an important form of human expression and creativity, music data has permeated into every corner of our daily life. At the beginning of 21st century, empowered by advances in networking, data compression and physical storage, modern information systems deal with ever-increasing amounts of musical data. However, effective searching and retrieving continue to be one of the most challenging research problems. The development of new technology to facilitate music information retrieval and management has gained considerable momentum. However, relatively less attention has been paid in this field. In comparison with data from other application domains, music information enjoys many unique characteristics and the most important ones are:

1. **Rich semantics:** Music data contains a large amount of information relative to its high-level semantic meaning. On the other hand, most user queries are semantically-based (e.g., "find all music items with guitar and drums performed by Michael Jackson"). How to generate a concise comprehensive representation for such information is an important but challenging problem. Any useful solution must be efficient in term of computation cost and effective in calculating a content descriptor that represents the semantics of the data item.
2. **Large volume:** In music applications, the size of data is huge (each item is much larger than a tuple in a conventional (relational) data repository). Dealing with such data items requires large amounts of computer resources such as storage and data processing power. A typical example is that audio and video data may exceed gigabytes on personal computers. Storage and data management solutions provided by state-of-art relational database management systems (DBMSs) are generally not adequate in such cases. New techniques for managing such large data sets need to be developed to provide economic and effective access and management.
3. **High dimensionality:** Representations of low-level acoustic features are high-dimensional in nature. Typical examples are the feature vectors for properties such as pitch and timbre extracted from raw audio data. In extreme cases, it could require thousands of dimensions to represent a particular feature, and dozens of dimensions are typical. It is extremely difficult for the current techniques to deal efficiently with such kinds of data. As a consequence, dimensionality reduction becomes an important technique in dealing with music data. However, it is important that the reduction does not lose useful discriminative information for indexing and classification.
4. **Complex structure:** Music can be treated as a nonlinear composite of various kinds of characteristics from different sources. Applying traditional solutions developed for the extraction of knowledge and querying results from structured data (e.g., tabular data) is not feasible in this case. Further, it appears that knowledge discovery and retrieval in music data cannot be simply based on the concatenation of the partial information obtained from each part of the target object. Therefore, developing multimodal techniques to integrate different kinds of information seamlessly is essential for effective knowledge discovery and information retrieval.

All of these musical characteristics make information retrieval, knowledge discovery and content management on music data challenging. Indeed, modern information technologies lag far behind in their support for efficiently accessing and managing music data.

The main objective is to assemble together, in a single volume, contributions on the topic of modern music information retrieval and management, including tools, methodologies, theory and frameworks. The book will present and provide insights into both the state-of-the-art music information retrieval issues and techniques and future trends in the field. It will also serve as a useful guide for researchers, practitioners, developers and graduate students who are interested or involved in the design, state-of-the-art development, and deployment of in music retrieval, music data management, music knowledge discovery and other related applications.

TARGET AUDIENCE

The primary target audience for the book includes researchers, graduate students, developers and users who are interested in designing, using, and/or managing complex music information systems. Potential users can be music researchers, entertainers or professionals from the music industry or amateur music lovers. The book will provide reviews of the concerned modern technology and insights for music information retrieval. It can be used as a comprehensive reference for both professional and amateur users or a textbook for graduate and senior undergraduate students who are specializing or taking a course in multimedia information systems.

ORGANIZATION OF THE BOOK

The book contains 14 chapters organized under 4 sections. Each section addresses a topic or main research theme, which is relevant to music information systems. Detail arrangement is as follows:

Section I: Indexing and Retrieving Music Database

Chapter I: Content-Based Indexing of Symbolic Music Documents. The chapter gives a review on basic concept and describes some relevant aspects of indexing of symbolic music documents. The effectiveness of different approaches is discussed and authors show how individual indexing can be combined together by applying data fusion methods.

Chapter II: MARSYAS-0.2: A Case Study in Implementing Music Information Retrieval Systems. The author presents that Marsyas, is an open source audio processing framework with specific emphasis on building Music Information Retrieval systems. It has been been under development since 1998, and has been used for a variety of projects in both academia and industry. In this chapter, the software architecture of Marsyas will be described.

Chapter III: Melodic Query Input for Music Information Retrieval Systems. The chapter gives a comprehensive discussion on key issues of building and using a system designed to search and query a music collection through the input of the actual or perceived melody of a song. Author also presents a detailed survey and discussion of studies, algorithms, and systems created to approach this problem, including new contributions by the author. Emphasis is placed on examining the abilities and likely errors of those with little or no formal musical training to remember and reproduce melodic phrases, as these must be taken into account for any music information retrieval system intended for use by the general public.

Section II: Music Identification and Recognition

Chapter IV: An Expert System Devoted to Automated Music Identification and Recognition. This chapter describes an expert system based on logic and algebra that automates identification and recognition of the cult music styles of the XVII century - beginning of the XX century. It uses a table that contains a list of characteristics (identifiers) of the music styles of the epoch, developed after interacting with a panel of experts. The user, while or after analyzing a score, introduces the identifiers and the expert system returns the score's style.

Chapter V: Identifying Saxophonists from their Playing Styles. The chapter focuses on the task of identifying performers from their playing style using high-level semantic descriptors extracted from audio recordings. The identification of performers by using the expressive content in their performances raises particularly interesting questions but has nevertheless received relatively little attention in the past.

Chapter VI: Tools for Music Information Retrieval and Playing. The chapter focuses on the advanced tool and analysis technique for music information retrieval and playing. The authors introduce and analyze the symbolic level of music: some of the main models and techniques developed up to now. The chapter also gives detail survey on musical feature extraction for music content representation.

Section III: P2P and Distributed System

Chapter VII: Collaborative use of Features in a Distributed System for the Organization of Music Collections. The chapter introduces a method of feature transfer which exploits the similarity of learning tasks to retrieve similar feature extractions. This method achieves almost optimal accuracies while it is very efficient. Nemoz, an intelligent media management system, incorporates adaptive feature extraction and feature transfer which allows for personalized services in peer-to-peer settings

Chapter VIII: A P2P based Secure Digital Music Distribution Channel: The Next Generation. This chapter presents a model enabling content providers to successfully sell digital music. Authors show that content providers must overcome three main hurdles to successfully sell digital music. The first is to establish an efficient and economically viable distribution channel. Second, they need to develop a secure and interoperable framework for protecting copyrighted digital music from piracy by integrating Digital Rights Management Systems into the distribution channel. The third hurdle is to set-up a robust payment mechanism that meets the content providers' needs for revenue capturing and the consumers' needs for hassle-free and legal content acquisition and usage.

Chapter IX: Music Information Retrieval in P2P Networks. In this chapter, authors present the most significant trends in recent research in the field of content-based music information retrieval in peer-to-peer networks. Despite the diminished attention the area has received in general terms, the relatively close area of metadata MIR in P2P is by far new. As metadata prove to be inefficient for the purposes of MIR as well as the peculiarities of music in comparison to text and image data, developing dedicated solutions for CBMIR in P2P networks becomes a necessity while the challenges faced therein, unique. Depending on the type of P2P network, a number of prominent research works are presented and compared in this chapter.

Chapter X: DART: A Framework for Distributed Audio Analysis and Music Information Retrieval. The chapter present DART framework designed for distributed audio analysis and music information retrieval. The associate project is being researched jointly between Cardiff University and the Laboratory for Creative arts and Technologies (LCAT) in Louisiana State University that capitalises on these developments to provide a decentralised overlay for the processing of audio information for application in Music Information Retrieval (MIR).

Section VI: Music Analysis

Chapter XI: Motivic Pattern Extraction in Symbolic Domain. In this chapter, author gives an overview of computational research in motivic pattern extraction. The central questions underlying the topic, concerning the formalization of the motivic structures, the matching strategies and the filtering of the results, have been addressed in various ways. A detailed analysis of these problems leads to the proposal of a new methodology, which will be developed throughout the study. One main conclusion of this review is that the problems cannot be tackled using purely mathematic or geometric heuristics or classical engineering tools, but require also a detailed understanding of the multiple constraints derived by the underlying cognitive context.

Chapter XII: Pen-Based Interaction for Intuitive Music Composition and Editing. This chapter present pen interaction and its use for musical notation composition and editing. The authors first review existing pen-based musical notation editors and argue that they are dedicated to classical musical notations and are often constraining for the user. Then a novel generic method is present and they also demonstrate how the presented method can be used to design pen-based systems not only for classical musical score notations, but also for plainchant scores, drum tablatures and stringed-instrument tablatures.

Chapter XIII: MUSICSTORY: An Autonomous, Personalized Music Video Creator. The chapter describes the MusicStory system which creates music videos from personal media (audio and image) collections. Basic idea for MusicStory is to search and present word/image associations based on a song's lyrics. It takes the emotional experience of listening to music, amplifies it and heightens its visceral appeal by externalizing concrete and visual imagery intrinsic in the music. The retrieved images vary in their association – some semantically on point and some distant. The flow of imagery moves with the pace of the song: providing quick transitions through fast songs, and leisurely transitions through slower songs.

Chapter XIV: Music Representation of Score, Sound, MIDI, Structure and Metadata All Integrated in a Single Multilayer Environment based on XML. The chapter presents an analysis of issues and concerns in music representation. The authors give very comprehensive literature review, analyze the requirement from real life applications and address the weakness of existing approaches. New content representation based on XML is design and present to support access of music. The authors also present application of this framework.

CONCLUDING REMARKS

Intelligent music information systems, which aim to provide effective searching and management on a large number of music data, offers an important platform to access and manage the vast amount of music contents for various kinds of application domains. In spite of large amount of output from the most recent research in the field of music retrieval, mining, management, current state-of-the-art technology is still in its infancy to fit real requirements from users in daily applications. Thus, it has always been a great challenge to develop useful tools, methodologies, theory and frameworks. In this book, we try to present some of the recent research progress undertaken during the past years. In case that the past is a guide to the future, these articles could serve as the seeds of new concepts and research ideas invigorating the field. In coming days, we hope to see the combination of different technologies and research areas to address the problem.