Towards the representation of Chinese traditional music: A state of the art review of music metadata standards

Article · January 2013

CITATION
1

READS
667

4 authors, including:

Mi Tian
Queen Mary, University of London
7 PUBLICATIONS **50** CITATIONS
SEE PROFILE

György Fazekas
Queen Mary, University of London
91 PUBLICATIONS **962** CITATIONS
SEE PROFILE

Mark Brian Sandler
Queen Mary, University of London
442 PUBLICATIONS **8,515** CITATIONS
SEE PROFILE

Towards the Representation of Chinese Traditional Music: A State of the Art Review of Music Metadata Standards

Mi Tian, György Fazekas, Dawn A. Black, Mark B. Sandler
Centre for Digital Music
Queen Mary University of London, UK
{fistname.lastname}@eecs.qmul.ac.uk

Abstract

This paper examines existing metadata standards for describing music related information in the context of Chinese music tradition. With most research attention focussing on Western music, research into computational methods and knowledge representation for world music is still in its infancy. Following the introduction of symbolic elements in the Chinese traditional system, a comparison between these elements and the expressiveness of some prevailing metadata models and standards including Semantic Web ontologies is presented.

Keywords: Metadata Standards; Chinese Traditional Music; Semantic Web; Ontology; Knowledge Representation; Music Information Retrieval

1. Introduction

The importance of audio related metadata has been steadily increasing with the wide use of digital audio formats, both in academic research and everyday life. In order to interact with audio items and facilitate data references and processing, as well as to ensure that the great mass of data remains manageable by humans and processable by machines, a knowledge representation system enabling common recognition and interoperability should be constructed (Bearman and Miller, 1999).

In many disciplines such as library science, education, archiving, e-commerce, and arts, different metadata schemes are being developed as standards to represents domain-specific terms and relations. Metadata related to music and a broader multimedia context generally specify editorial information, social and cultural information, and certain features and contents and the workflow of the topic. The basic metadata elements maintained by the Dublin Core Metadata Initiative (DCMI) are examples of metadata standards of common use, that offer descriptions of media related fields. Metadata standards generally compromise between treating one type of material well, or providing a more general domain coverage. As a result, existing metadata schemata are typically more applicable in the context of Western culture, without considering requirements of Eastern or more general world music traditions, and the needs of researchers, archivists or musicologists working in these fields. In this paper, a comparison of expressiveness of different metadata standards in the context of Chinese traditional music is provided.

Despite current trends towards a musical monoculture (Nettl, 1985) there are powerful music cultures with a classical tradition in China, India, Turkey, Indonesia, or the Arab world, where traditions present some new requirements for metadata management, complementing the Western music context. Many of these music traditions have excellent musicological and cultural studies available. These music styles to a large extent maintain performance practice traditions and they exist within very specific social contexts. Thus, these traditions can be an excellent ground on which new information models can be built, challenging the dominant Western-centred information paradigms.

Music was traditionally considered to be one of the four fundamental societal functions together with morals, law, and politics. The Zhou (11th Century B.C - 221 B.C.) period music had always been regarded as the foundation and crystallisation of Chinese music for the subsequent dynasties.

In the following two thousand years different feudal dynasties witnessed the development and transition of this old and diverse music form. When it came to the more recent Ming and Qing Dynasty, Chinese traditional music gradually evolved into the embryo form of its modern shape today. During this period the influx of folk songs and their subsequent stylisations led to the growth of many forms of regionally identified operas. Of these operatic genres two styles became so widely appreciated that they can be characterised as national dramatic genres. These were the Kun opera, which flourished especially during the Ming dynasty, and the Peking opera, which reached its zenith in the Qing dynasty (Liang, 1985). In the light of both historical and present-day context of Chinese music tradition, this paper aims to examine the elements of this culture that may be represented by existing metadata schema, and highlight the areas where these formats fall short of describing some culture specific but highly relevant terms. We examine conventional metadata standards as well as more complex knowledge representation models based on Semantic Web technologies, since they provide a promising direction for modelling the different levels of abstractions present in diverse musical cultures, and thus filling the semantic gap between existing metadata models, user requirements as well as computational methods for music collection management.

The rest of the article is organised as follows: Section 2 introduces the semantic web technologies of music data representation and music ontologies of the western music system. Section 3 presents an overview of the Music Information Retrieval (MIR) research into world music and the current status of ethnomusicology study. Section 4 gives a description of the unique elements in the Chinese traditional music system and its basic composition. Section 5 compares the expressiveness of some frequently used metadata standards when annotating items of this topic. Upon introducing items in Chinese traditional music system and corresponding conceptualisation with existing metadata standards,, the paper raises the awareness of constructing the culture-specific music ontologies.

2. Representation of Music Data on the Semantic Web

Music information retrieval techniques are becoming increasingly important in music collection management as well as musicological analyses. Semantic information such as note onsets, chords, keys and structure can be used in the development of intelligent tools for accessing music content on the web, for instance intelligent Semantic Web user agents that are able to execute complex queries currently requiring human level intelligence. A great variety of algorithms, systems and tools are already available for handling the increasing amount of music information, however these tools are primarily concerned with the analysis, extraction and representation of musical concept in the Western tradition (Tzanetakis et al., 2007).

2.1. Knowledge Representation for Audio Information

Although the usefulness of associating music elements with additional information is generally acknowledged, there is not yet a complete answer to how these associations should be made, and how metadata should be organised to annotate audio items. Balaban and Elhadad (1999) introduced a knowledge representation framework in which an ontology level, a representation level and an implementation level correlate. In the music-specific topic, the ontology level clarifies the music entities, distinctions, operations, constructs and their relations, and the representation level provides the formalisms that describe the ontology, and finally the implementation level directly interacts with the sound-level dimension in the ontology.

Music and multimedia metadata metadata schema can be classified into the following four groups (Fazekas and Sandler, 2012): bibliographic information which concerns mainly editorial type data, cultural information which interpret the work in certain social context, content-based information that describe the content for facilitating information management solutions utilising content semantics, and workflow information that denote the origin and production of the working process.

2.2. Semantic Web Technologies for Representing Audio Metadata

The Semantic Web (Berners-Lee et al., 2001) is a collaborative movement led by the World Wide Web Consortium (W3C). It provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries.

The basic idea of the Semantic Web is to provide a linked framework for the expression and reuse of heterogeneous data, thus bringing intelligence to the web through the use of automated reasoning. While music making is an increasingly social activity, the Semantic Web could become a platform for sharing not just music, but ideas between artists and engineers. However, this requires common grounds for how information is published, rather like designing a schema for a database. Fortunately, the continuously evolving semantic web provides us with the most general data model to date with a growing consensus: the Resource Description Framework (RDF) (Lassila and Swick, 2009). It expresses systematic statements about resources in the form of a triple: subject, predication and object. Each element in RDF graphs can be associated with a Uniform Resource Identifier (URI), which provides an efficient way of identifying and linking resources (eg. web pages, data and services). Although RDF provides a fundamental data model, it relies on a well-defined vocabulary to clarify specific terms and the relationships between them in an audio application. Ontologies are tools for establishing these necessary elements in a domain model.

2.3. Metadata Models and Standards

There are many existing technologies that are applicable in managing music related information. In this section we provide an overview of the most prominent schemata, including accepted or de-facto standards, as well as Semantic Web ontologies.

The Dublin Core Metadata Initiative (DCMI[1]) maintains a metadata set covering 15 basic elements: contributor, coverage, creator, date, description, format, identifier, language, publisher, relation, rights, source, subject, title and type. As part of an extended set of DCMI Metadata Terms, Dublin Core became one of most popular vocabularies to use in conjunction with RDF. The Metadata Object Description Schema (MODS[2]) is a schema for a bibliographic element set, particularly for library applications. Its relatively rich element set makes it suitable for extended use in a variety of purposes. The Encoded Archival Description Schema (EAD[3]) is an XML-based standard for the encoding of inventories, indexes, or guides for use in a networked (online) environment. Many EAD elements have been, or can be, mapped to other structural standards (such as MARC or DC) as well as content standards including music related information, increasing the flexibility and interoperability of the data. MPEG-7 (Martínez, 2004) is suite of standards for description and search of audio, visual and multimedia content. It uses XML to describe metadata, using a Description Definition Language (DDL) to specify a set of description schemes. MusicXML[4] is a file format for representing, sharing and archiving Western sheet musical. It is designed for the interchange of scores, particularly between musicians using different music applications. The Music Encoding Initiative (MEI[5]) is a schema for recording the intellectual and physical characteristics of music notation documents so that the information contained in them may be searched, retrieved, displayed, and exchanged in a predictable and platform-independent manner. It is also XML based, and offers a partial modelling of the discipline of musicology. ID3[6] tags are the audio file data standard for compressed audio files such as MP3. Later, it was also adopted by other formats such as WMA and MP4 in active use by software and hardware. AES-57[7] provides a vocabulary to be used in describing structural and administrative metadata for digital and analog audio formats. The

[1] http://www.dublincore.org/metadata-basics/
[2] http://www.loc.gov/standards/mods/mods-outline.html
[3] http://www.loc.gov/ead/tglib/appendix
[4] http://www.musicxml.com/wp-content/uploads/2012/12/musicxml-tutorial.pdf
[5] http://www2.lib.virginia.edu/innovation/mei/
[6] http://id3.org/d3v2.3.0
[7] http://www.aes.org/publications/standards/search.cfm?docID=84

EBUCore [8] is a set of descriptive and technical metadata based on the Dublin Core and adapted to media, designed as a minimum and flexible list of attributes to describe audio and video resources in the context of a service oriented Architecture. A compatible model has also been adopted by the AES-60 standard. The Music Ontology (MO[9]) Raimond et al. (2007) provides prevalent concepts and properties for describing music on the Semantic Web. It aims to provide descriptions from editorial information, through the music creation workflow, up to more complex decomposition of the signal-based or musicological audio features. Terms for elements of composition and authoring is followed by production and distribution down to a physical record or sheet music. The Music Ontology, however, does not cover everything we can say about music. Rather, it provides ways of plugging new terms under existing concepts which we can use to describe a sub-domain (Fazekas et al., 2010). Some additional fields that have already been dealt with include musical keys, chords, instruments, studio production or features commonly used in audio signal analysis and processing (Raimond, 2008). A detailed analysis and comparison of these systems is provided in section 5.1.

3. Ethnomusicology — The Discovery of the World's Music

Research in the fields of music-related data representation and Music Information Retrieval in previous years has mainly focused on Western popular and classical music, and their applications such as recommendation systems and transcription. But with the gradual mature of technologies, research has been taken on to seek to understand the whole process within which music is imagined, discussed and made. What has happened in the field of ethnomusicology is an increase of awareness of the fact that there is more to the study of music than the description and analysis of its form. Ethnomusicology is being increasingly led by cultural anthropology, or ethnology (Merriam, 1960), where cultural components are stressed as well as the musical elements.

3.1. Research into World Music

Seeger (1961) points out that music may be viewed in three general classes of context: *a)* as a concept in the universe of discourse (i.e., of speech-communication); *b)* as a phenomenon in the universe of nature; *c)* as itself, like speech, a communicatory medium operating within a funded aggregate of traditional communicatory content of its own that can be regarded as a universe of music-communication.

Scientific investigation of non-Western music was first made possible in the late 19th Century (Myers, 1992). Examples of popular forms of world music include the various forms of non-European classical music (e.g. Japanese koto music, Indian raga music, Tibetan chants), Eastern European folk music (e.g. the village music of the Balkans), Nordic folk music and the many forms of folk and tribal music of the Middle East, Africa, Asia, Oceania and Central and South America[10]. Researchers are now starting to put more emphasis on non-Western music repositories and approach a number of the current research challenges from a culture-specific perspective, one example of these ongoing research is shown in (Serra, 2012).

3.2. An Overview on Ethnomusicology

The context-based research of world music, often referred to as ethnomusicology, is an academic field encompassing various approaches to the study of music that emphasises cultural, social, cognitive and other dimensions or contexts instead of focussing solely on isolated sound components or a particular repertoire. Combining aspects such as folklore, psychology, cultural anthropology

[8] http://tech.ebu.ch/

[9] http://musicontology.com/

[10] http://en.wikipedia.org/wiki/World_music

and conventional musicology, ethnomusicology is the systematised study of music involving skills from a convergence of disciplines[11].

Table 1: Comparison of countries and culture areas covered in worlds of music (Titon 2009), excursions (Nettl, Capwell, et al. 1992), and musics of many cultures (May 1980).

	Titon	**Nettl et al.**	**May**
Africa		Sub-Sahara	South of Sahara, Ethiopia, Ghana
Asia	South India, Indonesia, Japan	China, India, Indonesia, Japan	China, India (classical), Indonesia (3 islands), Japan, Korea, Thailand
Europe	Eastern Europe	Europe	
Latin America		Latin America	South American Folk, South American Indian
Middle East		Middle East	Arabic (secure classical), Iran (classical), Jewish music
North America	Black America, Native America	North American Indian	Native America, Alaskan Eskimos
Oceania			Australian Aborigine, Polynesia

The origin of ethnomusicology dates back to the late 19th Century and the related research soon started to rely on various methods of audio recording and other technological approaches. Two meanings of the term "*ethnomusicology*" are common. One equates the prefix "ethno-" with the adjective "ethnic", meaning "barbarous, non-Christian, or exotic". This implies that the study now known as "ethnomusicology" is often limited to music other than its students' own. The other, with the prefix "ethno-", as in ethnology, emphasises on the cultural functions of music (Nettl et al., 1992). Table 1 shows how the ethnomusicologists' work covers the world map (May, 1980) (Titon et al., 2009) (Witzleben, 1997), reflecting on some shared inclusions and omissions of the related research in different regional places.

4. Content Semantics of Chinese Traditional Music

Semantics is a key feature of not only language, but also music (Koelsch et al., 2004). It indicates that music can, as language, determine psychological indices of semantic processing. Other than the information contained directly in the audio signals, several musical features of higher level (i.e. rhythm, harmony, melody, timbre) can be incorporated in semantic descriptors to associate music with meaning (Celma et al., 2006), either in terms of the music itself or from extra-musical associations. In these contexts, we now proceed to introduce the primary elements, genres and representation systems in Chinese traditional music.

4.1. Chinese Music System of Symbolic Representations

Taken in the sense of Western musicological concepts such as chords or counterpoint, Chinese traditional music greatly differs from the harmony-based Western music tradition (Van Aalst, 1884). For instance, Chinese music pieces are not definitely in terms of minor or major, they are constantly floating between the two, and are always in unison (in the same key). Thus, it might be problematic to transplant these elements directly in existing Western music systems.

In order to describe this and similarly broad constructions, it is useful to define notation systems in Chinese music here. Today music analysis (in Chinese or English) often uses as its reference the 88 keys of the piano. These 88 keys together play 88 notes but only 12 of these have distinct names. Chinese music have a scale composed of 12 semitones (that of 12 Lvs) (Thompson and Sound). This scale is used to transpose their diatonic gamut[12] in any of the 12 keys, resembling more or

[11] http://en.wikipedia.org/wiki/Ethnomusicology

[12] Representing the full range of pitches in a musical system.

less the Western chromatic gamut. Up to B.C. 1100, seven notes (the sounds emitted by Lvs) were in general use: Gong, Shang, Jiao, Chi, Yu, Bian Gong and Bian Chi (Van Aalst, 1884). Like the European diatonic scale, it is composed of five full tones and two half tones. Table 2 shows the Chinese system of notation and its equivalent in the Western octave scale.

Table 2: Chinese system of notation and its Western equivalent

Actual Names of Notes	Ancient Names of Notes	Names of Lvs	Western Equivalents
He	Gong	Huang	C
Si	Shang	Tai	D
Yi	Jiao	Gu	E
Shang	Chi	zhong	F
Chi	Bian Chi	Lin	G
Gong	Yu	Nan	A
Fan	Gong Yu	Ying	B
Liu	Gong Shao	Huang Qing	C
Wu	Shang Shao	Tai Qing	D

4.2. Composition of Chinese Traditional Music

Known historically since the dawn of Chinese civilisation, Chinese traditional music contains diverse range of artistic expressions. Despite a wide range of branches, it is now generally grouped into the following four types in terms of its aesthetic characteristics and evaluation as well as area of research: *folk music*[13], *literati music* (Ho, 1997), *religious music* and *royal court music* (Cheng).

The term folk music here broadly refers to all kinds of music of the public and should be differentiated with its subcategory "folk songs". Because of the enormous size of its audience, various topics it covers and rich emotions it conveys, folk music is the biggest and most popular branch of Chinese traditional music. It can be further grouped into five categories: Chinese opera, dance music, folk songs, instrumental music and singing and telling arts.

Different musical instruments are always unique to specific music genres. A wide range of featured traditional instruments are possessed by the Chinese music system (Yuan-Yuan and Shen, 1999). One of the earliest classification systems categorises Chinese traditional instruments into eight sounds or eight tones: silk, bamboo, wood, stone, metal, clay, gourd and hide. Though there are other popular instruments which may not fit these classifications.

Chinese traditional music enjoys unique and vivid performing characteristics. The onstage performance (dance, body movements, costuming, etc.) is unfolded directly to the audience and it is an important means of conveying emotions and narrative related to the scenario. Another set of performing skills is more relevant in music rendition and creation. An example of these is the different fingering techniques in string instrument playing, which is an important element when annotating this art form.

5. Towards a Culture-specific Ontology

As an activity that penetrates human life, music should be put into larger social, cultural and historical settings when analysed and studied. Though music enjoys a sense of commonality around the world, some musicological elements in one culture could hardly find their parallels in another. When constructing the corresponding music ontology, new elements and relationships should be defined to describe its uniqueness.

[13] Geographical colour of chinese folk song: http://www.huain.com

5.1. Expressiveness of Existing Metadata Schema Systems

Many different metadata schemata are being developed across disciplines, e.g. library science, education, archiving, e-commerce or media. While different formats have their own emphasis of domain coverage, a gap seems to exist in denoting culture-specific elements. The following table summarises the expressiveness of prominent metadata models, frameworks and standards, reflecting on some of the most important elements of Chinese music. The abbreviations of standards and ontologies described in the table can be found in Section 2.3.

Table 3: Expressiveness of traditional, Chinese Music under Existing Metadata Schema Systems

	DC	MODS	EAD	MPEG-7	Music XML	MEI	ID3	AES 57&60	EBU	MO
Title	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Subject	✓	✓	✓	✓	✓		✓	✓		✓
Identifier	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Albums	✓	✓		✓			✓	✓	✓	✓
Tracks		✓		✓			✓	✓	✓	✓
Formats	✓	✓	✓	✓		✓	✓	✓	✓	✓
Artists	✓		✓	✓	✓	✓	✓	✓	✓	✓
Dates of Creation	✓	✓	✓	✓		✓	✓	✓	✓	✓
Place of Origin	✓	✓	✓	✓				✓		✓
Purpose of Creation										
Occasion of Performing										
Time of Origin	✓	✓	✓	✓				✓		✓
Time of Prosper										
Ethnic Group										
Target Audience		✓							✓	
Instruments	✓				✓					✓
Language	✓	✓	✓	✓	✓	✓	✓	✓		✓
Key					✓		✓			✓
Genre		✓				✓	✓		✓	✓
Performing skills					✓					
Vocal Style										
Place of Prosper										
Western Parallel										
cosmetics and prop										
Stage Performance										
Notation					✓	✓				✓
Background Resources										✓
Edition	✓	✓	✓	✓		✓	✓	✓	✓	✓
Publisher	✓	✓	✓	✓				✓	✓	✓
Other Names	✓			✓						✓
Melody Descriptions					✓					✓
Lyrics					✓	✓		✓		✓
length	✓	✓	✓	✓	✓		✓	✓	✓	✓
Historical Context										
Prevalence										
Gamut Scale					✓					

Continued on next page

	DC	MODS	EAD	MPEG-7	Music XML	MEI	ID3	AES 57&60	EBU	MO
Music Sheet					✓					
Intonation										
Temperament										
Related Work	✓	✓		✓		✓	✓	✓	✓	✓
Related Artists										✓
File Description	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Copyright	✓	✓	✓	✓	✓	✓	✓	✓	✓	

Our examination of Western-centric metadata schemata demonstrates the lack of some crucial terms in specifying featured elements of the Chinese music tradition, including social context, or performing skills. Considering several aspects of the uniqueness of Chinese music culture, it is suggested that the following sets of elements be defined when annotating Chinese traditional music systems: *a)* gamut scales, notations and other terminologies of the musicological system; *b)* elements corresponding to featured performing skills and artistic forms (vocal styles, intonation, etc.); *c)* characteristic instruments, music genres, repertoires and other components of the music system; and *d)* social contexts, developments and other elements relate to the semantic meaning of the music. Albeit some of these elements are important parts of the Western-tradition too, their more pronounced role in Chinese music makes existing information systems less suited in applications for managing Chinese music content. It can also be observed that though the general information regarding the life cycle and some basic audio features of a certain kinds of music can be covered by existing metadata systems, its high-level features are to a large extent missing.

5.2 Analysis and Discussion

There are generally three circumstances in which a term is not specified in existing metadata standards. The first type corresponds to the musical elements with strong Chinese characteristics. Peking opera (Yin) is a popular form of drama and musical theatre in China, despite defined as "opera", some of its paramount components like facial costuming ("Lianpu") can hardly find their parallel in western opera and musicals, hence schemata are void of related terminology. It should also be noted that though some terms have indeed been defined in the existing metadata standards, there is room for revision and expansion before they can be applied in a description system for Chinese music. This lead us to the second problem related to those terms that though defined in some way, do not cover the full meaning of particular items Chinese music. For instance, some representation of "Time" is defined in most music metadata standards, in which it mainly elaborates on composition, recording and other issues in the life cycle of a piece. However in Chinese traditional music, more emphasis should be placed on the time of creation, evolution, propagation of works in a longer temporal context. Consequently, the representation of time-related information should be broadened to coverage these requirements. Finally, the third type of problem corresponds to cases where the terms in Western and Chinese music systems do not actually convey the same meaning. The gamut scale in both Western and Chinese systems has, for example, the heptatonic scale and the pentatonic scale, but these scales do have certain differences. Even in the Chinese music system alone, certain scales should often be assigned different interpretations (Van Aalst, 1884) since they have gone through a long period of developments and transitions. The creation of music is often motivated by events that have profound influence on society. In Qin Dynasty when the government completed the unification of the country, many instruments and music pieces were introduced from different places across China and foreign territories, and soon became nationally popular. Furthermore, during periods of vicissitudes of dynasties, specific emotions induced by social unrest served as great inspirations for music composition. Thus it is proposed in this paper that in the ontology construction of Chinese traditional music, the musical elements should also be linked with historical and social events.

The heterogeneity of the Chinese music tradition suggests that any metadata framework aimed at covering this domain to satisfy archival, collection management or other goals in music information systems, has to exhibit a great deal of flexibility and extensibility, while maintaining plurality in views requiring different metadata models, and interoperability with existing systems. This would be crucial to facilitate harmonisation or cross-domain utilisation of metadata schema for describing Chinese, and in a broader context, different music traditions of the world. We can observe that layered models like that of the Functional Requirements for Bibliographic Records (FRBR) originating from music librarian use cases (Dickey, 2008) are not widely adopted, and currently only the Music Ontology uses all layers of FRBR. We found however that layered conceptualisation would be especially useful for describing workflows and process history in the evolution of traditional Chinese music, since it would allow us to connect cultural and historical elements of prime importance with music-related entities (composers, performers, audio items) at the most appropriate conceptual level.

6. Conclusions

Examining existing metadata representation schemes in the context of Chinese traditional music reveals some very important missing concepts in the state-of-the-art. This is primarily due to the disparity in importance – or biases towards different social and cultural concepts – between Western and Chinese music traditions. We cannot however presume any single system to account for the heterogeneity in different music traditions, and fulfil the requirements of different communities and applications.

The creation of task or domain specific ontologies in a federation of loosely coupled systems could provide a solution to the problems revealed by this study. Finding a model which suits all needs thus can be reduced to providing a federated system with sufficient means to interoperate, exploiting similarity between objects across different subdomains. Compared to rigid domain specific systems, the use of flexible and extensible Semantic Web ontologies such as the Music Ontology can be highly beneficial in the context of describing Chinese music. Providing the necessary amendments and extensions to this ontology constitutes our future work.

References

Mira Balaban and Michael Elhadad. On the need for visual formalisms in music processing. *Leonardo*, 32:2, 1999.

David Bearman and Eric Miller. A common model to support interoperable metadata. Progress report on reconciling metadata requirements from the dublin core and indecs/doi communities, 1999.

Tim Berners-Lee, J. Handler, and O. Lassila. The Semantic Web. *Scientific American*, pages 34–43, 2001.

Oscar Celma, Perfecto Herrera, and Xavier Serra. Bridging the music semantic gap. *Workshop on Mastering the Gap: From Information Extraction to Semantic Representation*, 2006.

Pei-kai Cheng. e-learning of chinese traditional music. http://www.english.cciv.cityu.edu.hk/.

Timothy J. Dickey. FRBRization of a library catalog: Better collocation of records, leading to enhanced search, retrieval, and display. *Information Technology and Libraries*, 27(1):23–32, 2008.

G. Fazekas and Mark B. Sandler. Knowledge representation issues in audio related metadata model design. *In Proc. of the 133rd Convention of the Audio Engineering Society, October 26–29, San Francisco, USA*, 2012.

G. Fazekas, Y. Raimond, K. Jakobson, and M. Sandler. An overview of Semantic Web activities in the OMRAS2 Project. *Journal of New Music Research special issue on Music Informatics and the OMRAS2 Project*, 39(4):295–311, 2010.

Edward Ho. Aesthetic considerations in understanding chinese literati musical behaviour. *British Journal of Ethnomusicology*, 6:35–49, 1997.

S Koelsch, E Kasper, D Sammler, and K Schulze. Music, language and meaning: brain signatures of semantic processing. *Nature Neuroscience*, 7, 2004.

Ora Lassila and Ralph R. Swick. Resource description framework (rdf) model and syntax specification. http://www.w3.org/TR/1999/REC-rdf-syntax-19990222/, 2009.

Mingyue Liang. *Music of the billion: An introduction to Chinese musical culture*. NY: Heinrichshofen, 1985.

José M. Martínez. Mpeg-7 overview. International Standard, ISO/IEC JTC1/SC29/WG11, Available online: `http://mpeg.chiariglione.org/standards/mpeg-7/mpeg-7.htm`, 2004.

Elizabeth May. *Music of Many Cultures: An Introduction*. Berkeley: University of California Press, 1980.

C. Mckay. Emotion and music: Inherent response and the importance of empirical cross-cultural research. Technical report, McGill University, 2002.

Alan P. Merriam. Ethnomusicology discussion and definition of the field. *Ethnomusicology*, 4:3, 1960.

Helen Myers. *Ethnomusicology: An Introduction*. W W Norton & Co Inc, 1992.

B. Nettl. *The Western Impact on World Music*. Schirmer Books, 1985.

Bruno Nettl, Timothy Rommen, Charles Capwell, and Isabel K. F. Wong. *Excursions in World Music*. 1992.

Yves Raimond. A distributed music information system. Doctoral thesis, Department of Electronic Engineering, Queen Mary, University of London, 2008.

Yves Raimond, Samer Abdallah, Mark Sandler, and Giasson Frederick. The Music Ontology. *in Proc. 6th International Conference on Music Information Retrieval, Vienna, Austria*, 2007.

Charles Seeger. Semantic, logical and political considerations bearing upon research in ethnomusicology. *Ethnomusicology*, 5:2, 1961.

X. Serra. Opportunities for a cultural specific approach in the computational description of music. In *2nd CompMusic Workshop*, Istanbul, Turkey, July 2012. ISBN 978-84-695-4958-2. URL `http://mtg.upf.edu/system/files/publications/1-Xavier-Serra-2nd-CompMusic-Workshop-2012_0.pdf`.

Sinyan Shen. *Chinese Music in the 20th Century (Chinese Music Monograph Series*. Chinese Music Society of North America Press, 2001.

John Thompson and Toadall Sound. Website glossary. http://www.silkqin.com/11misc/gloss.htm.

Jeff Todd Titon, Linda Fujie, Timothy J. Cooley, David B. Reck, Anne K. Rasmussen, John M. Schechter, Jonathan P. J. Stock, and R. Anderson Sutton. *Worlds of Music: An Introduction to the Music of the World's Peoples*. Cengage Learning, 2009.

George Tzanetakis, Ajay Kapur, W. Andrew Schloss, and Matthew Wright. Computational ethnomusicology. *Journal of Interdisciplinary Music Studies*, 1(2):1–24, 2007.

J. A Van Aalst. *Chinese Music*. Statistical Department of the Inspectorate General of Customs in Shanghai, 1884.

J.Lawrence Witzleben. Whose ethnomusicology? western ethnomusicology and the study of asian music. *Ethnomusicology*, 41:2, 1997.

Mak Su Yin. Chinese opera information centre. http://corp.mus.cuhk.edu.hk/corp/html/indexE.htm.

Lee Yuan-Yuan and Sinyan Shen. *Chinese Musical Instruments (Chinese Music Monograph Series*. Chinese Music Society of North America Press, 1999.