



Macao's Soundscape: Cluster Analysis of Urban Music

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ABSTRACT

Macao Urban Musicology has drawn the attention of experts and scholars in the field of urban music anthropology recently. It can be said that the study of urban musicology in Macao is linked to a thorough review of the underlying literature. To study the subject of urban musicology in Macao more deeply, the study of local music literature is the most basic and critical link. The gradual broadening of the research field on Macao urban music also faces the importance of document resource construction. This paper aims to conduct a cluster analysis of the titles, authors, document publishers, and responsible publishers of the majority of music literature in Macao City. The objective is to uncover the correlations and classification rules among different documents. Therefore, the main content of this study aims to reorganize the relevant literature on Macao urban music in order to provide a convenient and fast search method for future researchers in this field. The conclusion aims to provide relevant data resources for the study of Macao urban music literature resources, summarize them, and enrich the research results in recent years. This will help promote better future development of relevant theoretical research.

Keywords: urban music anthropology; Macao Urban Music; music literature; cluster analysis; social networks analysis

1. INTRODUCTION

Music philology is an important part of the field of musicology. Given the wide range of urban music books and documents in Macao, which consist of a diverse coexistence of Chinese and Western music, researchers face challenges in the induction, processing, and classification of these materials. This complexity can make it difficult for researchers to effectively study or conduct research on the diverse and complex music literature available.

Compared with previous research directions, Macao Urban Musicology, which is also known as Macao-ology, focuses more on folk customs and country music. In contrast, urban musicology transcends the divide between tradition and modernity, aiming to delve deeper into the interaction between city dynamics and music culture, particularly focusing on urban transformations (as shown in Figure ¹). The literature on Macao urban music contains many types of music genres. Professor Dai Dingcheng has provided the first comprehensive classification of Macao urban music, encompassing a wide array of music genres. This includes six categories that delve into the historical and traditional aspects of Macao urban music: "Macao folk music, Macao ritual music, Macao art music, Macao entertainment music, as well as the persons, events and objects related to Macao urban music."² Hence, building upon Western scholars' citation methods in urban music anthropology, this paper extracts, compiles, and analyzes significant literature on Macao's urban music scene. This comprehensive review involves various document types and scrutinizes the changing role of Macao amidst the city's modernization process. It also focuses on using various research methods - such as data science, sociology, and political science, to investigate from the perspective of urban music. This is done to explore various phenomena and problems arising from the musical context in the urban environment, employing clustering analysis.

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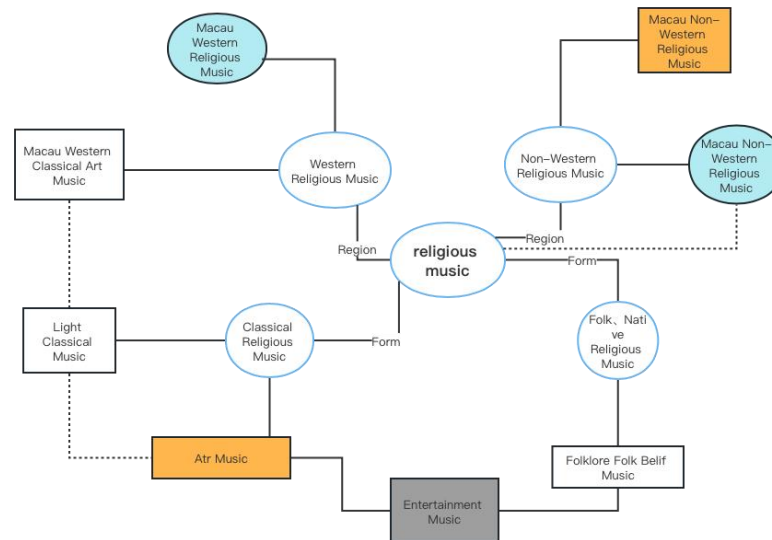
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¹ Solid lines represent strong correlation coefficients for music categories; dashed lines represent weak correlation coefficients for music categories.

² Dai Dingcheng. (2020). The Disciplinary System of Macao Urban Music: Connotation, Extension and Prospect. *Journal of Macao Polytechnic Institute* (02), 39.

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(Figure 1 takes Macao religious music as an example and its relationship with other music)

As data science continues to advance, so does research and exploration within the field of music as a subject. In today's era of literature data, the analysis mode for music literature has undergone a complete transformation from the traditional method of manual analysis and retrieval. This shift has significantly enhanced the accuracy and validity of music literature analysis. Dr. Dai Dingcheng said, "The data work of Macao's urban - music discipline system is the most basic and fundamental matter, and the building of a professional data center is the most effective way."³ He has expressed optimism regarding the development and application of Macao's urban music literature analysis model. Accordingly, cluster analysis is a convenient method to help research and analyze literature resources.

This paper will utilize cluster analysis to conduct a categorical examination of the titles, authors, document publishers, and responsible publishers of a significant portion of music documents, specifically scholarly articles. Given the diversity and richness of urban music in Macao, academic papers will serve as the primary source of music information. The aim is to uncover the inherent connections and commonalities among various documents. Due to its unique cultural, regional and institutional conditions, Macao urban music has gained significance over a diverse and rich variety of music genres. Next, the research is structured into six main sections. The first section is the introduction, which outlines the primary purpose of the study. The second section is the literature review, providing an overview of previous research findings in the field of music and cluster analysis. The third section offers a brief introduction to the general landscape of Macao's urban music. In the fourth section, Macao urban music literature is summarized and collected using relevant cluster analysis methods. The fifth section involves interpreting the gathered and summarized data. Finally, the sixth section discusses and summarizes potential future development paths and offers suggestions for enhancing Macao's urban soundscape.

2. ANALYSIS OF CURRENT SITUATION

Regarding the method of combining cluster analysis and music, my predecessor has accumulated considerable results, which have provided a feasible basis for the study of Macao urban music literature. In music notation, Chen Genfang and Dong Lingyu proposed, "In view of the classification of spatiotemporal heterogeneous information of a large number of ancient multispectral ruler music manuscripts preserved in China, by analyzing the notation criteria of multispectral ruler spectrum, the heterogeneous information carried by the manuscript is sorted by time and space."⁴ From the viewpoint of information classification, the ancient Chinese notation method is employed to effectively classify, integrate, and disaggregate heterogeneous information. Moreover, in terms of music evaluation analysis, some scholars have quantified music data and established relevant evaluation models. For example, "Fan Yun and Chen Yuxin have tried to develop a method to quantify the evolution of music and develop a comprehensive evaluation model based on cluster analysis to evaluate the impact of music, building cosine similarity models to measure musical similarity."⁵ Further, "Wang Chenxi and Yu Jiushi tried to classify and value the twelve features through clustering analysis, to establish two models for music impact determination, to develop parameters and describe the similarity of music influence, to analyze the style of artists for a specific time, to establish the measurement standards for definition."⁶ The above two methods are based on the common characteristics of music and data, aiming to establish more accurate analysis models based on different music characteristics.

³ Dai Dingcheng. (2020). The discipline system of urban music in Macao: connotation, extension and prospect. *Journal of Macao Polytechnic Institute* (02), 46.

⁴ Chen Genfang, Dong Lingyu. Research on Effective Spatial Information Extraction of Multispectral Manuscripts Based on Cluster Analysis[J]. *Journal of Hangzhou Normal University (Natural Science Edition)*, 2016, 15(03): 321-324.

⁵ Yu Fan, Yuxin Chen, Jinrong Yao, Zhanchen Li, Zhangliang Song. Evolution and revolutionary trend of artists and schools based on cluster analysis[J]. *Art and Performance Letters*, 2021, 2(5).

⁶ Wang Chengsi, Yu Jiushi. Research on the Evolution of Music Schools[J]. *Art and Performance Letters*, 2021, 2(5).

In terms of music retrieval, Ma Shuqing also proposed “a rhythm detection algorithm based on multi-path search and cluster analysis, that is, on the basis of the clustering algorithm, the music fit for its emotional state will be recommended. It overcame the weakness of the clustering algorithm that required the use of an instrument digital interface-MIDI to assist the input and achieved the desired effect.”⁷He mentioned that he proposed part of his innovation in the rhythm detection algorithm, which overcame the auxiliary interface that he had to rely on before, making his detection and tracking algorithm more convenient. Furthermore, Li Bo, Chen Zhigang and others proposed, “according to the existing music recommendation and collaborative filtering methods based on audio information, the user's music audition data and download data are analyzed, and a music recommendation algorithm is proposed by combining the Latent Dirichlet Allocation (LDA) topic mining model.”⁸They also recommended a new recommendation algorithm model based on the relevant data of audio information. In terms of social network analysis, Ju Chunhua and Huang Zhiqian have proposed “a music recommendation algorithm for social network behavior analysis integrating music sub-personality traits, which analyzes the user's state of posting on social media such as Weibo, selects the closest neighbor users with similar musical preferences in the emotional state, and finally integrates the music sub-personality traits for preference calculation to recommend the most suitable music for users.”⁹This method conducts research on music recommendation algorithms based on social network behavior analysis, which can match and recommend music sub-personalities more quickly.

Scholars like Zhang Lei and Chen Zhenxiang believe that “computable network-behavior information makes large-scale analysis of personality possible. It also provides unprecedented data for the popularization and application of personality theory, analyzes and defines the latest research results of personality analysis and prediction of social network users on the basis of expounding standards and methods of personality measurement.”¹⁰They also further expanded the results of social network analysis. The algorithm can recommend music of interest to users more efficiently. Therefore, based on the flexibility and variability advantages of clustering analysis and social network application in the field of musicology, the use of social networks to sort out and restate the relationship diagram is a new interpretation of network relationships. Through this, the relationship between network nodes can be clearly defined. Interdisciplinary research in musicology has long been a focal point, with cluster analysis and social network methods proving especially vital in enhancing convenience and connectivity across research on music literature and musical data in Macao.

In summary, while the cluster analysis method brings innovation to music-related ontology, including ontology, artist identification, genre identification, and related issues, there remains a gap in research on music literature resources. It is important to recognize that analyzing music documents and musical data requires not only digital analysis but also judgment, definition, and analysis of different musical categories based on regional and stylistic differences. To effectively leverage the relationship between cluster analysis and music documentary data, the distinct characteristics and categories of music, as well as the key factors influencing analysis results, must be identified. This paper employs methods from the field of data science to explore theoretical and practical analyses of relevant literature on Macao urban music. By doing so, the aim is to pave a more diversified research path for future generations studying Macao urban music.

However, the traditional literature analysis method for urban music in Macao, involving manual retrieval, analysis, and induction, not only consumes considerable time and effort but also falls short of meeting the requirements of academic research in contemporary urban music anthropology. In the information age, it is crucial to categorize and identify various types of music in Macao, such as religious music, folk music, and art music, along with their subcategories. This approach aims to enhance the accuracy and scope of music literature retrieval while strengthening the precision and relevance of document and data analysis. Consequently, cluster analysis is a convenient method to help research and analyze literature resources. Previous research has also provided important theoretical assistance to Macao urban literature data resources. Thus, this method will be further applied in the present research.

3. PROFILE OF MACAO URBAN MUSIC

From the initial collision of fishing village culture and Catholic culture to the subsequent fusion and explosion of a multi-musical culture in Macao during the middle period, and finally to the integration and intersection of multi-dimensional and diverse music culture in the later period, the evolution of Macao's music history is evident. Despite its relatively short history, Macao's music has retained its distinct characteristics. Numerous music genres have been preserved, resulting in a diverse and captivating array of musical works that embody a harmonious blend of plurality and unity. Therefore, the traditional characteristics of Macao music based on Chinese culture and Western musical civilization based in Portugal have been integrated and formed a unique musical style with Macao characteristics. In the historical development of Macao music, the two historical threads with the most significant influence on Macao music were divided into Western music gradually moving to the East and Chinese music moving to the South.

In his papers on the history of Macao music, Pro. Dai Dingcheng first proposed “the concept of Chinese music moving to the south - center music moving to the south.”¹¹As an immigrant city, there were varieties of folk music coming from the Chinese

⁷ Ma Shuqing. Music Rhythm Detection Algorithm Based on Multipath Search and Cluster Analysis[J]. COMPLEXITY,2021,2021.

⁸ Li Bo, Chen Zhigang, Huang Rui & Zheng Xiangyun. (2016). Music recommendation algorithm based on LDA model. Computer Engineering (06), 175-179+184.

⁹ Ju Chunhua, Huang Zhiyi & Bao Fuguang. (2015). A music recommendation method integrating music sub-personality traits and social network behavior analysis. Telecommunications Science (10), 122-130.

¹⁰ Zhang Lei, Chen Zhenxiang & Yang Bo. (2014). Personality Analysis and Prediction of Social Network Users. Journal of Computer Science (08), 1877-1894.

¹¹ In his thesis on the history of music in Macao, Professor Dai Dingcheng put forward for the first time the concept of “Chinese music moving southward” Mediterranean Archaeology and Archaeometry, Vol. 25, No 2, (2025), pp. 247-257

mainland, especially from the Lingnan area, which is also a Cantonese-speaking region, of which Wu-style Taoist music inherited from the Wudai dynasty in Macao is a typical example.” (Dai Dingcheng 2022a:48-59). Moreover, Macao's Wudai Tao music retains the original traditional Taoist style and is a unique representative of Tao music in Macao. The migration of Chinese central music to the southern regions contributed to the reciprocal development and evolution of China's internal musical genres, representing a trend in the region's musical structure. In contrast, the movement of Western music towards the East represents an external cultural influence stemming from Western vocal traditions. These two strands converged to establish the foundational tradition of Macao's musical history.

In Macao, “where Chinese civilization and Western civilization blend and coexist, the musical discourse based on Chinese culture is integrated with Western culture, that is, ”¹²the narrative history of cultural exchange, collision and blending, seeking common ground while reserving differences, is an important characteristic tradition of Macao music. For the first time, Professor Tai Dingcheng divided the musical history of Macao into “three stages: the early period (mid-16th century to mid-18th century), middle period (mid-18th century to late 19th century), and the late period (post-1900)” (Dai Dingcheng 2022b:4-14). The history of Macao's music demonstrates a progression from the collision of early fishing village culture with Catholic influences on the blending of diverse musical cultures in the middle period and finally to the fusion and convergence of multidimensional and diversified musical expressions in the late period. Despite its relatively short history, Macao's music has retained distinct characteristics, including a dizzying array of genres such as Macao Catholic music with its unique traits, Macao Wu's Taoist music, saltwater songs, nursery rhymes, Dishui Nanyin, Cantonese ditties, performances with eight-note gongs and drums, Portuguese and Hokkien folk songs, and more. Therefore, the traditional characteristics of Macao music based on Chinese culture and the Western musical civilization based in Portugal have been integrated to form a unique musical style with Macao's characteristics.

Macao has a short but unique music history. It not only has traditional Chinese local music culture but also has the characteristics of Western European music culture. Although the city is small, it is well-equipped with all the essentials. Macao's urban music culture is characterized by a unique blend of Chinese and Western influences, offering a distinct music and cultural experience. Its tradition is rooted in a diverse and harmonious musical civilization. It not only preserves its own development trajectory but also respects and tolerates each other and continues to develop multi-dimensionally with more diversified new time and space characteristics. Therefore, this paper defines and selects the relevant volume labels from Macao urban music literature in order to construct an identification and association system based on the resources of Macao urban music literature through cluster analysis. The method of cluster analysis was employed to select labels, category matrices, and correlations from the music literature in Macao. This approach aims to enhance the analysis and classification of literature amid current challenges of disorder, redundancy, and complexity. The goal is to improve the screening and analysis of documents and data related to music in Macao. Demonstrating these methods will show that utilizing cluster analysis to build the system of urban music literature resources in Macao leads to a more accurate degree of identification, making it worthy of promotion and application.

4. THE RESEARCH MODEL

4.1 Data collection

4.1.1. Objective

This research is premised on the systematic collection of academic documents about Macao urban music. The Web of Science database, which is known for its reputable collection of peer-reviewed journals, conference proceedings, among other scholarly publications, is the principal data source. The first step is the identification of the materials and involves the usage of a set of well-defined keywords and search terms. The list of terms includes “Macao urban music”, “Macao music culture”, and “urban music trends in Macao”.

4.1.2. Music philology

Music philology is a discipline that is concerned with the study of musical history and literature through a close examination of music texts and materials. . It forms the foundation for research methodology. This method works well for understanding the history, influences, and features of urban music reasons. By using Web of Science, varied documents can be found that give thorough information like titles, authors, where they were published, and who published them. After gathering these documents, these are closely examined to make sure they fit the research criteria.

4.1.3. Data analysis and variable examination

The dataset selected contains 255 entries and forms the basis for the research. The seven unique variables define each entry: document title, author, publication source, responsible publisher, year of publication, type of document, and subject area. Comprehensive data extraction involves rigorous analysis and classification of each document to ensure accuracy and consistency.

4.2 Implementation methods of cluster analysis

The method can be summarized as follows: Use Python to read data in an Excel document and vectorize the text data, which includes items of 'titles', 'document source', 'publication responsible party', and 'authors'. The code first uses the fill na() function

as opposed to “the spread of Western music to the east”. As an immigrant city, Macao still has a concept of “Chinese music moving southward” in its music field. It is a variety of folk music that is moved southward from mainland China, especially the Lingnan region, which is also a Cantonese-speaking region. Among them, the five generations of Macao The inherited Taoist Keji music is a typical representative.

¹² Mr. Fan Zuyin first proposed this concept, and please refer to Dai Dingcheng's re-elaboration of this concept in the article “The Cultural Convergence of Western Music Spreading to the East and Chinese Music Moving to the South—On the Uniqueness of Macao's Music History and Tradition”.

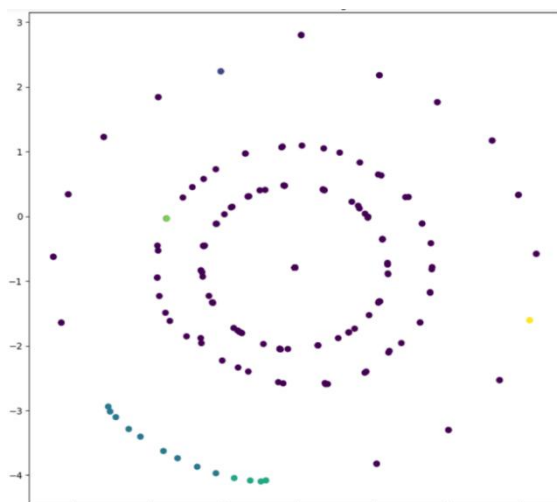
to replace every missing value in the column with an empty string and converts the text into a vector. Next, the high-dimensional vectors are mapped to a two-dimensional space and clustered. The cluster labels are also saved in an array. Finally, the code visualizes the cluster results and presents them using scatter plots. In a scatterplot, each point represents a sample, and its color indicates the cluster to which it belongs.

5. CLASSIFICATION EFFECT OF CLUSTER ANALYSIS METHOD USED IN CLASSIFYING URBAN MUSIC LITERATURE RESOURCES IN MACAO

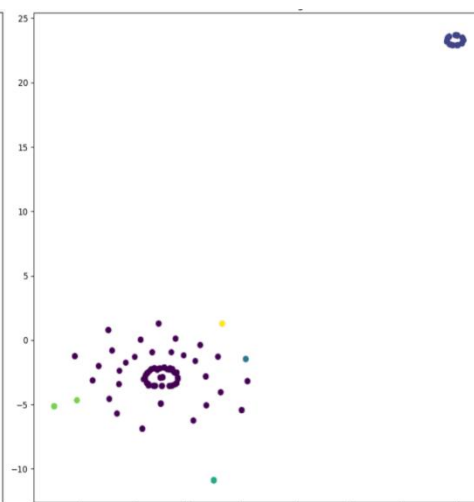
5.1 Cluster analysis

“The concept of clustering cannot be precisely defined, which is one of the reasons why there are so many clustering algorithms. Different researchers use different clustering models, and for each of these clustering models, different algorithms can be given.”¹³ This paper uses a clustering algorithm to classify music documents. The algorithm will divide documents into different clusters based on similarities among the titles, authors, responsible publishers, and more. Cluster analysis is a statistical method used to classify individuals or objects in a dataset into groups with similar characteristics. Based on Professor Dai Dingcheng’s six classifications of Macao urban music literature (Macao folk music, Macao ritual music, Macao art music, Macao entertainment music, as well as the persons, events and objects related to Macao urban music), through cluster analysis of relevant data, the researchers will find patterns and trends to better understand the characteristics and development of Macao urban music.

Based on the technique described earlier, the bibliographic name (Figure 2), the literature source (Figure 3), the publisher (Figure 4), and the author (Figure 5) were categorized into separate clusters. The clustering process was visualized using Gephi, a robust tool for network analysis and visualization. Gephi was utilized to generate visual representations that demonstrate the clustering of titles, sources, publishers, and writers. The x-axis and y-axis in these graphs correspond to distinct characteristics within the dataset. The y-axis shows how data samples compare to each other for another characteristic within the same group. The x-axis displays the relative location of data samples depending on a certain feature, such as the bibliographic name, source of the literature, responsible publisher, or author. By putting the data points on these graphs, researchers could see how alike or different they were. For instance, they could group together titles that shared themes, styles, or types of music. This made it easier for scholars to grasp what kinds of music were popular in Macao. Moreover, it showed where each music genre was most common across the region.

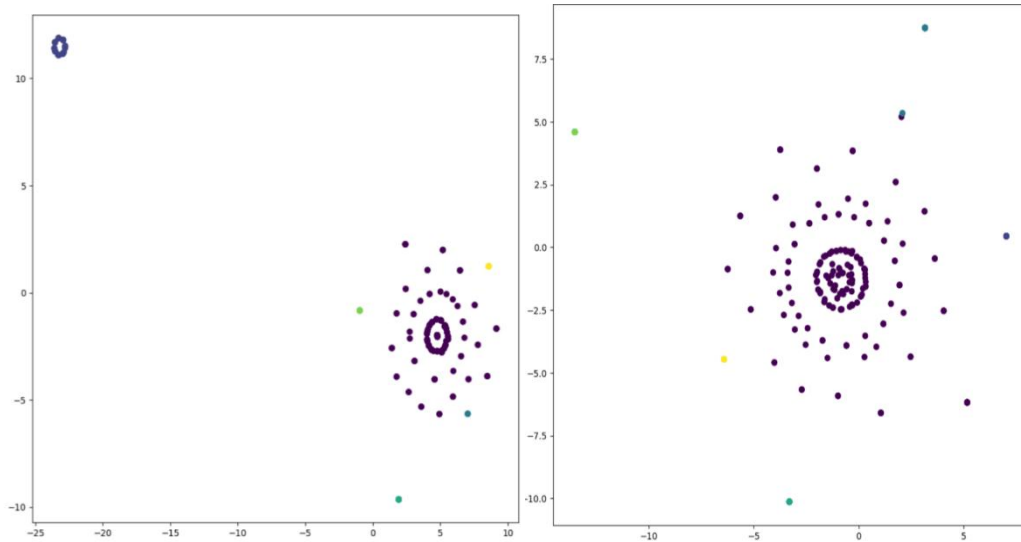


(Figure 2: Document name)



(Figure 3: Source of Documentation)

¹³ Estivill-Castro, Vladimir. Why so many clustering algorithms – A Position Paper. ACM SIGKDD Explorations Newsletter. 20 June 2002, 4 (1): 65–75. Mediterranean Archaeology and Archaeometry, Vol. 25, No 2, (2025), pp. 247-257



(Picture 4: Publication Responsible Party)

(Picture 5: Author)

5.2 Analysis of Multivariate Social Network

5.2.1. Definition of Social Network

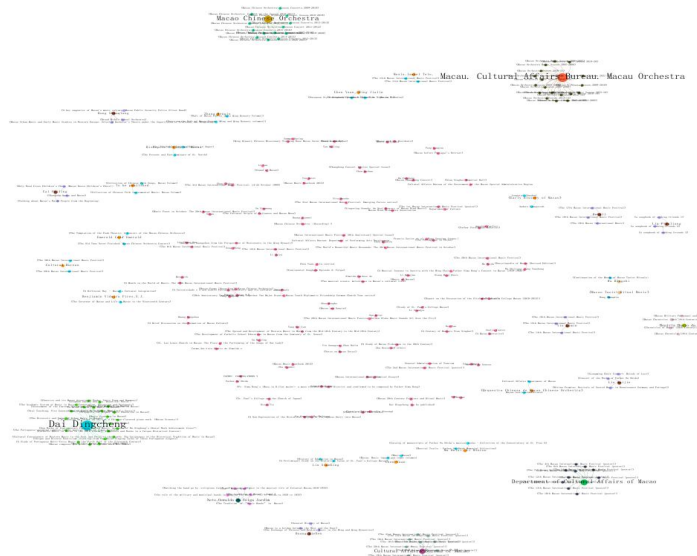
A social network is defined as a social structure consisting of several nodes, where the nodes usually refer to different individuals or organizations while the network structure represents various social relationships. In bibliometric study, what is referred to as a social network is relationships and contacts among different types of entities within the academic or research community. It could be an author, a journal, an organization, or perhaps even a keyword. In a network analysis, the nodes of a network (e.g., groups of authors, journals, or institutions) are connected to each other in various ways. Examples include sharing citations and keywords between references.

This paper explores the relationship between social networks through visual analysis and analyzes some variables through the social network graph, mainly analyzing the text of music literature and exploring the direct relationship between music documents and other variables. Through these analyses, the relationship between music literature, authors, publishing parties and sources can be explored in order to achieve a better clustering effect.

5.2.2 Social network diagram and relationship exploration

As shown in Figure 6, in the study of the relationship between music works and their authors, it can be found that Dai Dingcheng, Macao Cultural Bureau -Department, Macao Orchestra and Macao Chinese Orchestra show obvious aggregation on the cluster diagram. This fully indicates that the publishing authors of this music have made extremely important contributions to the city music of Macao. When literature and documents on the city music of Macao are searched, if the focus is given to only these authors, it will help quickly scan the general trend of urban music in Macao. The city music of Macao shows the diversity of Chinese and Western music, which is dominated by Chinese national music culture with the supplement of the Western music culture represented by Portugal. The authorities in Macao adopt an open and inclusive attitude towards cultural traditions, particularly in absorbing Western artistic aesthetics while emphasizing and promoting Chinese music culture's aesthetic consciousness. They proactively integrate and transform Western art into the local art scene, which becomes an integral part of their cultural discourse. This approach is a meaningful feature of the coexistence of diverse musical cultures in Macao. Thus, it can be concluded from this that the contributions to Macao's urban music culture are mainly reflected in the government and music groups, with relatively few individual contributions.

Except for Professor Dai Dingcheng, who has a certain degree of concentrated research on Macao's urban music, other scholars' research, such as Xu Xiaowang, Huang Qichen, Zhang Wenqin, Li Xiangyu and others tend to focus on the historical research of Macao city. So far, the more active scholars related to the field of Macao urban music are Cai Pei Ling, Hong Shaoqiang, Tam Meiling and others. However, their academic research cannot directly show obvious clustering effects. Therefore, it is necessary to directly understand and pay attention to the research field of Macao urban music.



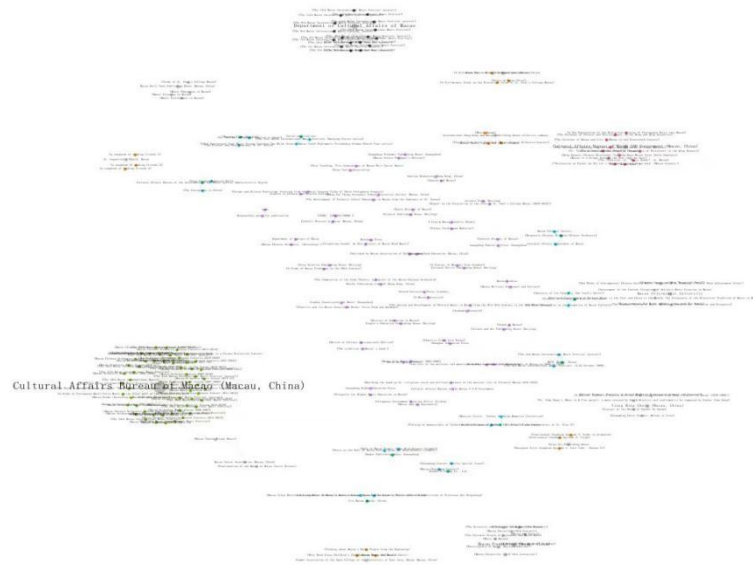
(Figure 6 The relationship between music literature and authors)

5.2.3. Research on the relationship between the publishing party and music literature

As shown in Figure 7, it can be seen clearly from the social network diagram of the responsible publisher that most of the books related to the urban music culture of Macao were mainly published by the Macao Cultural Bureau of Macao, China, while the number of other publishing houses is limited. In Macao, the publishing methods and channels are relatively diversified. Books can be published through Macao associations, government sponsorship, personal funding, and more, which also shows that the Macao Cultural Bureau of Macao, China, plays the most important role in the publication of urban music literature of Macao. The Cultural Affairs Bureau of Macao has also accompanied Macao through its long urban history. "Starting from the Macao Cultural Institute (the predecessor of the Macao Cultural Affairs Bureau), it was established by Decree No. 43/82/M on September 4, 1982, with the nature of A public legal person whose purpose was to assist in formulating and implementing local cultural and academic research policies by launching cultural exchange activities between China and Portuguese-speaking countries and promoting Portuguese language and culture in the region. Until its reorganization in 2005, in order to adapt to the local culture of Macao In order to develop and rationalize the functions of the public administrative structure, according to Administrative Regulation No. 20/2015, the cultural functions, related personnel and facilities formerly belonging to the Civil Affairs Bureau were merged into the Cultural Affairs Bureau, and the "Organization and Operation of the Cultural Affairs Bureau"¹⁴ was formulated. The Cultural Affairs Bureau will be restructured from seven offices, five divisions, five divisions and three divisions into eight divisions and sixteen divisions, with a total of 24 departments." It can be considered that after the reorganization, the Macao Cultural Affairs Bureau has occupied the leading position among the publishing houses related to Macao's music culture.

The vitality of the cultural media can also reflect the global influence of Macao's urban music, a journey still in progress. Although Macao's urban music has rich academic value, it still lacks the attention of the corresponding media. Macao's urban music literature imbued with Chinese, Western classical, and historical characteristics, garners consistent interest and appreciation within the Chinese community. It is hoped that the unique musical traits, creative style, and cultural backdrop of Macao's urban music will increasingly capture the attention of a global audience in the near future.

¹⁴ Detailed information comes from: Organizational Structure of the Macao Cultural Affairs Bureau.[2024.5.17].<https://www.icm.gov.mo/cn/structure>.



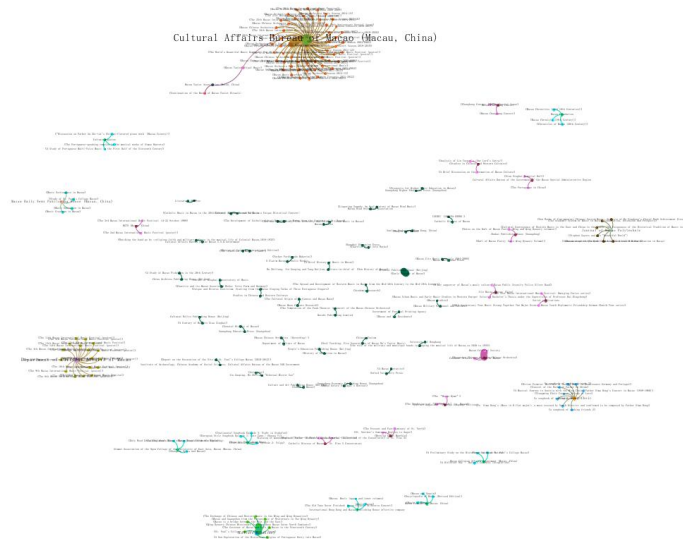
(Figure 7 The relationship between the publishing party and the music literature)

5.2.4 Research on the relationship between music literature and its type.

As shown in Figure 8 - the aggregation effect of the social network graph, the effect- node of literature sources and music literature are relatively discrete and less correlated with the authors and publishers. This shows that Macao's urban music literature is rich in types and sources, though it lacks a highly unified structure. Therefore, it also proves that the literature sources of Macao's urban music present a diversified situation. The figure below illustrates that the literature on Catholic music in Macao reflects the phenomenon of Macao's music gradually moving from west to east. The literature on Daoist music in Macao exemplifies the southward movement of Chinese central music. This aligns with the local characteristics of being multiple, multi-layered, and multi-dimensional, thereby providing valuable resources for researching the diverse music of Macao.

Historically, Western music had a significant influence on Macao, which was also deeply shaped by Western art and culture. As a hub for cultural exchanges between China and the West, Macao attracted Western musicians, laying the foundation for the diverse types of music literature found there today. Notable examples include L. Cattanio (1560-1649), a missionary and musician in Macao; Tomás Pereira (1645-1708), who taught music theory at St. Paul's College; and pianist Harry Ore (1885-1972), who frequently traveled to Hong Kong and Macao to teach music. However, in Macao, the issue of national identity seems to have been properly handled. This cultural exchange has attracted numerous Chinese and foreign musicians and composers to Macao. They have not only created many excellent Western musical works but have also actively composed music that aligns with Chinese aesthetics and thinking.

Making good use of the social network as a carrier to analyze the current situation of the Macao music industry is conducive to clarifying the complicated relationship. Music is an important part of the culture of Macao urban. By applying the social network model to analyze current relationships and combining scientific and engineering methods with musicology, the connections within Macao music literature through social networks can be illustrated. This approach allows to accurately depict the relationships among musicologists, publishers, and music literature sources using precise data. Traditionally, tables and numbers have been used to mark these relationships. However, this paper presents a more convenient way to explore and visualize these data relationships.



(Figure 8 The relationship between literature sources and music literature)

6. DISCUSSION AND CONCLUSION

6.1. Discussion

The underpinned study on Macao's urban music, based on the methodical collection of scholarly papers with the employment of the Web of Science database, offers a considerable understanding of the cultural and musical environment of Macao. The applied methodology, which utilizes music philology and modern data analytic tools, assists in acquiring an overall comprehension of the historical and actual patterns in urban music in Macao. In this way, the utilization of the cluster analysis method in the study brings along significant insights on the categorization of the collection of urban music literature materials in Macao. Thus, the inherent flexibility and adjustability of clustering algorithms allow for a comprehensive classification of the data on literature materials. These algorithms vary significantly in their definitions and implementations, enabling classification based on similarities in titles, authors, responsible publishers, and other characteristics. As a result, data was successfully clustered into meaningful clusters regarding Professor Dai Dingcheng's six classifications of Macao urban music literature. The findings have shown general patterns and trends regarding the characteristics and development of Macao's urban music.

The clustering results specifically illustrate distinct groupings based on bibliographic names, 'source of literature', 'responsible publisher', and authors. Thus, these clusters present the variety and particular features of the music capturing the literature in the country. Specifically, the titles with integrated comparable topics, styles, or genres were classified together, thereby offering a more distinctive representation of the variety and the prevalence of music genres used in Macao. Consequently, the application of visual mapping techniques allowed the researchers to analyze and compare their samples of data, leading to a comprehensive perspective on the cultural and scholarly environment of Macao's urban music.

6.2. Recommendations

Based on the analysis presented in this study, the following key recommendations are made for the promotion of the Urban Music Literature in Macao:

Firstly, a comprehensive study of urban music documentography should be conducted with the help of data analysis and synthesis methods. In other words, the use of statistical methods in collecting, recording, and preserving music literature data may assist in developing a comprehensive and detailed archive of Macao Urban Music. A much more inclusive approach, however, draws from the wide ranges of the arts and humanities, such as history, sociology, and cultural studies. An interdisciplinary approach will bring a more in-depth analysis of urban music, showing its historical background, social influence, and cultural value. By mixing these approaches, researchers can look into complex dimensions of urban music and their subtle relations with other large-scale social and cultural phenomena. Thirdly, the approach is that urban musicology is not only considered from the position of researching the specificity of the music in Macao but also its relation to the music in other regions. Thus, it is important to compare music developments in Macao with other urban centers worldwide to understand the influences and exchanges that shape the music specifics of Macao. Such studies can show the specifics of Macao music and the features that make it different in the context of the globalization of music.

6.3. Conclusion

Cluster analysis can serve as a study methodology to enhance comprehension and offer valuable insights into the urban music literature of Macao. This strategy facilitates academic progress and interdisciplinary collaboration, providing useful direction for safeguarding, advancing, and advocating for music culture in this domain. Macao culture, while being a part of Lingnan culture, has cultivated a distinct urban music legacy through the extensive exchange between Chinese and Western cultures. This tradition is in accordance with the indigenous folk religion and opera of the local community in Macao. It emphasizes the high standard of musicality and the profound emotional expression of the people in Macao. Prior to Macao's reunification with China, its urban music scene epitomized a diverse, multi-tiered, and multifaceted entertainment culture. After the reunification, the streets and alleys of Macao showcase a fusion of Catholic rituals, military and brass bands, local operas, the Macao Chinese Orchestra, and Buddhist and Taoist festivities. These artistic works reflect the features of Chinese culture and cosmopolitan artistic life.

Using cluster analysis, the urban music literature in Macao is divided into some significant clusters, each of which is characterized by its specific titles and instructions. For example, in one cluster, there may be documents with identical titles, authors, and publishers. These music files will be limited to a certain subject matter, style, or period of time. By comparing and analyzing these clusters, relationships and similarities present in different documents can be identified. This technology of analysis can help develop the categorization system of music literature. The results demonstrate the applicability and accuracy of the cluster analysis to the Macao city music literature.

The outcomes of the conducted research will offer a profound influence on further activity in music research-related studies, urban and city development areas, and city music life in Macao. Firstly, the results of the analysis increase our understanding of the variety of Macao's urban music and its differences, which can be used for the purposes of saving and delivering this cultural heritage. Secondly, the results will become an anchor point for urban developers and city strategy-making professionals to form a unique city music environment in Macao. This environment can attract tourists and music lovers in the first place and, therefore, develop the country's economy which majorly depends on its tourism. Thirdly, employing cluster analysis proves instrumental in comprehending the current approach to studying Macao's urban music and its prevailing trends. This form of analysis not only aids in market targeting but also facilitates personalized development in music research. Eventually, the results will enhance the public awareness and appreciation of Macao's urban music culture, thus improving the spirituality and culture of individuals for further enhancement in cultural influence and strength of Macao.

The most important aspect for future studies of urban music in Macao is to adopt interdisciplinary methodologies. This will allow a deeper analysis of the specificity of the relations and similarities between sources that will make improvements to the classification system for urban music bibliography. Studying Macao's urban music culture shows how Chinese and Western music mix together, making Macao's music unique and special. This has greatly contributed to building Macao's distinct musical culture. Another direction future research should be directed towards is the discovery and protection of more regional historical and cultural facts about Macao's urban music literature. This will contribute to a more profound comprehension of its cultural history and evolution.

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