Hybridity of Chinese and Western Music: The Application of the Chinese Instrument *Qin* to Western Orchestra

Dissertation Project

for the award of the title Doctor scientiae musicae

Submitted by Peilei Shang

Hamburg 2020

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Acknowledgement

First of all, I would like to express my deepest gratitude to all those who supported the completion of both my composition and the dissertation of the doctor project.

In order to make a further exploration on the hybridity of Chinese and western music, since October 2017 I have been conducting research on the topic of the hybridity of *qin* and orchestra. I have experienced this period as extremely interesting and instructive. I'm deeply indebted to my three supervisors: Prof. Dr. Manfred Stahnke, Prof. Dr. Georg Hajdu, and Prof. Xiaoyong Chen. They extended a great amount of assistance to me with their encouragement and patience throughout the duration of composing the composition and writing the dissertation. Their guidance and valuable insights into my research were instrumental for me. Besides, I also got a lot of inspirations from the seminar series of artistic research led by Prof. Dr. Georg Hajdu and Dr. Samuel Penderbayne at HfMT Hamburg. The discussions about artistic research were especially helpful to me while writing the dissertation.

I very much appreciate the *qin* player Yingjun Shen from Central Conservatory of Music Beijing, who played all the samples of *qin*, and also the recording engineer Yang Qiao, who made the recordings of them. The recordings of *qin* played an essential role in composing the orchestral piece.

I also had great pleasure of working with the conductor Prof. Ulrich Windfuhr, the *qin* player Hongyu Cheng, as well as musicians from the Hamburger Symphoniker, who not only made great efforts to rehearse and perform my composition, but also put forward many practical suggestions for my composition in the future.

Peilei Shang, Hamburg, 15.05.2020

Contents

Introduction

In accordance with the requirements of the doctoral program (Dr. Scientiae Musicae) at HfMT Hamburg, my project consists of two parts: the orchestra piece *Vagueness,* which was performed on February 20, 2020 by the Hamburger Symphoniker, and also this dissertation *Hybridity of Chinese and Western Music: The Application of the Chinese Instrument Qin to Western Orchestra*. This topic was firstly conceived and determined as my research topic in 2016. As the first phase, the orchestral composition, which can be treated as the experiment of the basic idea, was firstly composed. Then the dissertation makes a discussion on the theoretical, methodological, and analytical perspectives of the composition. The whole process is under the guidance of the framework of artistic research.

From my point of view, artistic research is conducted on the basis of artistic practice. It allows artists going inside to the artistic product through an original investigation, in order to create new intellectual knowledge that can be used by others. It is a process stressing on the unification of subjectivity and objectivity. Among others, Christopher Frayling has introduced an important model for artistic research including three aspects: research into art, research for art and research through art. According to Frayling, research into art refers to a research of aesthetic, historical and other theoretical perspectives. Research for art is considered as the "gathering of reference materials", and research through art as the specific activities of art that the artist is engaged in.[1]

As is suggested by Borgdorff, artistic research begins with a question that is pertinent to the research context.[2] The research question of my dissertation is defined as: how to apply the Chinese instrument *qin* to western orchestra? The answer to the question will be constantly searched throughout the whole dissertation. Likewise, the three degrees

[1] Christopher Frayling: Research in Art and Design. *Royal College of Art Research Papers*, Vol 1, No.1, 1993/4

[2] H. Borgdorff: The Debate on Research in the Arts, Focus on Artistic Research and Development, No.02 2006, Bergen: Bergen National Academy of the Arts.

of Frayling's model for artistic research are involved. In chapter I, the theoretical background of the research question related to cultural hybridity is deliberated. Chapter III demonstrates a historical and aesthetic research on the instrument *qin*. In these two chapters the research into art is reflected. The research for art is contained in chapter II, IV, V, VI and VII, where various "tools" for composing and analyzing the piece are created. The compositional and analytical method based on mimesis is developed in chapter II. Chapter IV explains compositional and technical tools for further analysis. In chapter V, VI and VII, the analysis process of the composition *Vagueness* is conducted in terms of the three categories of mimesis, namely covert, overt mimesis and also their combination defined in chapter II, illustrating the achievement of the hybridity in detail. The score of the orchestral composition, which is a critical component of the project, will be then understood as research through art.

The research topic, which is closely linked to cultural hybridity, is forwarded based on my personal interests. Moreover, cultural hybridity becomes increasingly important under the background of the acceleration of globalization. As the frequent collision and integration between cultures nowadays, none is absolutely pure and isolated. As such, I consider it of great value to make a further exploration, specifically, in hybridizing the Chinese instrument *qin* and western orchestra. I develop a perspective of mimesis for appreciating and analyzing the composition, which is discussed in chapter II. As my original value-added perspective, a multidimensional manifestation of *qin* will be realized. I also believe that the compositional and analytical approach on mimesis, as well as the discussion on cultural hybridity can inspire artists, who are engaged in the field of cultural hybridity.

Chapter I Theoretical Background: Cultural Hybridity

Introduction

My research question involves initially two cultures and their combination or mixture, which is based on the large context of cultural hybridity. In this chapter, I will make a thorough discussion on the cultural hybridity, exploring the history and presence, as well as the process of cultural hybridity, identifying what would the integration of cultures bring about. Furthermore, I will give an insight to the hybridity in music through examining different cases. Finally, the focus is narrowed to my research topic, discussing the motivation of hybridizing Chinese and western music, and the expressing potential of hybridizing the *qin* and orchestra. I will also talk about the following questions: what is my perspective of making hybridity (value-added) in the composition? To what extent the hybridity will be? What is the relationship of the two sides in the composition? All above will be discussed in the following text.

1.1 Getting into Cultural Hybridity

According to the Argentina-born anthropologist García Canclini, hybridity can be broadly defined as "combine discrete social structures or practices, which already exist in distinctly separate forms, to create new structures, objects and practices in which the antecedents merge."[3] In short, it describes the fact that different cultures come together, creating something that did not previously exist.

The phenomenon of cultural hybridity can be found everywhere throughout history. Language offers many examples of hybridity. The Japanese kana characters are

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[3] Néstor García Canclini: *Rewriting Cultural Studies in the Borderlands*, in M.J. Dear and G. Leclerc, eds. *Postborder City: Cultural Spaces of Bajalta California*, New York, Routledge 2003, pp. 277-286

originally invented based on Chinese characters. During Meiji's reform (1868-1912), a large number of foreign words, mostly English, are transliterated to "hirakana" words, making Japanese a hybrid language with high complexity. Due to the Hispanic migration to the United States in the 20th century, many English words are mixed into Spanish, "Spanglish", a language between Spanish and English, was born. Cultural hybridity also exists in literature and artistic fields. As western poetry was introduced to China while the new cultural movement in 1919, Chinese poets began to write poems combing the form of western poetry with traditional Chinese themes. In the architectural field, some churches around 15th century in Spain were decorated by Arabic inscriptions, since Spain was historically influenced by the Muslim culture. Some festivals also embody the cultural hybridity. The Brazil carnival was imported from Europe. The wearing of fancy dress and masks is originated from the European tradition. Meanwhile, dance became much more important than it was in a European carnival, since the Brazil carnival was affected by the dance tradition in Africa.[4] Hybridity is particularly obvious in the domain of music, whether in pop music or classical and contemporary music. Details concerning music hybridity will be elaborated later. From above we can conclude that cultural hybridity has not only a long history on a world-wide scale, but also has different types.

Though the term hybridity is initially applicated in the botanical and biological fields, the studies of hybridity have also been conducted in various sociocultural domains. In the nineteenth century, hybridity consistently aroused concern when talking about human races. The question was whether a hybrid, a cross between two species, were a proof of the unitary human species at its center place.[5] The discussion turned to be inconclusive later. Some scientists represented by the Scottish ethologist Robert Knox claimed that the hybrids are degenerated, which expressed their "cultural attention and anxiety".[6] The Russian literary theorist Mikhail Bakhtin (1895–1975) drew attention

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4 Peter Burke: *Cultural Hybridity*, Cambridge 2009, pp. 32
5 Robert Young: *Colonial Desire: Hybridity in Theory, Culture and Race*, Routledge, 1995, pp. 7.
6 Ibid., pp. 15.

to the importance of the cultural hybrid and of hybridization in the linguistic field. He describes hybridity as a mixing of two languages within the boundaries of a single utterance. According to Bakhtin, the unconscious hybridization is one of the most important modes in the evolution of all languages. Languages change historically primarily by means of a mixing of various languages (hybridization).[7]

In the final decade of the twentieth century, analysis of hybridization becomes most extensive. The mixed cultural identity of hybridity was expounded as a central point in postcolonial studies conducted by Homi Bahbah. In *the Location of Culture*, he stated that "the effect of colonial power is seen to be the production of hybridization rather than the noisy colonialist authority or the silent impressions of native traditions…".[8] His theory of hybridity can be treated then as a campaign against the cultural domination of colonial power. Besides, in the globalization stage, new technologies have compressed time and space and made the world smaller. Globalization can be seen as a multidimensional process in many approaches, such as economic, political, or sociological globalization. With the respect of cultural globalization, the experience, values and ideas of cultures are disseminated throughout the world faster and by more means than ever before. Under this background, hybridity has been used for the research in many fields concerning cultural globalization, for instance, the discussion of cognition of identities. Lipschutz has forwarded that through cultural hybridity in the globalization context, the identity patterns are becoming more complex, as people assert local loyalties and meanwhile share global values and lifestyles.[9]

Throughout all the discussions, the attitude towards hybridity varies. Some people, like racists, criticize hybridity, while more advocators notice its positive effects. The different views are based on different political positions. In fact, from the perspective

[7] Mikhail Bakhtin: *The Dialogic Imagination: Four Essays*, ed. Michael Holquist, trans. Caryl Emerson and Michael Holquist, 2008, pp. 358

[8] Homi Bahbah: *The Location of Culture*, London, 1994, pp. 112

[9] R.D. Lipschutz (1992): *Reconstructing world politics: the emergence of global civil society*, *Millenium,* 21 (3): pp. 389-420

of historical development, no matter how we react to it, no one can try to keep away from the hybridity of different cultures and retain a singular identity. Like Edward Said wrote in his work: “All cultures are involved in one another; none is single and pure, all are hybrid, heterogenous, extraordinarily differentiated, and unmonolithic.”[10] Moreover, the acceleration of globalization nowadays makes cultural hybridity an inevitable trend. It is unavoidable that different cultures will meet, conflict, and blend together.

1.2 The Process of Cultural Hybridity

Cultural hybridity generally describes a state. There actually exists a dynamic process that leads to this result. In order to have a better understanding of hybridity, it is necessary to clearly distinguish its process. Peter Burke has discussed “the process of hybridization”[11] in his *Hybrid Renaissance: Culture, Language, Architecture,* which I found quite convincing. In the following text I will illustrate the process based on Burke’s viewpoint.

Burke divided the process of hybridization into three stages. The first stage refers to the encounter of cultures. This is the perquisite to the next interaction of cultures. People from one culture get into contact with other cultures through interpersonal interaction, namely intercultural communication, whether it is systematic or chaotic. It can also be achieved through various media, such as books or internet. The second stage is the “appropriation of fragments”[12] from other cultures, which means to appropriate a foreign culture selectively. It occurs when a person from one culture adopts elements from another culture. The important feature of this stage is that the borrowed fragments remain more or less separated from the traditional culture, rather than being fused with

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[10] Edward Said: *Culture and Imperialism*, New York, 1994, xxv

[11] Burke used the term hybridization instead of hybridity on discussion, since in his opinion, hybridization refers more to the process.

[12] Peter Burke: *Hybrid Renaissance: Culture, Language, Architecture*, Budapest 2016, pp. 27

it. The last stage is the “integration of fragments”.[13] In this phase, the foreign cultures merge into the local culture, or in other words, they adapt to the receiving culture. This last process transforms the order of the original culture and produces new ecotypes based on the fusion of cultures.

The history of Buddhism in China is a good example for the three stages of cultural hybridity. Owing to the discovery of the Maritime Silk Road in Han Dynasty, Buddhism was first brought to China from India about 2000 years ago during the East Han Dynasty.[14] For over a hundred years, Buddhism was only circulated in the royal family and upper-class society. The ordinary folks barely had a chance to know about it. This period corresponds to the first stage of cultural hybridity, in which Buddhism had little affected the Chinese religious culture. The situation changed in the Wei-Jin Dynasty (ca. 280C.E.- 420C.E.). “Metaphysics” (*xuanxue*, 玄学), which was a Taoistic movement, was developed in the Wei-Jin Dynasty. It has some consistency with Buddhism: they both promote the idea of “empty” and “none”.[15] As a consequence, the Buddhism extensively disseminated and was welcomed by the ordinary people since then. Many Buddhist Sutras were also translated into Chinese. In this second stage, though Buddhism was more influential than before, it was still independent of traditional Confucianism and Daoism. Buddhism was not assimilated by the Chinese culture until Tang Dynasty (618C.E.-907C.E.). Different Buddhist schools with distinctive Chinese characteristics emerged in Tang Dynasty. Among them, the school of Zen (*禅,* chan) Buddhism retains its influence today. One of the most distinct features of Zen Buddhism is the farming among Buddhists. In India, Buddhists beg for alms traditionally. However, under the background of the small-peasant economy in ancient China, the monks farmed and gardened in order to be self-sufficient, forming the unique tradition of Chinese Buddhism. The hybridity was also reflected in the statues of

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[13] Ibid. pp. 28

[14] Sun Jingjing: *Fojiao zai zhongguo zaoqi chuanbode yuanyin tanjiu,* Science and Technology Vision, No. 1 2013, pp. 84

[15] Liu Yunhao: *The Relationship between Metaphysics and Buddhism of Wei-Jin Dynasties*, Zhejiang Social Science, No.7 2016, pp. 106-114

Buddha. Instead of the original face of Greek with curly hair and upturned moustache, Buddha statues built in Tang Dynasty have the typical faces of Chinese. In the third stage, Buddhism was fully integrated with Chinese traditional culture.

The "Sinicization" of Buddhism has gone through more than 500 years since it first reached China, bearing out the logical development of the cultural hybridity. Burke finally pointed out that after the third stage of hybridization, the new type of culture should remain relative stable and impermeable, which emblematizes the end of the hybridization.[16]

1.3 The Result of Cultural Hybridity

Acknowledging the inevitability of the cultural hybridity both from the perspective of historical phenomenon and future trend, the result and significance of cultural hybridity are still to be discussed. One of the representative views is the homogenization of culture. Those who hold this view argue that cultural hybridity in the context of globalization will eliminate the difference and independence of cultures on the whole. We must allow that in the upsurge of globalization, the mode of life tends to be consistent to some extent. However, we should not ignore the new hybrid forms of cultures it generates. In other words, instead of the disappearance of cultural differences, the complexity and diversity of cultural hybridity will reach an unprecedented level. For instance, even though McDonald's and KFC are globally popularized, the menu and flavor still cater to people's preference in the local context. The hamburger with Sichuan chili sauce and Beijing Chicken Roll from KFC in China are all typical fusion of traditional Chinese cuisine and western fast food.

As far as I'm concerned, the collision and integration between cultures are the driving

[16] Peter Burke: *Hybrid Renaissance: Culture, Language, Architecture*, Budapest 2016, pp. 31

force of the development of the culture, rather than leading to the decline of it. The mix of individual characteristics stimulates the collective creativity and leads to cultural innovation, producing a broadening of cultural offerings. Take the case of Chinese culture in modern times. The encounter with western thought brought Chinese a lot of new ideas and therefore more philosophical thoughts are established. The "New Confucianism" (*Xin ruxue*, 新儒学) put forward by Shuming Liang combined several western and eastern theories, including Yangming Wang's Theory of Mind, Henry Bergson's Philosophy of Life, and the Mind Only School of Buddhism.[17] The famous "Mao Zedong Thought" (毛泽东思想) is also a combination of Marxist Philosophy and practice of Chinese revolution. Examples in Literature and art are also numerous. It is the hybridity with advanced western culture which gives rise to diversity and prosperity of Chinese culture in modern times.

1.4 Hybridity in Music

Hybridity is particularly salient in the domain of music. Music which comes from different cultures mixes together, bringing about innovations. Many existing music genres are hybrid forms, such as jazz, in which African rhythm, formal, sonoric elements and European harmonic practices are integrated[18]; Reggae, a Jamaica popular music fused with traditional mento as well as American jazz.[19] As the world music was popularized in the 1980s, foreign music enters the western popular music. Different genres of music have been dynamically merged into each other.

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17 Zhou Meichang: *Wenhua zajiao youshilun*, Daizong Journal, vol. 2, 2000, pp. 61-63
18 G. Schuller, G. Morrison: *Early Jazz: Its Roots and Musical Development*, New York 1968, pp.3
19 Stephen Davis: "Reggae." *Grove Music Online*.
https://doi.org/10.1093/gmo/9781561592630.article.23065. Accessed on 20 Dec. 2019

In terms of hybrid musical performance forms, the Chinese orchestra provides a good example. It was standardized in the light of the western symphony orchestra that has a conductor and several sections of instrument groups in the 1920s. Besides the sections of bowed string, wind, and percussion, the plucked string section including instruments such as *Pipa, Yangqin, and Ruan* exemplifies the unique sound of the Chinese orchestra. For lack of low bowed Chinese instruments, in the string section, cello and double bass are used, which make the string section a well-balanced sonority. For other sections, an original Chinese instrument is reformed to adapt the needs of the Chinese orchestra. For instance, bass *Sheng* and bass *Suona* are reformed from a traditional soprano *Sheng* and *Suona* for filling up the absence of low pitch range in the wind section. Through improving into western standards, the range of traditional Chinese instruments are expanded. In this context, Chinese music was more and more presented in a concert hall.

In compositional music, particularly from the 20th Century, composers raised awareness of the non-western music along with the advent of ethnomusicology. Exotic, regional music is reflected in the compositional processes. Bela Bartok's music offers an important example. He spent a long time making recordings and collecting folk tunes from Eastern Europe, especially Hungarian music. In Hungarian peasant music, Bartok finds the pure Hungarian tradition, which is integrated into his composition. For example, in the third movement of his String Quartet No. 4, the melody of Romanian long song is presented by the cello. This melody has the quality of vocal folk-music and unfolds a syllabic structure of the old Hungarian rhythmic patterns of eleven syllables. The accompaniment (a chord played by two violins and viola) reminds us of the drone of eastern European Bagpipes.[20] The five movements of the piece correspond to the classical arch form (A B C B A). As the center of the arch, the 3rd movement is based on the traditional Romanian folk song "hora lunga", which is composed by recitations, improvisations and declamations. Bartok designed an interval circle based

[20] Dániel Péter Biró, Harald Krebs: *The String Quartets of Béla Bartók: Tradition and Legacy in Analytical Perspective*, Oxford 2014, pp. 134

on three types of pitch cells as the basis of the pitch organization of the whole piece. The central pitch class of the interval circle (D-#G) also occupies a central position in the "hora lunga" structure, as the "hora lunga" being the center of the entire piece.[21]

We can find out from the above example that the involved Romanian folk music is well merged into Bartok's compositional approach. The folk factors are based on the well-designed framework of pitch organization and classical form. They are used in a rather systematical way and are integrated with western compositional techniques.

Another treatment of exotic musical culture in the compositional composition can be found in Puccini's opera *Madame Butterfly* and *Turandot*. In both operas, exotic musical elements are involved. In *Madame Butterfly*, Japanese folk songs, Japanese bells are used, while in *Turandot*, the famous Chinese melody "Jasmine Flowers" (*Mo Li Hua* 茉莉花) emerges several times in different scenes. However, these elements have an interpolating property and are used for enriching the vocabulary of music, as the requirements of the scenario. Puccini does not transform the Chinese and Japanese elements into his own musical language in his works, but just inserts them into the Italian opera style.

Though the duality of musical elements exists in both Bartok and Puccini, the treatments are apparently different. The distinct treatments can be linked to Burke's theory on the three stages of cultural hybridity. The exotic elements in the two operas by Puccini can be classified into the second stage, where a foreign culture is appropriated and remains relatively independent. Bartok's string quartet, by contrast, moves forward to the third stage. The Hungarian music and western compositional languages are not isolated and juxtaposed, but are well collaborated and immerse in each other, creating a new musical idiom. In this sense, Puccini's case can hardly count for the thorough fusion, but only the rudimentary hybridity.

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[21] Ibid., pp 137-139

1.5 The Exploration of Hybridity in Music: The Application of the Chinese Instrument *Qin* to Western Orchestra

As my topic suggests, I will make a full exploration to the hybridity of Chinese and western music, which is not a new phenomenon. As Chinese composers began to study at the music conservatories in Europe and Russia at the beginning of the 20th century, the western musical traditions, compositional forms and techniques were exposed to them and also had an impact on them. Since then, Chinese composers have made continued efforts in combining the Chinese and western elements and creating new, hybrid works. The composers kept making attempts to incorporate Chinese cultural and musical elements into various traditional or contemporary western compositional techniques. Some representative works include Ma Sicong's *Tibet Tone Poem* 西藏音诗[22], in which Tibetan temple music is involved. Tan Dun's *Nine Songs* 九歌 fuses the musical elements of the sacrifice ceremony from the old empire *Chu* 楚. As a result of the hybridity, the Chinese musical elements will give freshness to the western based framework and reinvigorate western compositional music tradition, making the composition endow both Chinese and western music identities and aesthetics. Besides, this topic also links to my identity and my past works. As a composer who was born and educated in China, Chinese music penetrates into my life. It has become instinct for me to present myself with our own musical language. In my past works, I also had the experience in practicing the hybridity of Chinese folk music, operas and western compositional techniques. Therefore, it is the creative process of hybridity related to my own cultural background that motivates me to engage once again in this direction and combine the compositional practice with artistic research.

The hybridity is specifically achieved by the Chinese instrument *qin* and the western

[22] Ma Sicong (1912-1987) was a Chinese composer and the first president of Central Conservatory of Music Beijing. His violin suite *Tibet Tone Poem* 西藏音诗 was a famous example of the hybridity of Chinese and western music.

orchestra in my research. The use of both *qin* and western orchestra is also blended, which embodies the physical hybridity. The *qin* is a representative instrument of Chinese music and Chinese high culture. It occupies an important place in the life of the literary class for thousands of years. The *qin* has not only rich vocabulary of aesthetic appreciation, but also can present an exceptional richness of timbre and subtlety of articulation. Though it is used as a solo instrument, it values the nuance of every single note, which is different from other Chinese melody instruments. The uniqueness and abundance of *qin* is worth making a thorough research. Correspondingly, the orchestra also stands for the western high culture. It is full of flexibility and allows for a wide range of musical ideas. The infinite possibilities of sound combination will lead to the high expressive potential. Hence I believe it would be the optimal choice to presents *qin* sound and music with the orchestra.

From the perspective of Chinese musical elements, after going through typical works of hybridity of Chinese and western music composed by native and foreign composers, it is easy to find out that the hybridity is mainly focused on limited aspects, which are mostly the rhythm or pitch organization of the source. Unlike the previous cases, the added value in my research is reflected in the multi-dimensional manifestation of *qin* including *qin*'s timbre, playing techniques, melody, ornaments, temperament and aesthetics. All these properties of *qin* are involved in the hybridity with orchestra, instead of reflecting only one or several aspects. The representation of different perspectives has the advantage of showing the intricacy of *qin*, since a one-sided view on it is unconvincing for thoroughly revealing the rich connotation of *qin*. Correspondingly, various western compositional techniques are employed, including particularly the spectral techniques, in order to demonstrate both the outer and the inner world of *qin*. The expression of orchestra compositions will then be maximally extended. Therefore, the various and complex elements that are involved in hybridity integrate the two musical identities in the full extent. The methods that achieved my particular perspective can be then treated as a model of combining Chinese and western music that can also be used in further hybrid compositions.

As the third stage of Burke's hybrid process suggests, the hybridity in my composition will have a high degree of fusion of Chinese and western influences. *Qin* is not used for appropriation, but for expanding the compositional repertoire of orchestral timbres and musical ideas with new elements. Speaking of the influence from the west, Bruno Nettl forwards the term "modernization", which he describes as "using western technology and techniques to permit maintenance of the indigenous traditions".[23] My composition is also based on the essence of the Chinese cultural value. The chosen western techniques or products are purposely used for expressing the spirit of *qin* music. Therefore, the balance between *qin*'s introverted quality and turbulent emotions that an orchestra is expert in must be well adjusted, showing the polyphony of the two worlds.

[23] Bruno Nettl: *The Study of Ethnomusicology: Twenty-nine Issues and Concepts*, Urbana, University of Illinois Press 1983, pp.432-433

Chapter II The Method for Composition Based on Mimesis

2.1 Develop the Compositional Method: Mimesis

After having discussed the phenomenon of cultural hybridity, it is worth further exploring how cultural hybridity is achieved. The general means that bring about the hybridity of culture can be consequently used as the compositional methods which enables the hybridity of *qin* and orchestra in my piece. Let us look back to the second stage of the process of cultural hybridity, which was introduced in 1.3. In this stage, people from one culture begin to adopt elements from another culture that have been exposed to them, which implies the beginning of the interaction between cultures. The word "adopt" reveals the meaning of selecting and obtaining. In order to obtain knowledges, to imitate is the inevitable path.

Michael Taussig describes the mimetic faculty as "the nature that culture uses to create second nature, the faculty to copy, imitate, make models, explore difference, yield into and become other." [24] Christoph Wulf also believe that through mimetic processes, the contact with other cultures leads to new shapes, forms and metaphors. New lifestyles and new cultures will be produced.[25] The examples of cultural hybridity in the last chapter cannot be realized without the process of mimesis: Japanese kana character is a mimesis of the structure of Chinese character; without the old connection to African music, in this case at first unconscious, there could be no jazz music… Mimesis is "the essential force of cultural integration."[26] It allows people to learn from other cultures and to build a relationship with them. It is a prerequisite to the later creation of new hybrid forms.

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[24] Michael Taussig: *Mimesis and Alterity*, New York Routledge 1993, pp. xiii

[25] Christoph Wulf: *Globalisierung als Herausforderung der Erziehung, – Theorien, Grundlagen, Fallstudien.* Münster 2002, pp.84

[26] René Girard: *Des choses cachées depuis la fondation du monde*. Paris: Grasset. (English translation: *Things Hidden since the Foundation of the World: Research undertaken in collaboration with René Girard and G. Lefort*. Stanford: Stanford University Press, 1987) pp.17

Based on the above discussion, I engage in mimesis as the basic method of composing *Vagueness*. In the piece, *qin* is treated as the mimetic object. The research question can be externalized to the issue as to how I achieve the mimesis of the Chinese instrument *qin* with western orchestra. Not as complex as in the cases of cultural evolution, it specially involves two forms of instrumental music from two cultures, namely *qin* and orchestra in my case. The process of mimesis of *qin* by the orchestra can be treated as the process of hybridity of the two. The result of mimesis, as the third stage of the process of cultural hybridity suggests, must be the fusion of the two. The orchestra and *qin* should be deeply merged into each other.

In the following sections, the aesthetic principle of mimesis involved in my composition named *Vagueness* will be established, and then the focus will be on the musical mimesis. Finally, I will make a brief description of the application of mimesis in my composition.

2.2 The Aesthetic Principle of Mimesis Used in *Vagueness*

As Stephen Halliwell forwarded, "The concept of mimesis lies at the core of the entire history of Western attempts to make sense of representational art and its values."[27] Despite the various comments on mimesis throughout the western history, the discourse of mimesis centers on two fundamental ideas based on Plato and Aristotle, which describe art as "world-reflecting" and "world-creating" respectively.[28] These two ideas are resonant with different relationships between art and the reality, accuracy and flexibility, reflection and inspiration. The two contradictory views of mimesis raised by Plato and Aristotle will be discussed in this section, thereby building up the basic aesthetic principle of mimesis in my composition.

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[27] Stephen Halliwell: *The Aesthetics of Mimesis*, Princeton 2002, preface

[28] Ibid. pp. 23

The Greek term Mimesis originated from Greek literature around the 4th century BC.[29] It primarily linked to the theoretical principle of creating art. It has been seen as a key term for literary and artistic theory from Greece to the present. Before the philosopher Plato theorized mimesis in a systematic way, mimesis was already described in thoughts of some Greek thinkers. Democritus treated mimesis as an imitation of the nature functions: "We have been the pupils … of the sweet-voiced swan and nightingale in our imitation of their song."[30] Both Plato and Aristotle have explicitly asserted that artistic practices, such as poetry, painting and music, are all mimetic arts.[31] Jacques Derrida also stated in his book *Acts of Literature* that "the whole history of the interpretation of the arts of letters has moved and been transformed within the diverse logical possibilities opened up by the concept of mimesis."[32] Mimesis is a broad notion that not only has the meaning of "imitation", but also includes the sense of resemblance, representation, or mimicry. It implies different meanings in different historical contexts. Apart from the artistic domain, mimesis has also been discussed in psychology, anthropology, educational theory, feminism and post-colonial studies.

Mimesis has been generally associated with aesthetic issues based on art since Plato. It is in his *Republic* that Plato explores the concept of mimesis most comprehensively through the discussion of the figure Socrates and his disciples. In Book three, the target of discussion is poetry. Socrates makes the statement that the poets in general "use imitation in making their narrative".[33] The mimesis occurs between the poet himself and the fictional "someone other than he".[34] In *Republic* Book 10, Plato introduces the metaphor of the mirror in analogy to visual arts, in order to discuss what basically mimesis is. Plato views art as a mimetic imitation of an imitation (art mimes the phenomenological world which mimes an original, "real" world). He denies the artistic

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29 S. Sadie (Ed.): The New Grove Dictionary of Music and Musicians, vol.16, London 1980, pp. 709
30 Wladyslaw Tatarkiewicz: *History of aesthetics*, vol. 1: Ancient aesthetics, edited by J. Harrell, Warszawa 1970, pp. 93
31 Stephen Halliwell: *The Aesthetics of Mimesis*, Princeton 2002, pp.7
32 Jacques Derrida: *Acts of Literature,* New York Routledge 1992, pp. 135
33 Plato: *Republic*, translated by Robin Waterfield, Oxford 1993, pp. 88 393c
34 Ibid., 393a

creativity and skills and argues that painters are craftsmen who can "create" everything just by taking a mirror and carrying it everywhere, implying that the artistic images are only the shadows of the things they imitate, which "present the physical appearances of things, not their rational truth."[35]

Plato's student Aristotle states his view of mimesis in his *Poetics*. He reinforces the basic idea from Plato that art is mimetic. However, he also challenges some of Plato's claims. According to Aristotle, the art is treated no more as only a reflection of an object, as Plato suggests, but "a craft with its own internal laws and aims"[36] which "possesses highly structured procedures for the achievement of the purposes".[37] For Aristotle, the art imitates the process of nature. The development of tragedy, for instance, "having passed through many changes, it found its natural form, and there it stopped".[38] He states that art works have a similarity to natural objects, rather than to illusion and irreality.

Aristotle differentiates art forms from one another in three aspects, namely the medium, the object and the manner or mode of imitation. The medium concerns the materials or tools that art uses for imitating people and objects. For instance, painters use figures and colors; melody and rhythm are employed in music. Aristotle considers the objects of imitation as "men in action". He asserts that these men must have a moral type of goodness or badness and the artists can make a character either better or worse than its stereotype, while this moral type depends on the good or bad effect on the audience in Plato's theory. The characters made by artists cannot be compared with moral distinctions in the real life.[39] Therefore, we can conclude that though Aristotle also considers art as essentially imitative, he separates mimesis from a strict reproduction, emphasizing that artists create art, rather than being just a passive imitator. Aristotle

35 M. Potolsky: *Mimesis*, New York 2006, pp. 22
36 Ibid, pp. 33
37 Stephen Halliwell: *The Aesthetics of Mimesis*, Princeton 2002, pp.153
38 Aristotle: *Poetics*, translated by S. H. Butcher, London 1902, pp.19
39 M. Potolsky: *Mimesis*, New York 2006, pp. 35

treats the manner of imitation as an artistic choice, which should be "appropriate to the nature of the material".[40] By giving the example of painting a hind, he suggests that it is less important to imitate exactly than to imitate artistically: "not to know that a hind has no horns is a less serious matter than to paint it inartistically."[41]

To summarize, both Plato and Aristotle bring mimesis, which is one of the most common human actions, to art and assert that art imitates the world. While Plato considers mimesis as a complete copy and thus unnatural and false, Aristotle treats mimesis as a living organism that has its own crucial functions and criteria. He stresses that the art works are independent from any objects they imitated, rather than being regarded as subordinate to the reality. Plato's "world-reflecting" conception concerns more about the outward looking of the artistic work compared to the reality, while Aristotle's "world-creating" conception pays more attention to the world in an art work itself, which may resemble the real world in certain respects, but is not judged by direct comparison with the real world.[42] These two poles of the aesthetics of mimesis have been debated based on different terms, combined and balanced over centuries. But the fundamental claims of mimesis in Plato and Aristotle hardly have been changed essentially.

Denying that art simply "mirrors" the reality, Aristotle emphasizes the creative freedom of mimesis. The "world-creating" model motivates artists to run away from the limitation of the real life in the representational art, igniting artists' creativity and imagination. The aesthetic pursuit of individual artists is encouraged. Therefore, for composing my piece, Aristotle's "world-creating" model is taken as the aesthetical guidance. Unlike Plato's "world-reflecting" model, which is merely a reproduction of the reality, the composition is not fully attached to its mimetic object *qin*, but has its character in itself. The composition has the status of mimesis as representation

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[40] Ibid., pp.36

[41] Aristotle: *Poetics*, translated by S. H. Butcher, London 1902, pp. 99

[42] Stephen Halliwell: *The Aesthetics of Mimesis*, Princeton 2002, pp. 23

connected to *qin*, which is secondary, and as an artistic creation independent from *qin*, which is the most significant. My aim is not to present a work where auditory fidelity to *qin* is highly valued, but to produce new artistic experience inspired by *qin* through mimesis. The artistic choices of what and how to imitate are based on my own aesthetic standard. Consequently, the result, which may be either distant or affinitive to the original *qin*, remains a high degree of flexibility. The evocation to *qin* will not be the judgement of the successful mimesis.

2.3 Mimesis and Music

Unlike the visual resemblance in figurative art, or the semantics of language, mimesis in music has a height of abstraction. Nonetheless, both the performance and composition of music are deeply tied into mimesis historically. In the following discussion of mimesis in music, the focus of my engagement will be on different views and treatments on the mimesis in musical works in the history. The various musical practices concerning mimesis will also be summarized and categorized.

As is mentioned in the formal section, Aristotle claims that music is one of the art forms of mimesis. In his *Politics*, Aristotle discusses the nature of music in terms of mimesis. The related statements are as follows: "Rhythm and melody supply imitations of anger and gentleness, and also of courage and temperance and of virtues and vices in general, which hardly fall short of the actual affections, … , for in listening to such strains our souls undergo a change."[43] It is clear from this statement that music imitates various emotions and contains different characters. These properties, which are treated as the objects of musical mimesis, have an arousing effect on people's mind and correspond to the properties of the individual person. Thus, people perceive and feel the equivalent qualities in the musical world.

[43] Aristotle: *Politics*, tran. Jowett, Oxford 1885, pp. 252 1340a18

Aristotle also points out that the color and shape in visual art are not likeness, but "signs"[44], which hardly arouse strong emotion in response to what they depict.[45] By contrast, music, no matter with or without accompanied text, emotions and feelings are carried by parameters like melodies and rhythm. Music is hence essentially linked with the emotional expression through mimetic likeness. Halliwell further suggests that Aristotle's advocation of mimetic property of music not only involves the "arousal" of emotion, but also presents the "objective" expression, which refers to the property of depicting something outside of music. These two types of expressions are fused together in Aristotle's conception. These properties are intrinsic in the musical work itself and meanwhile rely on the response of the hearer.[46] Aristotle's view actually gives music a mimetic definition as a whole. The vocabulary and attitudes towards mimesis in music always changed since then. Though later views treat mimesis hardly as the essence of music, the significance of mimetic function of music has been consistently emphasized.

Mimetic thinking of music has developed and related to different ideas of a great breadth in the period of Renaissance. For the theorists during Renaissance, music has the ability of representing and expressing emotion, human actions and ideas. The mimetic property embodied in imitating sounds in nature, human voice and speech, and contents in a text (as Vincenzo Galilei explained in his *Dialogo della musica antica e della moderna*). Examples of mimesis can be found in the chansons such as Janequin's *Le chant des oiseaux* (1528), where singers imitate the bird calls and in La Battaille, where battle sounds are imitated.[47] All these approaches of mimesis suggest that music has close relationships with reality, humankind and culture.

Mimesis in music was increasingly intensified through the dissemination of program

[44] Ibid. 1340a…
[45] Stephen Halliwell: *The Aesthetics of Mimesis*, Princeton 2002, pp. 246
[46] Ibid., pp. 247-248
[47] Claude V. Palisca: *Music and Ideas in the Sixteenth and Seventeenth Centuries*, University of Illinois 2006, pp. 62

music in the nineteenth century. Program music always represents some extra-musical concepts. The narrative and descriptive qualities become the essential components. Hector Berlioz's *Symphonie fantastique* is a notable example, where mimesis exists throughout the symphony. The sound of thunder, footsteps, mocking laughter can be heard explicitly. Except from the mimesis of specific natural or human-made sounds, the symphony is inspired from a story of an artist's life and the structure of music is based on the storyline. We are able to trace the path of the artist's life from successive scenes, including scenes of the ball, the nightmare, the march to the scaffold, and in the fields. The presentations of these scenes are also through mimesis. We can therefore conclude that the whole piece is founded on the basis of mimetic discourse. The composer recreates visual and literary ideas by musical means, so that the listeners can associate them with the corresponding images.

Apart from depicting or expressing any non-musical sounds or events, the mimetic objects could also be musical materials, which incorporate various musical parameters. A great many examples can be found in Chinese compositional music from the beginning of the twentieth century, in which Chinese traditional folk music is imitated. In the celebrated violin concerto *Liang Shanbo and Zhu Yingtai* (梁山伯与祝英台) composed by He Zhanhao and Chen Gang, elements of Chinese *Yue* opera are imitated. Melodies of the love theme in the piece are inspired by the tunes of *Yue* opera. "Hasty bowing with slow singing" (*jinla manchang* 紧拉慢唱), a characteristic gesture of *Yue* opera, is also imitated by the solo violin and the orchestra. Another example is Zhang Haofu's *Luogu Jing* (锣鼓经) for percussions. In the piece, mimetic elements are typical percussion patterns of Peking opera. These patterns of rhythm are further combined with western counterpoint techniques, such as canon, imitation, and invertible counterpoint.[48] It is obvious that both the two examples of mimesis also involve the cross-cultural synthesis of the western and Chinese music. The mimetic

[48] Wang Dan: *Zhang Haofu "Luogu Jing" chuangzuo jifa yanjiu*, http://www.doc88.com/p-2827499356208.html. Accessed on 24 Nov. 2019

objects are several aspects of traditional Chinese music, which are played by western Instruments and hybridized with western compositional techniques.

In the 20th century, the medium of mimesis is no longer limited in the instrumental timbre. The recorded sound is used as a compositional medium, which expands the possibilities of mimetic discourse in music. *Musique concrète* and electroacoustic music are the two main fields for the practice of mimetic discourse, in which the composers use concrete environmental sounds as the raw materials and directly evoke images. In Luc Ferrari's series of works which is described as "anecdotal", various recordings of environments are used and mimetic elements are also dominant.[49] His *Presque Rien No.1* employs a day's recordings of activities on the beach. The recordings are almost unaltered, leaving abstract sounds in this piece completely disappeared. Trevor Wishart's *Red Bird* provides another example of mimesis using recorded sounds. In the piece, series of sounds from nature are employed as raw materials. We are always able to associate the sounds to images of the real world, such as broken glasses and the slamming of a door. However, the images are consistently transformed through processing and editing of the source sounds. For example, the human words at the first beginning are quickly transformed and become the sound of birds. We may also say that the original recording, which is already a mimesis of human words, is processed for imitating the birds. Smalley has since classified this category of transformation as 'source bonded transformation'.[50] In comparison to *Presque Rien No.1*, the original sound material is much altered in the transforming process in *Red Bird*. Nevertheless, visual clues can still and easily be found through mimesis.

All the theories and examples illustrated in the previous text, no matter what media are used or what objects are imitated, can be broadly summarized into what I call the "overt mimesis", which refers to the mimesis to the auditory appearance of the mimetic model that can be aurally perceived. The natural and human-made sounds, musical materials,

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[49] Simon Emmerson: *The Language of Electroacoustic Music*, Hampshire 1986, pp.19
[50] Denis Smalley: *Defining Transformations*, Interface Vol. 22, No. 4, 1993, pp. 279-300

as well as the character or emotion in music which Aristotle suggests, are directly related to the aural clue, just like visual clue for mimesis in painting or in the human behavior. Next I'm going to start a discussion about spectral music, where mimesis is appreciated in a different sense.

Spectral music was initially defined by Hugues Dufourt in his article "Musique Spectrale"[51] and had then been developed by a group of French composers since the 1970s. Tristan Murail pointed out this new aesthetic approach in his article entitled "Spectra and Sprites": "A composer does not work with 12 notes, x rhythmic figures, x dynamic markings, all infinitely permutable; he works with sound and time."[52] The sound here refers no more to a specific musical note, but an organic entity that can be decomposed. In spectral music, the nature, namely the inner quality of sound is investigated. Rather than based on a motif or a cell, spectral music is constructed on the sound spectra and its variants. The result of computer-based sound analysis can be applicated for generating harmony, rhythm, and form. Spectral music composers place a strong emphasis on timbre. They believe that the result of instrumental synthesis in spectral music can be perceived as a fused sonority with timbral character. Timbres can be separated from frequency elements that form the harmonic structure, on the contrary, the harmonic relations can create a single sound, thus forming the "harmony-timbre continuum."[53]

The most foundational and important idea of spectral music is the instrumental synthesis derived from additive synthesis. A sound, regardless of musical or non-musical sound, always contains a sum of sine waves.[54] It can be decomposed into many single sine waves according to the Fourier's theorem.[55] Conversely, we can derive a

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[51] Hugues Dufourt, Musique spectrale, *Société Nationale de Radiodiffusion, Radio France/ Société Internationale de Musique Contemporaine* 3 1979, pp. 30-32

[52] Tristan Murail, *Spectra and Sprites*, trans. Tod Machover, *Contemporary Music Review* 24, no. 2/3 (2005), pp. 137-147

[53] Ibid.

[54] Sine wave is the simplest sonic component. It contains only a single frequency.

[55] D. C. Champeney, *A Handbook of Fourier Theorem,* Cambridge University Press, 1987.

composite sound from a number of the component frequencies by using additive synthesis.[56] In theory, any sound can be synthesized. This method was firstly used for sound synthesis in computer music. The spectral music composers were inspired by this technique and applied it into the instrumental compositions. The process is then metaphorically called instrumental synthesis.[57] To use instrumental synthesis, the target sound from a musical instrument should be first digitized and analyzed. Then the selected component frequencies will be orchestrated in terms of composer's preference.

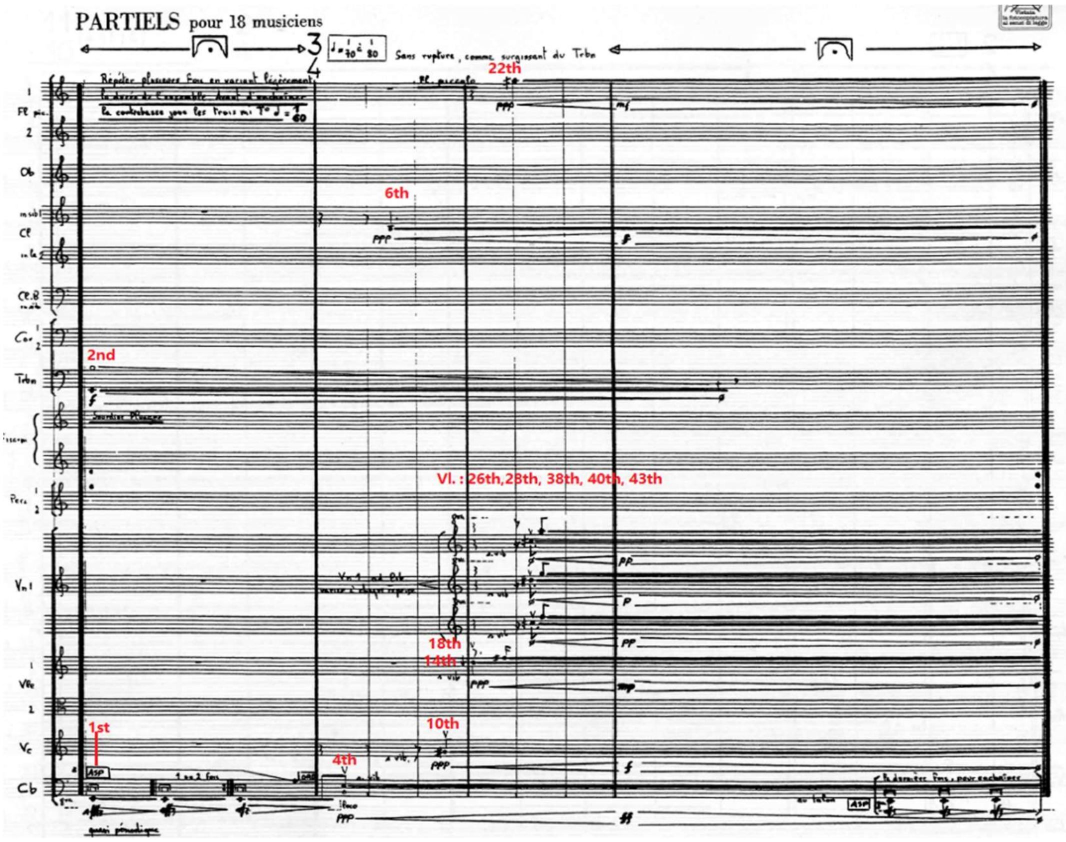

Figure 1: the beginning of *Partiels*

Gérard Grisey has provided a paradigm of instrumental synthesis in his *Partiels* (1975) for 18 musicians. In the beginning of *Partiels*, the pitch E1 (41.2Hz) of trombone is chosen as the source material. The fundamental tone (E1) and the selected harmonic partials, which are integer multiples related to the fundamental frequency, are

56 J. A. Moorer: *Signal processing aspects of computer music--a survey*, Computer Music Journal, vol. 1, no. 1, 1977, pp. 4-37.

57 F. Rose: *Introduction to the Pitch Organization of French Spectral Music*, Perspectives of New Music, vol. 34, no.2 (Summer, 1996), pp. 6-39

distributed to instruments from the ensemble (see figure 1, the used harmonic partials are marked in red). Apart from the dimension of frequencies, other descriptions of the sonogram of the source material, such as the respective intensities, entries of each component, are taken into consideration. In a trombone spectrum, the upper partials come up slightly later than the lower ones. As such, the instruments on the score emerge ranked in ascending order. Grisey also assigns different dynamic levels according to the spectrum to the instruments. For instance, the lower components have obviously much higher intensity than the upper partials.

With the visual aid of the spectrum, the physical structure of a sound can be viewed and analyzed. Composers can then orchestrate it based on the spectral content. However, as is shown in Grisey's example, the result of orchestration is not the same as the original model. Thus, we may hardly identify the source sound when listening to the orchestrated sound. Nevertheless, this transcriptive procedure of instrumental synthesis can be engaged in the mimetic discourse, since the source sound has a strong relationship with the resultant musical values. The certain features of the original sound are still preserved. Similarly, other spectral music techniques can also be considered as the mimesis of different spectral features of a sound. Unlike the mimesis of the overt characteristics of a sound, spectral music obviously belongs to covert mimesis, which is not a direct imitation of the aural result, or in other words, the timbre that we can directly perceived, but an internal mimesis of the inner structure of the sound. From another point of view, spectral techniques can be treated as the mimesis of the electronic process. The idea of instrumental synthesis is the imitation of an electroacoustic tool. Modulation techniques, such as frequency modulation and amplitude modulation, can be considered as a "translation" of electronic musical techniques into the instrumental language.

To conclude, in retrospect of the mimetic theories and practices in the musical composition field in the history, we may find out that the sense of mimesis is multifarious. It is treated as substantially the foundation of music in which human emotions and characters are imitated. It associates with the auditory appearance in the most common sense. These two ideas can be categorized into overt mimesis. On the contrary, as a type of covert mimesis, spectral music achieves a distorted sound result in comparison to the sound source though, it still has a close reference to the nature of sound.

2.4 Mimesis Engaged in *Vagueness*

To achieve the hybridity that involves multi-dimensional manifestation of *qin*, the mimesis of multifarious aspects of *qin* is needed. Likewise, different manners of mimesis should be oriented to each aspect. Therefore, instead of focusing on one specific way of mimesis, I developed a way of pluralistic mimesis, which is an approach that attempts to involve various ways of mimesis related to the ones discussed in 2.3. I will use the hierarchical cluster analysis for categorizing the different types and aspects of mimesis. The taxonomy begins with the biggest cluster "mimesis". Then it splits into smaller clusters hierarchically according to certain chosen features of *qin*, forming a top-down hierarchical clustering. The dendrogram in Figure 2 illustrates the clustering.

In the dendrogram, the general mimesis is split into three sub-clusters, namely "overt" mimesis, "covert" mimesis and the combination of them. This split is based on the two essentially distinct types of mimesis, as is already introduced. Overt mimesis refers to the imitation of the auditory appearance of *qin*. Any features that we can directly perceive through listening to the sound are categorized into it. Covert mimesis refers to the mimesis of the physics of the *qin* sound in the spectrum, which cannot be aurally identified. In my case, spectral music technique is employed and is the only subcategory, while overt mimesis has four sub-clusters including the mimesis of different aspects of *qin*, namely mimesis of timbre, syntax, temperament and aesthetic elements. For the category of the combination of overt and covert mimesis, spectral music techniques are employed. Meanwhile, the aural result of *qin* playing techniques can be easily defined. Then comes the 4th hierarchy. Instrumental synthesis, inharmonic spectra, ring modulation and filtering belong to the spectral techniques. The split under overt mimesis is more complicated: the timbre and the syntax in the 3rd hierarchy have two sub-clusters each. The direct mimesis of *qin* timbre is further split into two smallest clusters.[58]

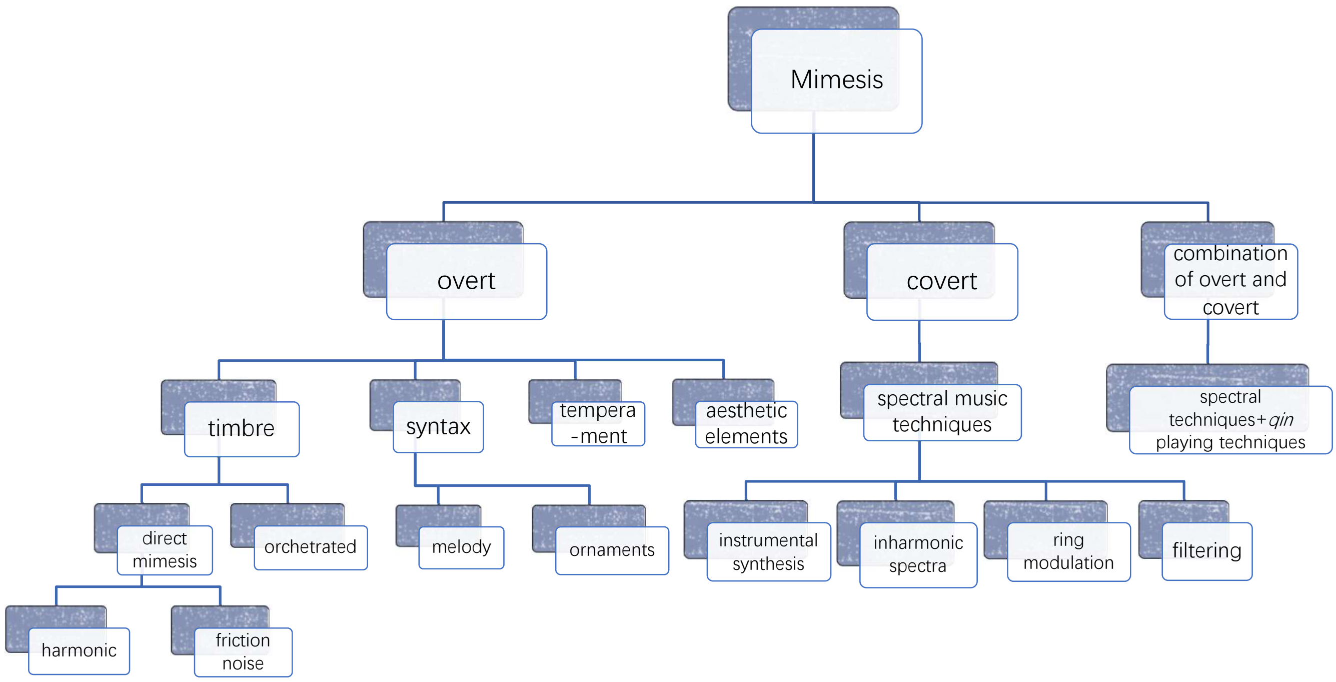

Figure 2: hierarchical clustering of mimesis in *Vagueness*

The dendrogram once again proves that mimetic aspects of *qin* in *Vagueness* are various. The categories of overt and covert mimesis are two poles that define the breadth, while the multiple sub-clusters under the three main clusters ensure the depth of the involved approaches. The combination of the overt and covert mimesis further increases the complexity. Each approach of mimesis has its unique technical practice and aesthetic motivation. Therefore, the richness of the sound result will be increased.

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[58] The 4th hierarchy of the combination will not be listed due to its complexity. Detailed treatments are discussed in chapter 7.

I'll make a detailed analysis of *Vagueness* in the later chapters in terms of the hierarchical cluster analysis, assessing how mimesis is used for composing the piece. Before that, it is essential to have a thorough knowledge of the mimetic object *qin*.

Chapter III Description of Qin

3.1 The Origin of *Qin*

Qin is the most revered of all Chinese musical instruments (see figure 3). It is supposed that the *qin* was invented over 4,000 years ago. There have been a great sum of stories and arguments about the people who created the instrument. Among them are the mythology figures *Fuxi* 伏羲, *Shennong* 神农, and *Shun* 舜 the most frequently mentioned inventors in the ancient tablatures.[59] But all of the stories involve much speculation. Evidence from oracle bone inscription is sufficient to show that *qin* did exist at least as early as the Shang dynasty (1600-1046 B.C.).[60] *Qin* has been widely called "*guqin*" during the last 100 years. The prefix "*gu*", which means "ancient" in Chinese, also suggests its long history.

Figure 3: full view of *qin*

Source: https://en.wikipedia.org/wiki/Guqin

3.2 *Qin* and Literati

Qin represents both Chinese philosophy and traditional musical culture and occupies a very important position in Chinese culture. As early as Zhou Dynasty (1045 B.C.-256

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[59] Li Meiyan: *Qindao yu meixue* 琴道与美学, Beijing 2002, pp. 57-58

[60] Xu Jian: *Qinshi xinbian* 琴史新编, Beijing 2012, pp. 3

B.C.), the system of ritual and music was laid down in order to maintain the hierarchical order. At that time, *qin* was played in court music and accompanied many ceremonies[61] and was even used to be buried together with the dead nobles.[62] In addition to playing as a part of the orchestra at the ceremonies, *qin* was already played as a solo instrument by many professional players. In the Spring and Autumn period (771 B.C. - 476 B.C.), *qin* was considered a tool of self-refinement and state administration by the class of literati and scholars represented by Confucius. There was the saying: "*shi wu gu bu che qin se*" 士无故不彻琴瑟[63], which means that scholars should never give up playing *qin* and *se* (another string instrument) without good reason. From then on, *qin* has become the symbol of Chinese high culture. In Han Dynasty (202 B.C.-220), *qin* was singled out for favour by the literati and was treated as the top of the *bayin* 八音.[64] This is shown by the passage from *Xinlun-qindao* 新论·琴道: "*ba yin guang bo, qin de zui you*"八音广博，琴德最优, which means that *qin* is the most outstanding instrument among *bayin*. In the course of Wei and Jin dynasty, *qin* has become an exclusive instrument for scholars and literati.[65] Apart from the literati, *qin* was also beloved by emperors, monks and Taoist with high literate. Historical famous players include poets and literati like Qu Yuan, Ji Kang, Li Bai. Emperor Song huizong, Taoist Sima Chengzhen. *Qin* is also one of the four arts[66], which a well-developed scholar was expected to be skilled in.

The literati play a leading role in the inheritance and innovation of Chinese traditional music culture. Owing to the close association between *qin* and the literati, *qin* has become undoubtedly the representative of the traditional Chinese music. The well-

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[61] Ye Mingmei: *Guqin yinyue yishu* 古琴音乐艺术, Hongkong 1991, pp. 5

[62] Zuo Qiuming: *Zuozhuan-xianggong ernian* 左传·襄公二年 retrieved from https://www.gushiwen.com/dianjiv/75932.html

[63] Dai Sheng: *Liji-quli* 礼记·曲礼 http://www.guoxue.com/jinbu/13jing/liji/liji002.htm

[64] Chinese musical instruments can be divided into eight separate categories: silk, bamboo, wood, stone, metal, clay, gourd, and skin. They are collectively called *bayin*.

[65] Miao Jianhua: *Guqin meixue sixiang yanjiu* 古琴美学思想研究, Shanghai 2006, pp. 57

[66] Traditional Chinese four arts include *qin*, chess, Chinese calligraphy and Chinese painting.

educated literati have high-level ability in theory and research. They composed a large amount of *qin* pieces and invented a peculiar notation system, making the *qin* has the largest repertoire among all the Chinese instruments before twentieth century.[67] What's more, they wrote a number of books discussing the theory and aesthetics of *qin*. The extensive *qin* literature has constructed the theoretical framework of *qin*. Details will be elaborated in later chapters.

3.3 The Construction of *Qin*

After a long period of development and evolution, *qin* became standardized as the one we see today between eastern Han Dynasty and Jin Dynasty. The body of *qin* is made from two boards with a length of 120cm. They are joined (glued) together to form the sound box. The top board is somewhat rounded and made of lighter wood, while the bottom is generally flat and made of heavier wood.[68] According to *Xinlun* 新论 by Huan Tan 桓谭[69], the rounded shape is the symbol of the heaven and the flat shape is the symbol of the ground. Traditionally, the top board is made of Chinese parasol wood and the bottom one is made of catalpa wood. Many parts of the *qin* body are named after our human body, such as *qin'e* 琴额 (forehead), *qinjian* 琴肩 (shoulder), and *qinyao* 琴腰 (waist).[70] Two sound holes are on the bottom board of *qin*. The one near the middle of the bottom is called *longchi* 龙池. Near the left bottom is the shorter *fengzhao* 凤沼. *Yanzu* 雁足 helps support the *qin* body, and the strings are wrapped around it. On the bottom of the top board is located the *nayin* 纳音 (sound absorber). The function of *nayin* is to keep the sound resonating inside *qin* as long as possible.

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[67] Mao Yuan: *Guqin yishulun* 古琴艺术论, Nanjing 2002, pp. 3

[68] Mao Yuan: *Guqin yishulun* 古琴艺术论, Nanjing 2002, pp.7

[69] Huan Tan 桓谭, 40 B.C.-32, philosopher of the eastern Han Dynasty

[70] Zhang Huaying: *Guqin* 古琴, Hangzhou 2005, pp.83

The *tianzhu* 天柱 (heaven pillar) and *dizhu* 地柱 (earthly pillar) are inside the *qin* body, transmitting sound vibrations.[71] There are two crescent concaving holes designed for resonance at both ends of *qin*, one is called *shengchi* 声池 (sound pool), the other is *yunzhao* 韵沼 (tone pond). The body of *qin* is lacquered and always develops *duanwen* 断纹 (cracks) over time. According to the crack patterns, the age of *qin* could be judged. *Qin* with the pattern of *meihua* 梅花 (botanic, prunus mume) is considered the most antique one.[72]

The seven strings of *qin* were originally made of silk. Since the 1970s, the modern nylon steel strings (metal strings wrapped in nylon) are popularized. They produce a sound with more metallic quality.[73] Along the lowest string are 13 studs made of clamshell called *hui* 徽, marking the position of the harmonics. The strings are dragged over the *yueshan* 岳山 (bridge) and the end is tied by *yingtoujie* 蝇头结. A cord with fringe handing down called *rongkou* 绒扣 connect *yingtoujie* and the tuning pegs (see figure 4), which is used to fine tune the *qin*. Tunings are achieved by adjusting the tension of the strings using the tuning pegs.[74] Although the *qin* was played on the player's lap in ancient time, it has been laid on a *qin* table 琴桌 to maintain its stability since Song Dynasty (960-1279).[75] Figure 5 shows the whole construction of *qin* from the top, inside and bottom of the *qin*.

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71 Gong Yi: *Guqin yanzoufa* 古琴演奏法, Shanghai 2002, pp. 7

72 Gong Yi: *Guqin yanzoufa* 古琴演奏法, Shanghai 2002, pp. 12

73 Wei Xu: *Lun guqin yanzouzhong sixianyu gangxian fenggede chayixing* 论古琴演奏中丝弦与钢弦风格的差异性 In *Modern Music* No. 5 2019, pp. 143-144

74 Gong Yi: *Guqin yanzoufa* 古琴演奏法, Shanghai 2002, pp.8

75 Gong Yi: *Guqin yanzoufa* 古琴演奏法, Shanghai 2002, pp.13

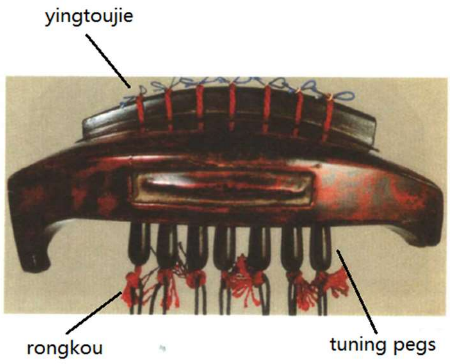

Figure 4: the forehead side of *qin*

source: Zhang Huaying: *Guqin* 古琴, Hangzhou 2005, pp.85

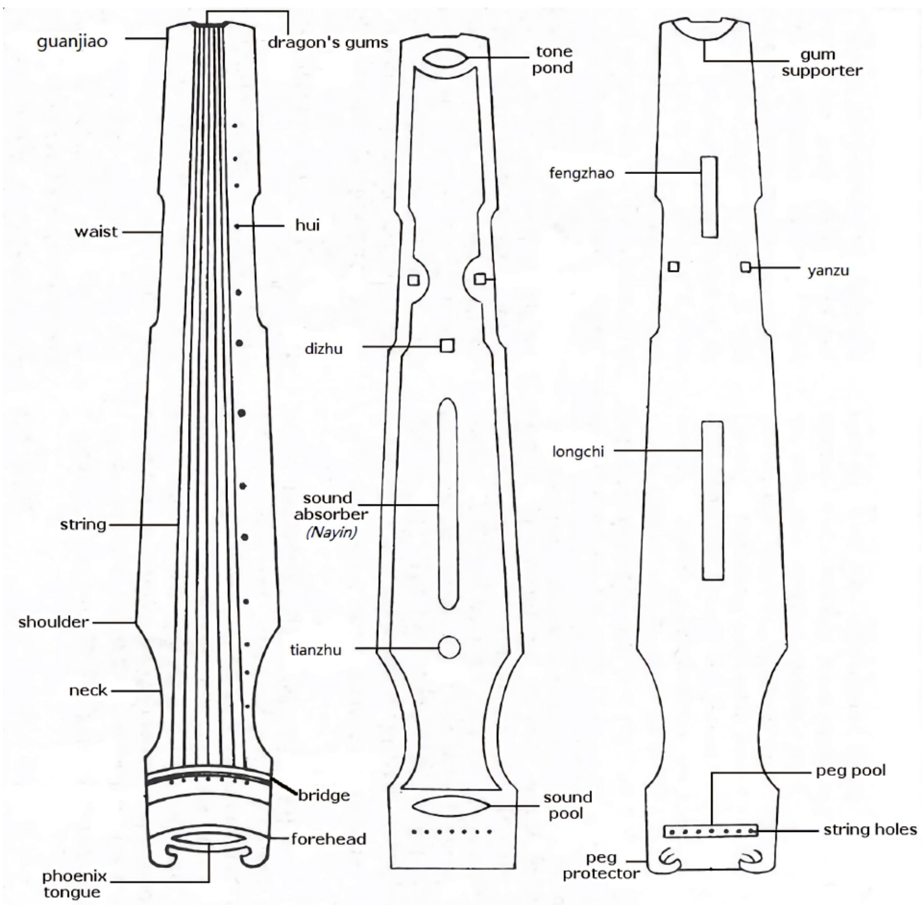

Figure 5: the top, inside and bottom side of *qin* (from left to right)

https://en.wikipedia.org/wiki/Guqin_construction

3.4 Modes of *Qin*

The Chinese word "*diao*" 调 means mode. For *qin*, the mode of music links closely to the tuning of the open strings. The scale formed by the seven open strings determines the mode that is used in a piece. The basic tuning of the seven strings from the lowest to the highest string are C2 D2 F2 G2 A2 C3 D3. This tuning is in *qin* terminology called *zhengdiao* 正调. There are many variants of the basic tuning, which can be achieved by lowering or raising one or more strings. The following tunings are the most commonly used: *manjiao diao* 慢角调 (Manjiao Tuning) is the tuning lowering the third string a half tone from the basic tuning. Raising the fifth string a half pitch from the basic tuning will get *ruibin diao* 蕤宾调 (Ruibin Tuning). By raising the 2nd, 5th and 7th strings from the basic tuning we can get *qingshang diao* 清商调 (Qingshang Tuning). *Mangong diao* 慢宫调 (Mangong Tuning) is the tuning lowering the 1st, 3rd and 6th strings from the basic tuning.[76]

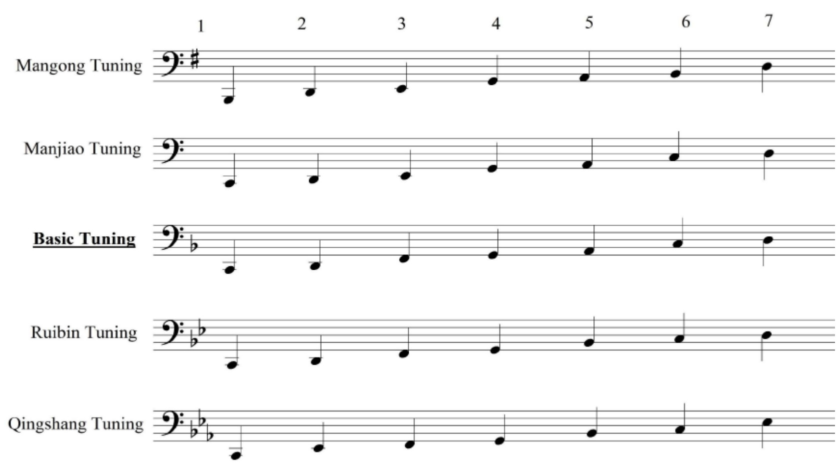

Figure 6: the basic and five most commonly used tunings of *qin*

It is quite apparent that each of the above tunings can form a pentatonic scale. The corresponding key signatures of these pentatonic scales also form a circle of fifths centering on the basic tuning. The relationships of these tunings are illustrated by figure 6. Some tunings including non-pentatonic notes also exist: by lowering the 7th string

[76] Li Xiangting: *Guqin shiyong jiaocheng* 古琴实用教程, Shanghai 2004, pp.105

from *qingshang diao* 清商调 we can get *qiliang diao* 凄凉调 (C2 bE2 F2 G2 bB2 C3 D3). By lowering 4th and 6th strings from *manjiao diao* 慢角调 gives C2 D2 E2 #F2 A2 B2 D3, which is called *ceshang diao* 侧商调.

3.5 Notation of *Qin* Music

The earliest *qin* notation is a type of tablature called *wenzi pu* 文字谱 (longhand tablature). It gives all the details of performance using written Chinese characters. The only authentically ancient example of *wenzi pu* is a manuscript dating from Tang Dynasty (7th century) called *Jieshidiao-Youlan* 碣石调·幽兰 (see figure 7). It is also the earliest known tablature of *qin*.[77] The longhand tablature is of high complexity. For example, *Jieshidiao-Youlan,* the four-part piece, was notated by more than 4000 Chinese characters. The performance of the first note is described by "耶卧中指十上半寸许案商，食指、中指双牵宫商", in total 19 characters.

The hard work made ancient Chinese be eager to simplify the notation. In the middle of the Tang Dynasty, Cao Rou 曹柔 invented the shorthand tablature called *jianzipu* 减字谱.[78] This kind of notation shows finger positions and stroke techniques only in a single cluster of signs, a kind of super-character, which is constructed by several parts of diverse Chinese characters. The top part of the cluster as super-character indicates which left-hand technique should be used and where they stop the strings. The bottom part indicates which right-hand technique should be used, and which string to be plucked.[79] For example, the cluster in Figure 8 (i) means to pluck the string with the

[77] Zhang Huaying: *Guqin* 古琴, Hangzhou 2005, pp.71
[78] Zhang Huaying: *Guqin* 古琴, Hangzhou 2005, pp.72
[79] S. Sadie (Ed.): The New Grove Dictionary of Music and Musicians, vol.19 London 1980, pp. 651

middle finger of the right hand in an inward movement, while stopping the 4th string at the 9th stud with the thumb. All the small-sized characters next to the main character are mostly for left-hand vibrato, portamento and glissando, which are precisely described.[80] (see figure 8 (ii), the small characters are marked with an underline) Even though the note values in the shorthand tablature are not precisely indicated, the left-hand techniques already have rhythmic implications. Besides, there are still some small-sized characters functioning as durational markers. For instance, *sheng* 省 means a short pause. The master players can follow the existing instructions, adding their free imagination of the programmatic nature of the piece.[81]

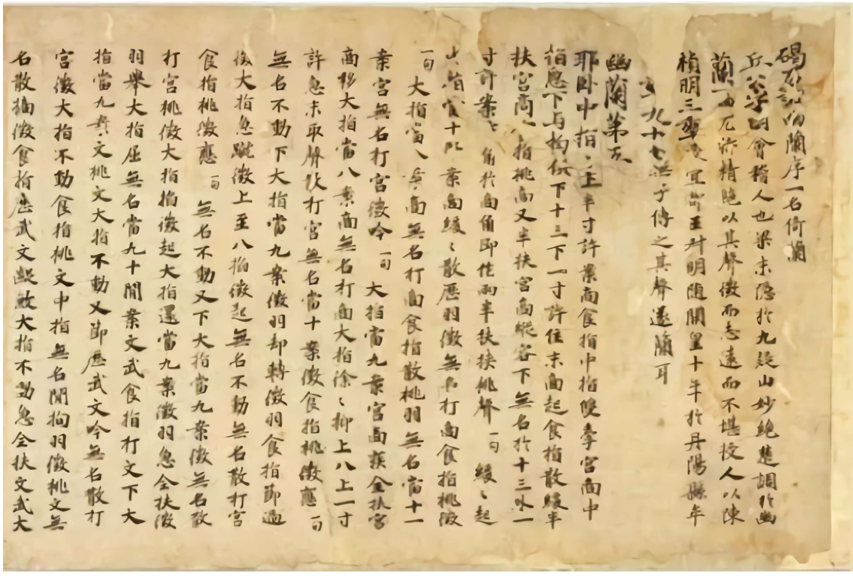

Figure 7: the manuscript of *Jeshidiao-Youlan*

Source: https://www.jianshu.com/p/44cf7ff16ad3

The invention of *jianzipu* has promoted the development of *qinpu* 琴谱 (*qin* tablature collection), in which a number of *qin* pieces in this shorthand tablature were collected. The oldest surviving *qinpu* is *Shen Qi Mi Pu* 神奇秘谱 compiled by Zhu Quan 朱权[82] in 1425. It has 62 *qin* pieces, including a lot of the ancient *qin* music before the Tang

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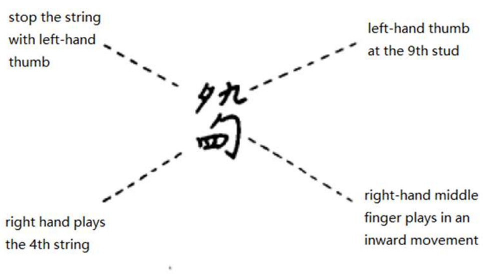
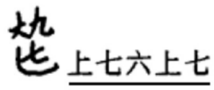
[80] Gong Yi: *Guqin yanzoufa* 古琴演奏法, Shanghai 2002, pp.27

[81] Zhang Huaying: *Guqin* 古琴, Hangzhou 2005, pp.75

[82] Zhu Quan 朱权, 1378-1448, 17th son of the founder of the Ming Dynasty Emperor Zhu Yuanzhang.

Dynasty.[83]





(i) (ii)

Figure 8 i, ii: examples of *qin* shorthand tablature

Since reading *qin* tablature takes much time and efforts, Chinese *qin* masters began to transcribe a range of shorthand tablature into standard staff notation from the 1950s. This process is called *dapu* 打谱. *Dapu* brings old *qin* music to life. It aims to interpret the *qin* tablature as accurately as possible.[84] According to the tuning marked on the tablature, it is easy to know the pitches indicated by each tablature figure. Appropriate note values can be worked out based on *qin* master's understanding of the piece and show high flexibility. For this reason, there are many *qin* pieces with several versions, in which the rhythm differs from each other. In the *qin* handbooks nowadays, the shorthand tablature also appears on the score along with the staff notation (see figure 9). The staff notation can never replace the tablature, but only give an intuitive impression of the music, which a tablature can hardly embody.

Figure 9: qin shorthand tablature corresponding with staff notation

Source: Xu Jian, Wang Di: *Guqin quji* 古琴曲集, Beijing, 2011, pp. 235

[83] Xu Jian: *Qinshi Xinbian* 琴史新编, Beijing 2012, pp.206

[84] Zhang Huaying: *Guqin yinyue dapu zhi lilun yu shijian yanjiu* 古琴音乐打谱之理论与实践研究, retrieved from http://cdmd.cnki.com.cn/Article/CDMD-84201-2006060497.htm, pp.1

3.6 Playing Techniques of *Qin*

The *qin* playing techniques are of high variety. According to *Cunjian guqin zhifapuzi jilan* 存见古琴指法谱字辑览[85], *qin* has 1070 fingerings with or without specific names, which is far superior in number to any other Chinese or western instrument.[86] The fingering is based on either single or compound techniques. When playing *qin*, the right hand plucks the strings between the bridge and the first *Hui*, and the left hand presses the strings to control the precise pitch. The three basic playing techniques are known as *sanyin* 散音, *anyin* 按音 and *fanyin* 泛音. *Sanyin* means that only the right hand plays a string without the left hand pressing a string, i.e., an open string. *Anyin* means that the right hand plays while a left-hand finger presses the string firmly. *Fanyin* means that the left hand slightly touches the string to produce a harmonic sound. For plucking the string, the right hand should keep fingernails exceeding finger about 1-1.5mm long.[87] The eight basic right-hand techniques involve plucking a string outward and inward with the four fingers except the little finger. These techniques are used for playing a single note, plucking two strings at the same time, and also plucking over several strings in succession, which produces a very fast arpeggio. Since the *qin* is fretless, which enables smooth sliding between notes, the playing techniques for left hand are mainly a number of variations from vibrato, glissando and portamento. Other left-hand techniques also increase the richness of *qin* sound. There are also some techniques that require both hands play in tandem.

The full expressing potential of *qin* lies in the various techniques, which brings very subtle timbres. Hence the playing techniques occupy a very important position of my composing. The selected playing techniques will be explained in detail in the analysis of the work.

[85] *cunjian guqin zhifapuzi jilan* 存见古琴指法谱字辑览 is a dictionary of qin fingering,

[86] Guo Ping: *Guqin congtan* 古琴丛谈, Jinan, 2006, pp.112

[87] Li Xiangting: *Guqin shiyong jiaocheng* 古琴实用教程, Shanghai 2004, pp.12

3.7 Temperaments of *Qin*

Qin is tuned with the tuning pegs to adjust the pitch. There are basically two methods of tuning. The first is to compare open and stopped notes: one plays an open string while pressing another string at the position that produces the same pitch, and adjusts if they sound different. However, this tuning could be hardly precise, because with the stopped sounds it is rather difficult to put the left finger down in precisely the correct position. The preferred way of tuning is to use harmonics to tune the *qin*. It requires that two unison harmonics in different strings are fine in tune.[88] Qin has been tuned based on two types of temperament from history to the present. I'm going to talk about these two temperaments next.

3.7.1 *San Fen Sun Yi* Temperament

San Fen Sun Yi 三分损益 is a traditional Chinese temperament, which is used by tuning Chinese instruments. This temperament is produced by adding and subtracting one-third of a string length, namely the 2:3 ratio. When subtracting a third of the length, a fifth interval above will be generated. By adding a third of the length we will get a fourth interval below. The process of tone generation is illustrated in figure 10 (the last two lines show the cents of tones in *San Fen Sun Yi* temperament and the deviation in comparison to equal temperament respectively). After two times of subtracting and adding one-third based on the fundamental C (Chinese name "gong" 宫), the pentatonic scale can be achieved.

From figure 10 we can find out that *San Fen Sun Yi* temperament is not an equal-temperament tuning. Each time when adding or subtracting one-third, two cents are added. Thus, after generating all twelve tones, it is impossible to achieve a perfect octave, namely the 2:1 ratio. This imperfection is also known as the "Pythagorean

[88] Gong Yi: *Guqin yanzoufa* 古琴演奏法, Shanghai 2002, pp.17

comma” in the Pythagorean tuning. One difference between *San Fen Sun Yi* and Pythagorean tuning is that the *San Fen Sun Yi* generates tones only in the order of a fifth above followed by a fourth below, while Pythagorean tuning allows achieving tones both fifth above and below.

宫 *gong*		徵 *zhi*		商 *shang*		羽 *yu*		角 *jue*
C	⟹	G	⟹	D	⟹	A	⟹	E
0		702		204		906		408
0		+2		+4		+6		+8

Figure 10: first five tones of *San fen Sun Yi* temperament

As is mentioned in 3.1, qin has 13 nods called *Hui* 徽. The *hui* marks the position of harmonics. By touching the position corresponding to the 7th *hui* on the string, the 2nd harmonic (an octave higher) can be produced. The 4th and 10th *hui* produce the 4th harmonic. The 5th and 9th *hui* correspond to the 3rd harmonic, which sounds a twelfth higher than the fundamental. To tune with harmonics, the *San Fen Sun Yi* tuning always compares harmonics at the 4th, 5th, 9th and 10th hui with another open string. To tune with stopped notes, notes on the 9th and 10th hui, which are a fourth and a fifth higher than the open string respectively, are used. Both the two methods above use the interval of fourth or fifth, which guarantee the *San Fen Sun Yi* tuning. Figure 11 shows the result of “*Manjiao* Tuning”[89] based on *San Fen Sun Yi* temperament with stopped tones illustrated in *Xi Lu Tang Qintong* 西麓堂琴统[90].

open string	1st	2nd	3rd	4th	5th	6th	7th
cent(s)	0	204	408	702	906	1200	1404

[89] See 3.4 Modes of qin

[90] Xi Lu Tang Qintong 西麓堂琴统 is a *qin* hand book with 25 volumes compiled by Wang Zhi in Ming Dynasty, in which essays about *qin* theory and a great number of *qin* tablatures are included.

pitch	C2	D2	E2	G2	A2	C3	D3

Figure 11: example of tuning with *San Fen Sun Yi* temperament

3.7.2 Just Intonation

The other temperament that is used for tuning qin turns out to have the same result as just intonation, strictly speaking, the five-limit tuning. In just intonation, intervals are tuned as whole number ratios (2:1, 3:2, 4:3…). Compared with *San Fen Sun Yi* temperament, the above major third and minor sixth to the fundamental (the ratio of 5:4 and 5:3) are quite lowered in cent. When touching the 3rd, 6th, 8th and 11th *hui*, the 5th harmonic is produced, which is a just major third (386 cents) to the fundamental. Using these points for tuning is the evidence of just intonation tuning. Taking the example of tuning the 5th string with stopped tones recorded in *Qinxue Rumen* 琴学入门[91]: "the 5th open string equals the 8th hui of the 1st string". The stopped note of 8th hui on the first string (C2) is A2 (a major sixth higher than the open string). This A2 belongs to the just intonation, since it coincides with the 3/5 point of the string. Thus, the 5th string (884 cents) is tuned -16 cents lower than the equal temperament and even -22 cents lower than the *San Fen Sun Yi* temperament. Figure 12 shows the complete tuning result of "*Manjiao* Tuning" illustrated in *Qinxue Rumen*:

open string	1st	2nd	3rd	4th	5th	6th	7th
cent(s)	0	<u>182</u>	<u>386</u>	702	<u>884</u>	1200	<u>1382</u>
pitch	C2	D2	E2	G2	A2	C3	D3

Figure 12: "*Manjiao* Tuning" according to *Qinxue Rumen*

[91] *Qinxue Rumen* 琴学入门: Qin theory and tablature anthology compiled by Zhang He in Qing Dynasty.

The underlined figures indicate the cents which are different from *San Fen Sun Yi* temperament: the E string and A string are in accordance with the 5:3 and 5:4 ratios of just intonation, and both of them are also -22 cents, almost a quarter tone lower than they are in San Fen Sun Yi temperament. The two D strings, which equal to the minor whole tone in five-limit just intonation, are also -22 cents lower than it in the *San Fen Sun Yi* temperament.

The two methods of tuning strings based *on San Fen Sun Yi* temperament and just intonation are commonly used in *qin* repertories. According to some *qin* Masters, since late Ming Dynasty, more *qin* music is tuned base on San Fen Sun Yi temperament.[92]

3.8 The Aesthetics of *Qin*

As Robert van Gulik has pointed out, *qin* aesthetics are "a veritable treasure house of ancient Chinese music in general…".[93] They are closely related to Confucianism and Taoism, which are the most famous two schools of Chinese philosophy. Confucianism links *qin* with moral ideas and treats *qin* as the instrument for self-cultivation. Confucianists put forward the proposition of "*qinzhe, jinye*" (琴者，禁也), implying that *qin* music should be restraining, reticent and away from low desires.

Traditional attitudes towards *qin* are more affected by Taoism. The Taoist Master Laozi has raised the concept of "*Da Yin Xi Shen* (大音希声), which means that the greatest music is sparse with sound. Being influenced by this notion, *qin* is chosen for emotional meditation and is rather played alone or with a small group of people. *Qin* music values the ringing of each sound and even encourages the listeners to "hear" the sound out of

92 Chen Yingshi: *Guqin de huifen jiqi famingzhe* 古琴的徽分及其发明者, Zhongguo Yinyue, Volume 1, 1987, pp. 10-11
93 Robert Hans van Gulik: *The Lore of the Chinese Lute*, Tokyo 1940, Preface I

the string. For *qin* players, the soundless situation conveys as much as the musical part. The unique playing technique that is in accordance with this distinctive feature of *qin* music is to slide a string even when the note disappears. The non-sounding[94] of *qin* is an important aspect that reflects the aesthetic ideal of "*Da Yin Xi Sheng*". The void left by non-sounding is known as "*wu*" (non-being), which is a significant concept of Taoism.[95] Apart from *qin* music, the concept of void and space penetrates many aspects of Chinese culture. Chinese painting, for instance, treats the empty space as solid space. Laozi has stated, "Knowing the white, retaining the black, then the world is formed." (*Zhi qi bai, shou qi hei, wei tianxia shi*, 知其白，守其黑，为天下式).[96] White in Chinese painting suggests emptiness, and black means solidity. The contrast of the void and solid forms gives the distinctive beauty of Chinese painting.

As is mentioned before, there are numbers of theoretical books where *qin* aesthetics are discussed. Among them, *Xishan Qinkuang* 《溪山琴况》by the *qin* master Xu Shangying 徐上瀛 in Ming Dynasty is one of the most representative *qin* literature concerning *qin* aesthetics. In the book, he puts forward "*24 Kuang*" (二十四况), namely 24 features of *qin* music based on the previous *qin* performing practices. These 24 features are: *he* 和 "harmonious", *jing* 静 "serenity", *qing* 清 "pure", *yuan* 远 "profound", *gu* 古 "antiquity", dan 澹 "tranquil", *tian* 恬 "peaceful", *yi* 逸 "grace", *ya* 雅 "elegance", *li* 丽"beauty", *liang* 亮"bright", *cai* 采 "lustrous", *jie* 洁 "clean", *run* 润 "sleek", *yuan* 圆 "rounded", jian 坚 "firm", *hong* 宏 "grand", *xi* 细 "detailed", *liu* 溜 "gliding", *jian* 健"vigorous", *qing* 轻 "light", *zhong* 重 "heavy", *chi* 迟 "retarding", and *su* 速 "hasting". Among these qualities, eight of them are particularly highlighted: harmonious, pure, tranquil, peaceful,

94 Non-sounding in *qin* music doesn't mean that there's absolutely no sound, but no musical tone.
95 Taoists consider that the phenomenon world comes from an original state of "wu" (non-being).
96 Laozi: *Dao De Jing* 道德经 Chapter 26

profound, antiquity, grace and elegant, which all stresses on the highest degree of refinement. These 24 concepts are a comprehensive expression of Confucianism and Taoism aesthetic ideals of *qin*. The quality of "harmonious" reflects more the Confucius thoughts that *qin* music promotes the unity between human beings and the heaven (*tian ren he yi* 天人合一), which is a popular assertion of Confucianism, while other qualities, such as the musical contexts of purity, profoundness, peace, and tranquility, match the natural and meditative feature of Taoism well.[97]

[97] Miao Jianhua: *Guqin meixue sixiang yanjiu* 古琴美学思想研究, Shanghai 2006, pp. 182-183

Chapter IV Spectral Music Techniques and Preparation Phase for the Acoustic Analysis of *Qin*

Spectral music techniques are used for achieving the covert mimesis in *Vagueness*. The general procedure of applying spectral music techniques is that the spectrum of each chosen *qin* sound will be thoroughly analyzed, and then the result will be transferred or transformed and be presented by orchestral language. In this chapter I will firstly focus on the spectral music compositional techniques, especially the spectral treatments that are employed in my composition. Terms, ideas and technologies of spectral music will be introduced and discussed. Then comes the preparation phase for the acoustic analysis of *qin* sounds. Information about the recorded samples of qin, as well as the software used for the signal analysis, will be given.

4.1 Spectral Music Composition Techniques

4.1.1 Instrumental Synthesis (Additive Synthesis)

As is already explained in 2.4 when talking about the covert mimesis, instrumental synthesis implements the additive synthesis specifically in the instrumental music field. The original idea comes from electro-acoustic additive synthesis, which refers to building up complex sound through combing the sine waves. In the case of instrumental synthesis, the simple oscillators are replaced by musical instruments. In the practice of instrumental synthesis, frequency and amplitude content over time of the source sound will be analyzed and applied into orchestration.

Though all the elements are based on the sound model during the procedure of instrumental synthesis, the result is not the same as the original model. Sometimes even very far from it acoustically, because a sine tone is replaced by a musical instrument that is already a complex sound and has a definite character. It is for this reason that the sound created by instrumental synthesis retains some essential features of the original sound, meanwhile has much more complexity and richness in timbre. From the perspective of compositional techniques, as Grisey stated, this way of treating timbres, noises and intervals is ecological.[98] Instrumental synthesis provides a creative way of organizing harmony, manipulating orchestration and composing timbre.

In my piece, the instrumental synthesis is largely based on various *qin* sounds as source materials. The synthesized sounds reveal to great extent the quality of *qin* sound. I will discuss the different cases in detail in later texts.

4.1.2 Inharmonic Spectra

Like many other instruments, the trombone has a harmonic spectrum and this property is retained in the beginning of *Partiels* (see figure 1). However, in practice, the composers always use spectral music composition techniques to produce spectra that have great difference from the harmonic series, which largely enrich the inharmonicity of the spectra.

When any frequency component is not an integer multiple of the fundamental, the spectrum is no longer a harmonic spectrum, but has the nature of inharmonicity. It is intelligible that many unpitched percussion instruments have inharmonic spectra, such as the tam-tam and the cymbal. Some pitched percussions also have a complex spectrum with inharmonicity, such as bell or tubular bells. We can clearly hear other components besides the fundamental pitch in a bell sound. Another category of inharmonic spectra is the sound in which the spectrum is always slightly compressed or stretched, though we still perceive a global sound rather than separated pitches. Lord Rayleigh has proved in his book *The Theory of Sound* that the piano stiffness of the

[98] G. Grisey: "Did You Say Spectra?", *Contemporary Music Review*, Volume 19, 2000, part 3, pp.1-3

string affects the restoring force, resulting in the partial frequency higher than harmonic series.[99] Similarly, strucked instruments also have the quality of inharmonicity.

The spectral composers exploit this property of piano spectrum in their pieces and use a formula to reproduce this effect: $f_n = n^x * f_0$. It means that the partial frequency n equals the fundamental frequency f_0 multiplied by the partial number raised to the x power, which is always greater than 0. The frequency is expressed in Hz.[100] If x equals 1, the result remains unchanged, exactly the harmonic frequency. When x is greater than 1, we can get a stretched spectrum. When x is between 0 and 1, the spectrum will be compressed. The farther away x is from 1, the more exaggerated the spectrum is compressed or stretched.

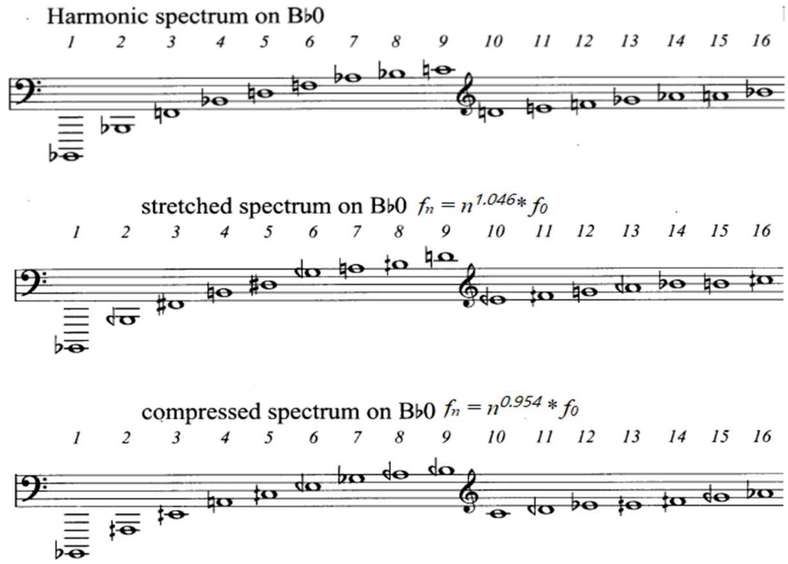


Figure 13: harmonic, stretched and compressed spectrum from *Vortex Temporum*

An example of using this formula to get an inharmonic spectrum can be found in Grisey's *Vortex Temporum* (1996) for chamber ensemble. In this piece, both the stretched and compressed spectra are based on piano pitch B♭0. The three staves in

[99] P. Chumnantas, C. Greated, R. Parks: *Inharmonicity of nonuniform overwound string*, Journal de Physique IV Colloque, 1994, 04 (C5), pp. 649-652

[100] J. Fineberg: "Guide to the Basic Concepts and Techniques of Spectral Music", *Contemporary Music Review*, 2000, Vol. 19, Part 2, pp. 81-113

Figure 13 show respectively the harmonic spectrum up to the 16th partial based on B♭0, the stretched version, and the compressed one of the same spectrum. The exponent of the compressed spectrum is 0.954, while for the stretched spectrum, the partial number is raised to the power of 1.046. All the notes of the last two spectra are represented by the nearest quarter tone.[101] From the three spectra in Figure 13 we can draw the conclusion that the higher the partial, the more obvious the deviation from the original spectrum is. The 16th partial of the last two spectra is more stretched and compressed than the second partial in comparison with their equivalents in the harmonic spectrum.

4.1.3 Modulations

Apart from the additive synthesis, there are also other spectral music techniques that are greatly influenced by electronic processes, more specifically, nonlinear synthesis techniques, which include two types of modulation, namely ring modulation and frequency modulation. The result of these modulations also falls into the inharmonic domain. Unlike the spectra discussed before this point, modulation involves no longer the distortion of a single spectrum, but the interaction of two independent waveforms.

Ring modulation refers to the process that two signals are indistinctive and modulated by each other. The result of the signal contains only the summation and difference of the two signals' frequency.[102] In the case of two sine waves, ring modulation will generate two sidebands, which are the summation and difference. For two complex sounds with more components in their spectra, each frequency from one spectrum will be combined and subtracted with the ones from the other spectrum, resulting in a more complex sound with a series of summation and difference frequencies. Before the

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[101] R. Hasegawa: "Gerard Grisey and the 'Nature' of Harmony", *Musical Analysis*, vol. 28, No. 2/3 (July-October 2009), pp. 349-371

[102] R. H. Burchardi: "Digital Simulation of the Diode Ring Modulation for Musical Applications", Proc. of the 11th Int. Conference on Digital Audio Effects (DAFx-08), Finland.

spectral composers employed ring modulation, it has already been extensively used in Stockhausen's music. In Stockhausen's *Mantra* for two piano players and electronics (1970), the piano pitches through a microphone are modulated by a sine wave generator in the ring modulator. This electronical application of ring modulation has then been transposed by composers of spectral music to enhance the inharmonicity and richness of the sound. In the procedure of ring modulation, composers choose two frequencies A and B, then add and subtract the two frequencies, obtaining the summation and difference tone. When the partial frequencies built on A and B are chosen, each partial from A should be added and subtracted by the each partial from B. For example, if we choose both the first two partials based on A and B, the result of ring modulation is as follows: A+B, A-B, 2A+B, 2A-B, 2A+2B, 2A-2B, in total six frequencies.

Though frequency modulation has been used for radio broadcasting since the 1930s, it was thoroughly researched as a musical synthesis tool by John Chowning in the 1970s. In frequency modulation, the two signals are called respectively carrier and modulator. The frequency of a carrier wave is varied according to a modulating wave.[103] The spectrum produced by frequency modulation can be expressed by the following equation: frequency = carrier ± (modulator * index).[104] Each integer value between 0 and the selected maximum index value should be multiplied by the modulator frequency. The ratio m/c determines the degree of harmonicity of the result. Complex ratios produce inharmonic spectra, simple ratios such as 1/2, 3/4 create harmonic ones. Spectral music composers used frequency modulation to generate harmony-timbre with instruments. In the beginning of *Gondwana* (1980) for Orchestra by Tristan Murail, inharmonic spectra produced by frequency modulation is used for synthesizing the sound of bell, which has a distinctive spectrum that contains lots of inharmonic partials. Murail choose #G3 (207.6Hz) as the modulation frequency, G4 (392Hz) as carrier frequency and the number nine as index of modulation, obtaining nine sum pitches,

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[103] J. M. Chowning: "The Synthesis of Complex Audio Spectra by Means of Frequency Modulation.", *Journal of the Engineering Society*, vol 21, no. 7, 09. 1973

[104] Index refers to the ratio of the peak deviation to the modulating frequency. When it is greater than 0, the carrier will be modulated.

nine difference pitches, and along with the carrier and modulator for integrating the first chord.

4.1.4 Filtering

Filter effect is also a commonly used technique in spectral music. A filter is used for signal processing. It allows certain frequencies or components to pass through it, while removing undesired ones. There are four basic types of filter: high-pass, low-pass, band-pass, and band-rejected filter. A high-pass filter allows the frequencies above the cutoff frequency to pass through and attenuates the frequencies below it. A low-pass filter does exactly the opposite, allowing the frequencies below the cutoff frequency to pass through while the ones above the cutoff frequency are attenuated. The attenuation of the filtered frequencies depends on the filter slope. The slope can be either set to make a gentle transition to the cutoff frequency, or set to simply cut the rest of frequency band immediately. A band-pass filter allows given bandwidth (a certain range of frequencies) to pass through and attenuates the frequencies both above and below the bandwidth. A band-reject filter, on the contrary, attenuates the frequencies in a certain range, but allows frequencies outside the range to pass through unaltered.[105]

Since the spectrum of any complex sound, e.g. instrumental sound has a lot of content, spectral music composers are inspired by filter technique in signal processing and a variety of treatment is invented. For example, they leave only the desired components and the rest is omitted. Or certain frequencies are exaggerated while others are weakened. Grisey employed the filter effect in his *Modulations* (1976-77) for ensemble. He analyzed the spectra of four types of mutes on the trombone on E_2 and then chose the enhanced partials corresponding to every mute.[106] Another example is from

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[105] A. Cornicello: "Timbral organization in Tristan Murail's Désintegrations and Rituals", Ph. D. Brandeis University, 2000

[106] F.Rose, "Introduction to the Pitch Organization of French Spectral Music", *Perspectives of New Music*, vol. 34, no.2 (Summer, 1996), pp. 6-39

Désintégrations (1982 – 83) by Murail for ensemble and tape. At the first beginning, the harmonic elements are derived from two piano spectra based on low #A0 and #C2 respectively. The spectra are filtered and only leave 6 – 8 partials for constructing each chord. The filtered chord from the first eight measures are illustrated in Figure 14. The partial number is marked on the right side of each note. It is apparent that the first 8 bars are built from the alternation of the two spectra. Except for the fundamentals, the partials below the 5th are omitted. The harmonic structure based on #C2 keeps certain consistency with the one on #A0 in frequency.

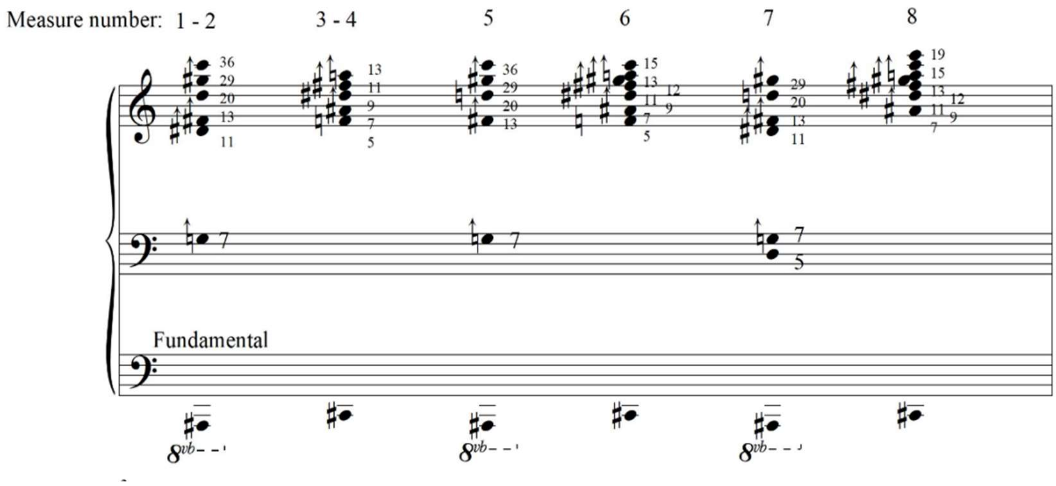


Figure 14: the filtered elements from the first 8 bars of *Désintégrations*

4.1.5 Horizontal Organization

Up to this point we have discussed different types of spectral music techniques for vertical organization of music, which provide multiple options for creating a variety of timbre. There is another interesting way of generating spectra, i.e., horizontal organization. In this process, the spectrum is decomposed and the components are played one by one, creating "filters inspired by 'phasing'".[107] The lined up spectrum

[107] T. Murail: "The Revolution of Complex Sounds", tran. J. Cody, *Contemporary Music Review* Vol. 24, No. 2/3, April/June 2005, pp. 121 – 135

can be treated as the movement of the components within a sound. The partials construct no longer one specific timbre, but a horizontal figure that has the meaning of melody. Murail used this technique in his *Ethers* (1978) for flute and ensemble. Figure 15 shows a passage that the components are played one after another, forming a circuitous horizontal movement.

Figure 15: horizontal movement of the spectrum components from *Ethers*

4.1.6 Summary

From the discourse in this chapter, it is easy to find out that many spectral techniques are derived from sound synthesis techniques. Among them, additive synthesis can be regarded as the basis of all synthesis techniques, since it simply refers to the process that creates complex sound by combining spectra components based upon the analysis of a spectrum. Other spectral music techniques, such as distortion of spectrum, filtering, ring modulation and frequency modulation, are different treatments for obtaining a certain range of spectrum or increase the inharmonicity of a spectrum. After the analysis is modified by these techniques, a sound can be synthesized with a variety of characteristics, enhancing the richness of timbre.

4.2 Recordings of *Qin*

Before I started to compose *Vagueness*, all sorts of *qin* sounds were recorded in a recording studio in Beijing. The player was a master candidate majoring in *qin* performance from Central Conservatory of Music Beijing. The strings of the recorded *qin* are typical nylon steel strings. As to the tones, all the three basic techniques (*sanyin* 散音, *anyin* 按音, *fanyin* 泛音), as well as the complete set of right-hand, left-hand techniques and techniques of both hands in tandem are recorded. Each technique is involved in several samples played by different notes, which ensure a large database. The note selection follows the following principles: For the notes produced by terminating the string(s), distribution in all registers are taken into account. For the sake of comparison between spectra, similar techniques are presented by the same note. The player was told that all the notes should be played at the same dynamic value (in this case, *mf*). Besides, the recording of every sample must be stopped until the sound completely disappears, because the whole process of a sound behavior will be analyzed later. All the recorded playing techniques are listed below:

Techniques for right hand:

Right Hand Techniques / Type of sound	Single Sound	Multiple sound (on one string or interval)
Open strings	*Tuo* 托, *Pi* 劈, *Mo* 抹, *Tiao* 挑, *Gou* 勾, *Ti* 剔, *Da* 打, *Zhai* 摘	*Lun* 轮, *Gunfu* 滚拂, *Bo* 拨, *La* 剌, *Dacuo* 大撮, *Fu* 伏,
Stopped strings	*Gou* 勾, *Ti* 剔, *Mo* 抹, *Tiao* 挑, *Pi* 劈	*Suo* 锁, *Quanfu* 全扶, *Banfu* 半扶, *Die* 叠, *Lun* 轮, *Bo* 拨, *La* 剌,
Harmonics	*Mo* 抹, *Tiao* 挑, *Tuo* 托, *Pi* 劈, *Tiao* 挑	*Dayuan* 打圆, *Quanfu* 全扶, *Dacuo* 大撮
Open Strings and Stopped Strings		*Dayuan* 打圆, *Dacuo* 大撮, *Xiaocuo* 小撮

Techniques for left hand and both hands:

	Name of the Techniques
Left Hand	*Shang* 上, *Xia* 下, *Jinfu* 进复, *Tuifu* 退复, *Yin* 吟, *Nao* 猱, *Chuo* 绰, *Zhu* 注, *Daiqi* 带起, *Zhuaqi* 抓起, *Qiaqi* 掐起, *Tuichu* 推出, *Yan* 掩, *Xuyan* 虚掩, *Zhuang* 撞, *Wanglai* 往来, *Tang* 淌, *Tuo* 拖, *Wu* 忤
Both Hands	*Duiqi* 对起, *Fenkai* 分开, *Fanghe* 放合, *Yinghe* 应合, *Qiacuosansheng* 掐撮三声

4.3 Software for Signal Analysis and Spectra Processing

After recording all the samples, I used the Fast Fourier transform (FFT) to facilitate sonic analysis. FFT has been widely used to identify the frequency components of a waveform. It represents frequency content of an entire signal. The 2 - dimensional data can be displayed as a plot of frequency (x-axis) against amplitude (y-axis), or amplitude against time, which is called a spectrum. Besides, the spectrogram of the samples is also generated. A spectrogram shows how the frequency content of a signal changes over time. It is a 3-dimensional function of amplitude (brightness or color) vs frequency (vertical axis) vs time (horizontal axis). With the aid of these two types of presentations, the details of a sound event can be comprehensively analyzed.

As for the tools, the main software I used as the spectrum analyzer are Praat, Sonic Visualizer, SPEAR and *Macaque*. Praat mainly helps to generate a spectral slice of a sound event. Pitches, formants and intensity of a sound can be analyzed using Praat. Sonic Visualizer is mostly used for viewing a spectrogram. The spectrogram can be presented according to different display parameters with an easy operation. SPEAR is mostly used for analyzing and editing a sound signal. In SPEAR, a sound can be represented as many individual sinusoidal waves. The analysis data can be freely manipulated by cut and paste. *Macaque* is an application running in the *MaxScore*, which is a notation software package for Max. In *Macaque*, the harmonic contents in a spectrum can be particularly transcribed to note events with dynamics. Rhythm and pitch can be also detected in terms of different parameters.

Chapter V Analysis of Covert Mimesis Used in *Vagueness*

In this chapter I'll make an analysis of factors relates to the covert mimesis in *Vagueness*, which involves particularly spectral music techniques in my case. The aim of this chapter is to figure out how I present the inner structure of *qin*'s sound. Among the five parts of *Vagueness*, the covert mimesis is in great measure employed in the first (bar 1-26) and the second part (bar 27-59) of my work, and partly involved in the fifth part (bar 145-170). I will analyze the employment of covert mimesis in part I, II and V in this chapter.

5.1 Analysis of Part I

5.1.1 Introduction

For the purpose of presenting the sound of *qin*, additive synthesis is generally the starting point. Before synthesizing a sound, filter techniques help to get the desired components of a spectrum. Therefore, the first part of the piece principally focuses on these two basic spectral music techniques. Qin sounds played by different techniques will be used as models for being synthesized. I choose *sanyin* (open string), one of the three basic categories of *qin* sound, as the main type of sound in the first part. *Anyin* (single note and two strings together) is also slightly involved. As is already introduced in the last chapter, *sanyin* can be played inward and outward by each of the four fingers of the right hand, in total eight basic right-hand techniques. Their names and ways of plucking are illustrated in figure 16.

	Pi 劈	*Tuo* 托	*Mo* 抹	*Tiao* 挑	*Gou* 勾	*Ti* 剔	*Da* 打	*Zhai* 摘
Finger	thumb	thumb	index	index	middle	middle	ring	ring
Direction of plucking	inward	outward	inward	outward	inward	outward	inward	outward

Figure 16: eight basic *qin* playing techniques of right hand

In total 9 sound models are used in the first part of the piece. These sound models are based on all five notes of the basic tuning of *qin* (C D F G A) and all the fingers of the right hand are involved. The models used in part I are listed in order in figure 17, in which the last one is played by *dacuo* 大撮 on two strings, which means to use *tuo* 托 and *gou* 勾 for playing two strings at the same time.

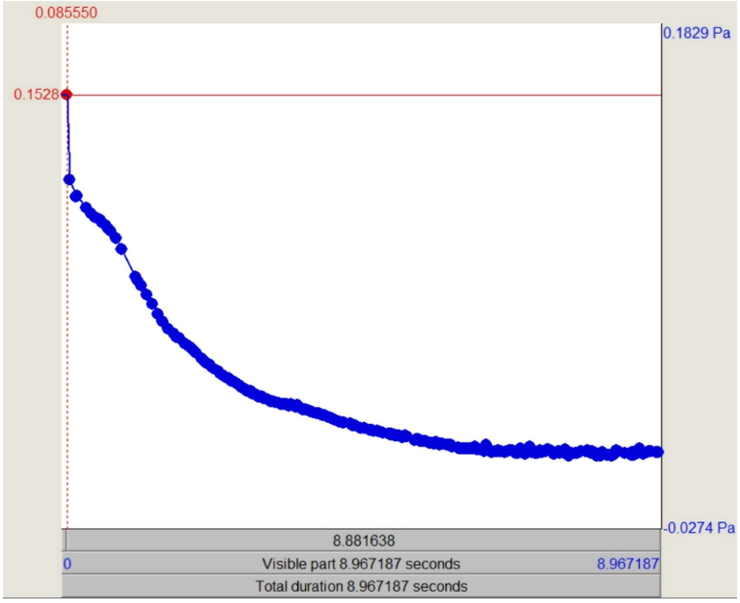
Sound model	1	2	3	4	5	6	7	8	9
Fundamental	G2	G2	C2	C2	D3	D3	F2	A2	A2+ A3
Right-hand playing technique	*Ti* 剔	*Gou* 勾	*Mo* 抹	*Da* 打	*Gou* 勾	*Ti* 剔	*Tuo* 托	*Mo* 抹	*Dacuo* 大撮
Types of sound	*Sanyin*	*Sanyin*	*Sanyin*	*Sanyin*	*Anyin*	*Sanyin*	*Sanyin*	*Sanyin*	*Anyin (two strings)*

Figure 17: sound models in part I

5.1.2 Analysis of the First Sound Model (*Ti* Sound Based on G2)

The first playing technique I used as the model is *ti* 剔. I made a thorough analysis of a *ti* sound based on G2 (97.99Hz) with the previously introduced software, and afterwards employed the features to build my own orchestral sonority through instrumental synthesis.

Figures 18 (a) shows the amplitude spectrum (amplitude as a function of time) of G2 played by *ti*. The amplitude is expressed by Pascal. As is shown in the spectrum, the recording lasts for approximately 9 seconds, which begins with the attack and ends until the sound disappears. It is a remarkable fact that this duration is much longer than with western plucked instruments, such as the guitar or the harp. Longitudinal comparison can be made between open strings of *qin* and guitar. The amplitude spectrum of a guitar sound at the dynamic of *forte* on the open string E2 only has a duration of 3.3 second (see figure 19). The case of *anyin* has some different features, which will be discussed later.



second	Amplitude (Pa)	Decreased value (Pa)
0	0.152	
1	0.082	0.07
2	0.062	0.02
3	0.027	0.035
4	0.017	0.01
8.96	0.004	0.013

(a) (b)

Figure 18: (a) amplitude spectrum of G2 played by *ti*

(b) the change of amplitude value of the same spectrum

From figure 18 (a) we can also have an insight to the ADSR envelope[108] of the sound. It has an abrupt attack and arrives the peak in loudness immediately after the string is plucked. As is depicted in Figure 18 (a), the peak amplitude (the number on the upper left) reaches 0.152 Pa at 0.0855 second. From this point on, the amplitude gradually declines over time until it disappears. Like other plucked instruments, the spectrum of *qin* has a typical attack - decay envelope, since there is no sustain period and the boundary between decay and release period is consequently ambiguous. The amplitude decays however not evenly. The form in Figure 18 (b) illustrates the value of amplitude

[108] ADSR envelope depicts changes in loudness of a sound over time. It has four phases, namely attack, decay, sustain and release. Attack refers to the period that from the beginning of a sound to the point that it reaches the peak loudness. Decay shows how quickly the sound drops to the sustain level after the initial peak. Sustain refers to the level that a sound maintains when it is held. Decay shows how long it takes to silence after the key is released.

at each second as well as at the release point. We can observe that the amplitude has the sharpest reduction in the first second, i.e., by 0.07 Pa. Afterwards, the decline becomes gently. The last five seconds have a tiny reduction of only 0.013 Pa, which is more like a stable sustain than a decay.

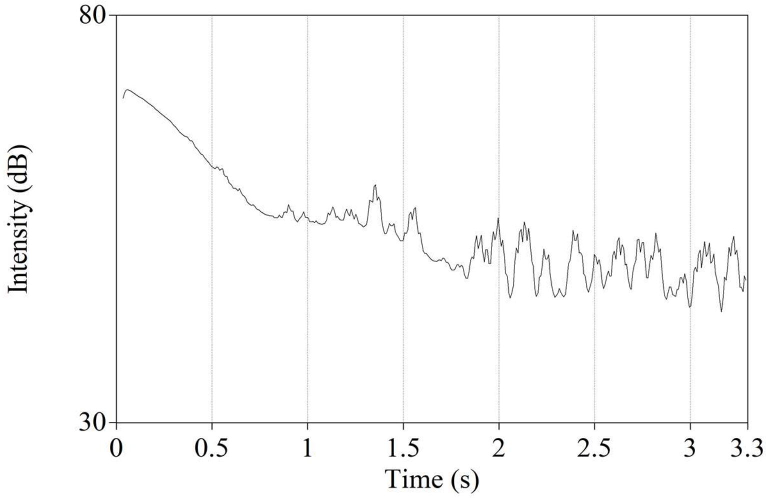


Figure 19: amplitude spectrum of guitar on E

Figure 20 shows the spectrogram of the same recording. The time evolution is represented from left to right. The frequencies are shown on the y axis, with high frequencies at the top and low ones at the bottom. The intensity of the components is indicated by different colors. It varies from dark green (weak) to red (strong), which is shown on the very left next to the frequency figures. The time ruler is shown by the vertical black lines with the number of seconds on top of the spectrogram. From the spectrogram, more details of the sound are revealed. Generally, when the string is plucked, the high partials decay faster than the low ones. The highest frequencies around 6000Hz immediately arise and release, while the components between 2000Hz and 5000 Hz release within a second. Partials between 1000 Hz and 1700 Hz have a longer duration, about three seconds. The ones between 600Hz and 850Hz last for 7.5 seconds. Only the 2^{nd}, 3^{rd}, and 4^{th} partials are left until the sound disappears. The fundamental G2 is prominent only for 0.5 second and afterwards becomes much weaker. As to the energy of the components, several partials (3rd, 4th, 5th, 7th, and 8^{th}) have stronger energy over a period of time (shown by segments in red), but their position and duration varies. The change of amplitude over time generally plays an important role in my following synthesis process.

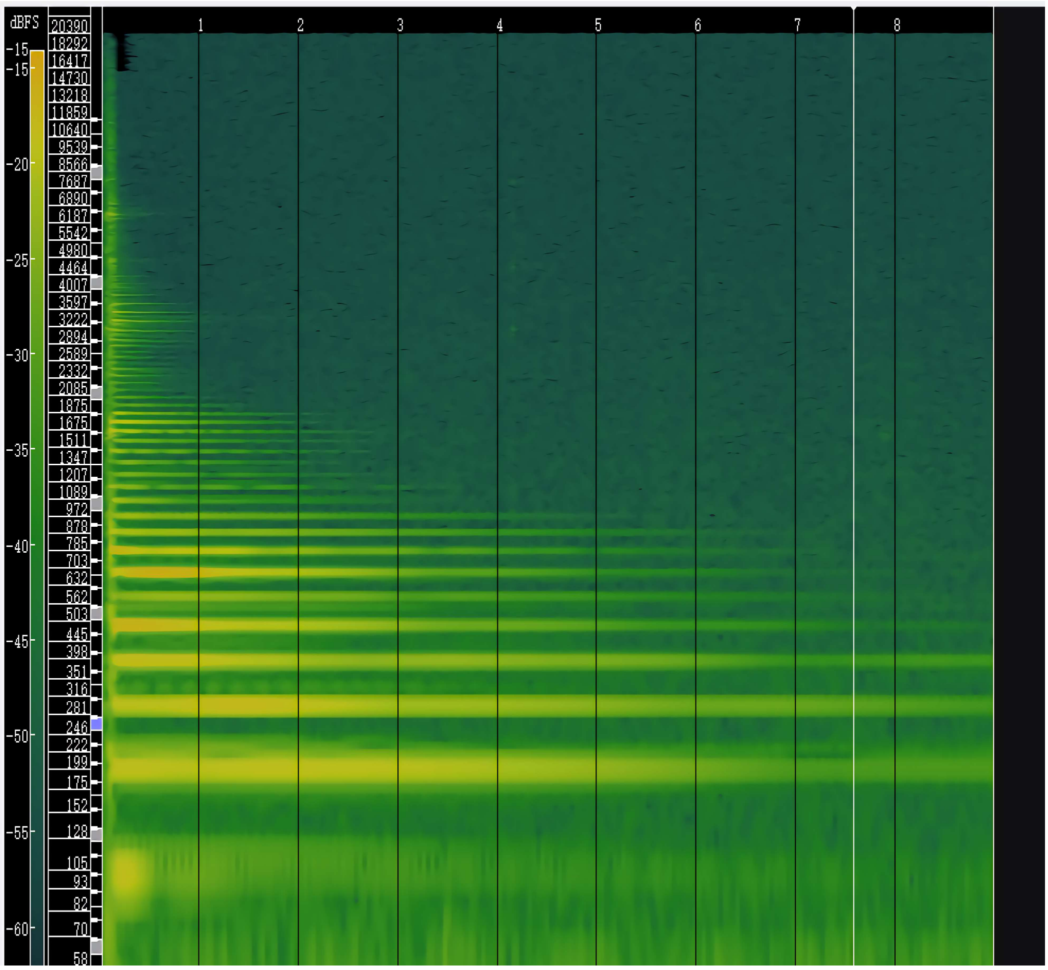


Figure 20: spectrogram of G2 played by *ti*

Figure 21 shows the frequency spectrum (amplitude as a function of frequency) of the first 0.2 second, which is approximately equal to the attack time. The highlighted frequency ranges, namely formants, are marked with letter f. This slice of spectrum reveals, among other aspects, that between the harmonic partials (the ones proportionally distributed with high amplitude), there exist many constantly random frequencies, namely white noise. The noise is transient and arises along with the harmonic components instantaneously. It can be hence concluded that plucking the *qin* produces a mixed spectrum containing both periodic spectrum and elements of noise. In fact, the noise element is inherent in musical instruments. Typical noises include the attacks of pitched percussion instruments, or the bow noise when playing string instruments. The amplitude of noise components varies in different instruments. For example, the bow noise in string instruments is much less than the attack noise in a Xylophone. In the case of *qin*, we can see from figure 21 that the intensity of the noise is even close to the main partials at some point, identifying the considerable level of the noise. It is obvious that the noise element is caused by the fingernail, since the surface of the fingernail strums the string when playing outward.

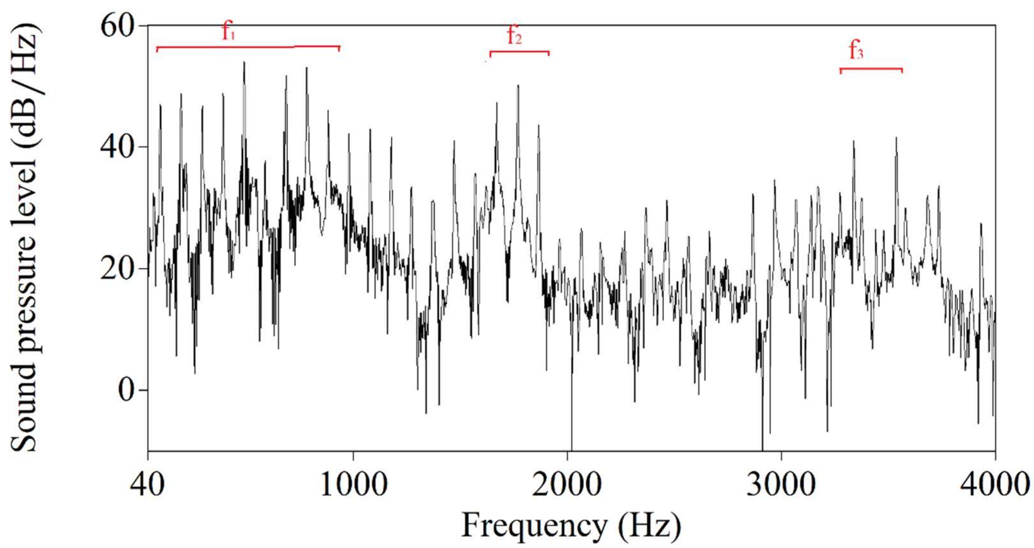
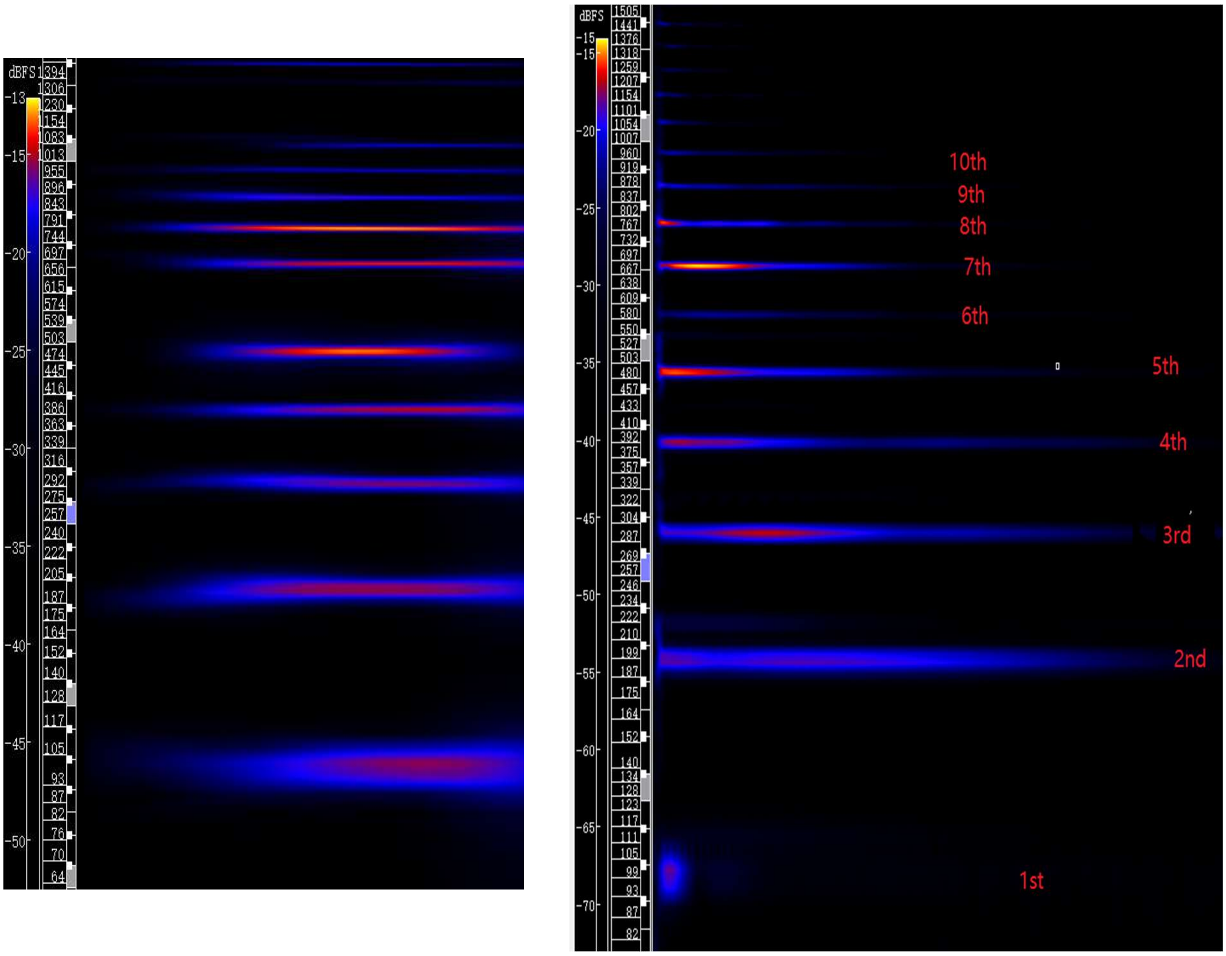


Figure 21: spectrum of the first 0.2 second of G2 played by *ti*

In order to figure out the order of entries of the partials in the attack period, I use SPEAR for cutting all side bands off, leaving only the pure harmonic components. Figure 22 (a) shows the zoomed-in spectrogram (from the 1^{st} to the 10^{th} partial) of the first 0.2 second after manipulating by SPEAR. From this spectrogram plot we can find out that the harmonics do not enter simultaneously, but at different time points in a random order. though the distinction between each other is very slight.

As is discussed in the previous chapter (4.1.2), the phenomenon of inharmonicity occurs in struck string instruments like piano and guitar due to stiffness of strings. It is then a reasonable assumption that *qin* sound also exhibits inharmonicity and several studies have already identified it. H. Penttinen has measured the degree of inharmonicity of *qin* and then made the following conclusion: for each string, the inharmonicity arises when plucking the string. The inharmonicity coefficient for lower strings (string 1 to 4) is around 10^{-4}, which is larger than for higher strings (string 5 to 7) that is 10^{-6}.[109]



(a) (b)

Figure 22: partial frequency spectrogram (the 1st to the 10th partial) after manipulation by SPEAR

(a) first 0.2 second

(b) the whole duration (partials are marked on the right side)

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[109] H. Penttinen, Jyri Pakarinen, and Vesa Välimäki: "Model-Based Sound Synthesis of the Guqin", *The Journal of the Acoustical Society of America,* 01 Dec, 2006

5.1.3 Instrumental Synthesis of the First Sound Model

After getting the whole picture of the sound model, I am able to take properties of the spectrum as an important reference to create the sound with the orchestra. In general, the envelope of the sound model is obeyed. I would like to start with the attack transient.

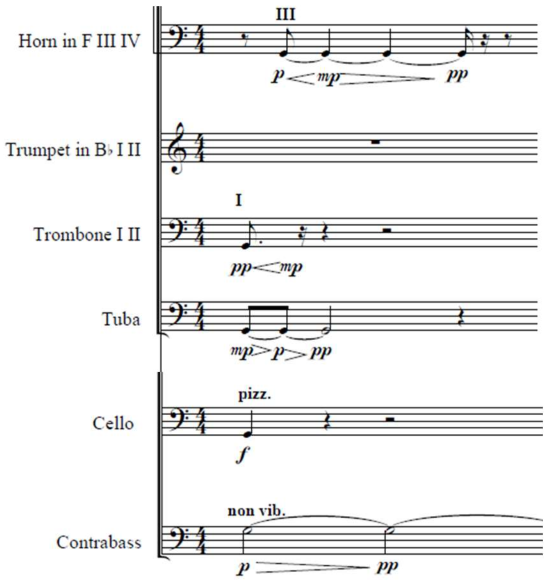


Figure 23: plucking sound simulation and treatments of fundamental

The most striking characteristic of *qin* is the sound of plucking that has a percussive attack. As a matter of fact, the fundamental tone G2 (the component at the very bottom in figure 20) has its peak energy for less than half a second, then abruptly becomes weak. This process can be transformed into a spot of sound with a shadowing long note, just like the decay of the plucking. To simulate the plucking sound, I choose pizzicato to play the fundamental G2 on tutti violoncello with the dynamic of *forte*. Meanwhile, G1 played by double basses acts as the lasting shadowing note. Though it shows in the spectrum that the amplitude of the fundamental tone is weaker than some partials (see figure 22 (b)), it is still lengthened by horn III, trombone I and tuba asynchronously playing unison, since I want to intensify the fundamental. The G played by each instrument has variations in dynamic and duration that is distinct from the others. The combination and amplitude changes bring subtle changes of timbre. The result is shown in figure 23.

In the spectral music repertories, composers focus much on the harmonic partials of the sound model and the noise component doesn't involve much during the process of instrumental synthesis. However, a lively and enjoyable *qin* sound depends very much on the noise component. Also, the intensity of the noise component is not negligible according to the spectrum in figure 21. It is undoubted that by adding the noise element, the richness in timbre of the sound result will be expanded. Based on additive synthesis, Xavier Serra has propounded a way of spectral modelling called the sinusoids-plus-noise model, where the noise element is taken into key account. He stated that the re-synthesis of musical instruments can be modeled as the sum of frequency peaks and a noise residual. In this model, additive synthesis is used for deterministic (sinusoidal) part, while the noise component is created by filtering white noise.[110]

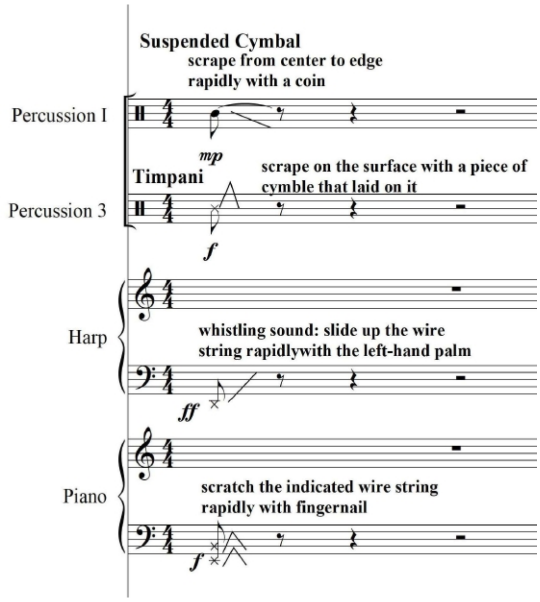


Figure 24: manipulation of the noise component

As a reflection of the sinusoids-plus-noise model in my piece, the stationary peak frequency components are generated by instrumental synthesis. The noise component

[110] Xavier Serra: "Musical Sound Modeling with Sinusoids plus Noise", *Musical Signal Processing*, pp. 91-122, Barcelona, 1997

is represented as various noises with or without defined pitch by percussions and special techniques on non-percussive instruments at the attack point. Regarding the first sound model, I use special techniques on harp, suspended cymbal and piano at the attack for making the noise (instructions of playing are illustrated in the score in figure 24). This forms a scratchy quality of sound as a whole. The choice of playing techniques and instruments for each noise element at the attack in the first part have some common characteristics, which will be discussed in detail later.

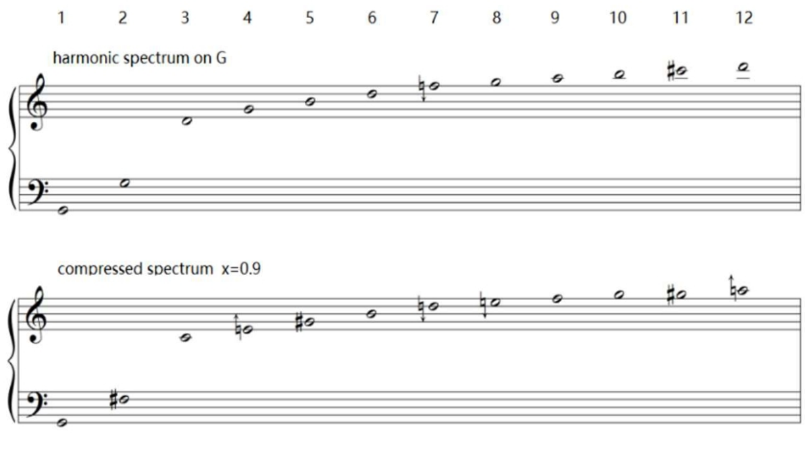


Figure 25: harmonic spectra based on G2 and its compressed version (x=0.9)

As mentioned already, inharmonicity exists in *qin* sound. This property of *qin* makes it rational to make a distortion of the original spectrum. In my work, I utilize the formula $f_n = n^x * f_0$, which is introduced in 4.1.2, to achieve the inharmonicity of the preliminary harmonic spectrum. For the *Ti* sound based on G2, I choose 0.9 as the distortion coefficient ($x = 0.9$) and the spectrum is therefore compressed. The result calculated by the formula is shown in figure 25, where the first two staffs show the original spectrum, while the last two staffs show the distorted one. The notes are approximated to the nearest quarter tone. Partial numbers are on top of the notes. We can see from figure 25 that as the partial goes up, the deviation gets more pronounced. the 12th partial is much compressed, about 427 cents lower than its harmonic equivalent. This degree of deviation is much more exaggerated than the actual inharmonicity of *qin*. The distorted spectrum enriches the language of harmony, since the original harmonic structure is greatly changed.

As is indicated in figure 20, frequencies at all ranges arise in the attack period as soon as the string is plucked. Despite the abundance of the spectrum, it is impossible and worthless to express all the content in the spectrum, or even all the harmonic partials. Spectrum components are thus used in filtered form. The selected partials are played, while others are neglected. Due to the high flexibility of the selection, the final decision should be made after the experimentation.

Initially, I choose the 1^{st} to the 12^{th} partials exclusively and adapt them into the score. This choice is based on the formants of the attack period, since we can see from figure 21 that the first formant region is about between 100Hz and 1000Hz. Among the selected partials, the 2^{nd}, 3^{rd}, 4^{th}, 5^{th}, 7^{th}, which have higher amplitude than others (see figure 22 (b)), are emphasized by two or three instruments doubled with each other. Other higher partials are omitted, just like the function of a low-pass filter. The distortion coefficient is 1.05 in this version. Following the property that partials enter at different time points in the attack period, the 4^{th}, 3^{rd} and 2^{nd} partial stagger the downbeat and then enter in turn. (see figure 26, partial numbers are marked on the score)

I was not content with the above version for the following reasons: Firstly, the high partials are more or less neglected. Secondly, strictly following the spectrum, all the partials enter within a short time about one second, though at different time point. The problem is that there is too much content in the very short attack period and the sound is kind of "saturated", leading to the featurelessness of the fused timbre. The harmony will consequently leave more impression on us than timbre. Hence, I decided to put more emphasis on the distinctive characteristics of *qin* timbre. In order to give prominence to the plucking point and the noise components, one effective way is to exaggerate the time before the entries of the sustained partials, in other words, reducing the components that arise in the first beat. Besides, since high partials are exclusive in the attack period, they should be attached enough importance.

Figure 26: the beginning of the first version of the first sound model

Based on the above discussion, I wrote the new and final version, which is shown in figure 27 (the fundamental, high partials and noise elements are excluded, number of partials are marked). In this version, I used the 1st to the 9th partials for instrumental synthesis. Among them, only the 2nd and 3rd partial (#F3, #C4) are played by bassoon I and horn I together with the plucking point (fundamental), noise elements and the high partials at the downbeat. Both the two instruments can produce a soft sound with the dynamic of pp in this register, which make the two partials standing well in the background. In case of other partials, I substantially postpone their entering. For example, the 4th partial played by clarinet II doesn't show up until the third beat, which will leave much more space to the expression of the fundamental and the high partials. The last partial to enter (9th partial) emerges even on the second beat in the second measure. The enlargement of the space between partials in the third version enables every partial to be heard adequately and separately. Since all the partials show up in the attack period, in this sense, the attack period in the final version is actually much more extended than the previous one. However, on the other hand, all the partials are played by a low level of amplitude, which corresponds more to the level of amplitude in the decay period than the attack period.

As is stated already, the long-lasting property of the analyzed sound model can be considered as an important clue to the synthesis. In the final version, the sound model lasts for 18 beats, circa 21 seconds, leaving much time for subtle change of each component. The variation of the amplitude in whole also follows the contour of the spectrum displayed in figure 22 (a): the attack with strongest energy only arises at the first beat and then, just like the drastic decline in the spectrum, is replaced by the soft partials sustaining for the other 17 beats. Amplitude changes of partials are not excessive, in order to maintain the relative low level of dynamic.

In terms of the instrumentation, I take the spectrogram as reference. All partials are mainly played by woodwinds for maintaining unity of timbre. As is shown in figure 22 (b), the 5th and 7th partial have relative larger energy with longer duration than others. Therefore, I choose the oboes, which have a more penetrative and brighter sound than a flute or a clarinet, to play the two partials. Besides, two violins play unison, adding a mild color to the oboes, in order to hide the characteristics of them to a certain extent. It should be noted that in order to resemble the sound a component of the whole timbre-chord, all the strings are played without vibrato, remaining uncharacteristic. I basically use the strength of each partial in the spectrogram analysis to assign dynamics to the instruments. For instance, spectrogram (see figure 22 (b)) shows that the 5th partial has a large energy at the beginning and turns weak soon, while the 7th has a fast crescendo to the largest amplitude and then decays. These features are all embodied in the variation of dynamics. Another example is the 3rd partial played by bassoon I. Its amplitude undulates in the second measure, since the amplitude of the 3rd partial in the spectrogram also rises and falls like a wave.

Figure 27: the final version (without fundamental, high partials and noise elements)

The release of the partials is also in correlation to the spectrogram. The energy of the written partials goes down progressively until they disappear at different time points, in which the 2nd and 3rd partial last till the end of the sound, right in accordance with the spectrogram. For some partials, not only the dynamics are decreased, but also the timbre is changed. For example, the 2nd and 3rd partials are first played by horn I and bassoon I, then gradually replaced by violas, since a woodwind is objectively louder than a string instrument under the same condition (see figure 27). This transformation of timbre is also generally used in the delay period of the following sound models in this part.

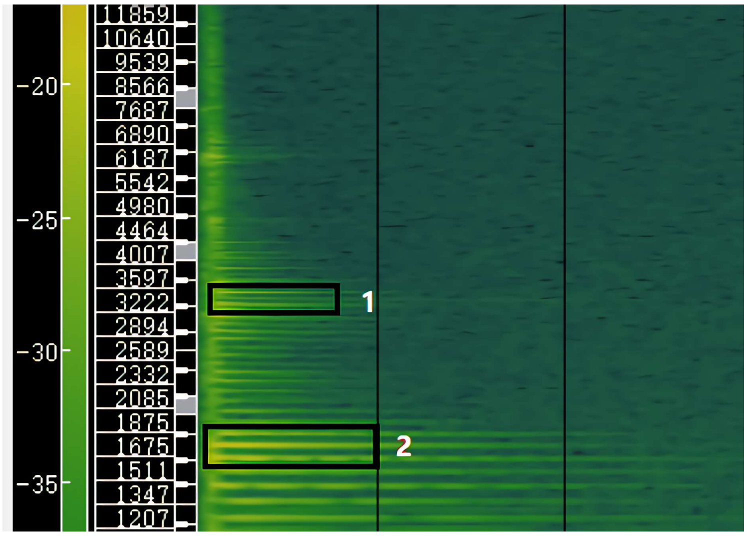


Figure 28: high frequencies of G2 played by *ti* (formants are marked with blocks)

As is indicated in figure 20, The components are distributed from fundamental to the peak frequency as soon as plucking the string. Among them, the high components are exclusive for the attack period and more attentions should be paid. In my work, I narrow the range of frequency selection to two regions, which are indicated with two blocks in Figure 28, because they are two of the formant regions of the spectrum, in which the frequencies with relative stronger energy exist. The first block contains frequencies from 3222Hz to 3597Hz, while the second one contains frequencies from about 1650 Hz to 1900 Hz. I finally choose the frequencies that have the strongest energy in both formants, which are G7, #G7 and #G6, A6, #A6 respectively. Note that the distorted spectrum mentioned before is not used for constructing the high partials, since I intend to preserve the pitches in the high register. Therefore, the high partials shown in figure 29 remain unchanged.

The selected partials are played by two types of playing method on violin I, II and viola, i.e., artificial harmonic and “molto sul ponticello” simultaneously (see figure 29). The harmonic sound is of course very clean and bright. Molto sul ponticello, comparatively, produces a lot of high partials and a metallic sound accompanied with some noise elements. Through combining these two types of playing method, we can get a much brighter sound than only the harmonics because of the very high frequencies produced by molto sul ponticello. The richness in timbre can also be achieved. As is indicated in figure 29, the pitches played by molto sul ponticello are right an octave lower than the harmonics. Nevertheless, they produce a multiphonic like sound including both the same pitch as the harmonic ones and higher components, which can be treated as the supplement to the extremely high frequencies in *qin* spectrum.

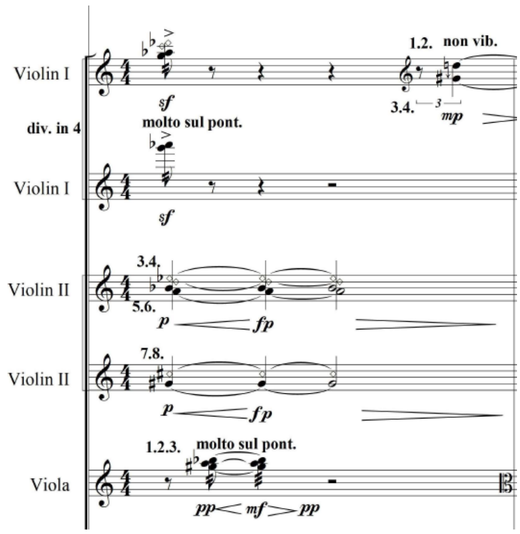


Figure 29: Instrumental synthesis of the high partials

The duration of the partials in block 2 in figure 28 are longer than the higher ones in block 1. This feature is also reflected in the score: G7, #G7, which are played by violin I playing artificial harmonics are as short as an eighth note with full energy. Conversely, the lower partials #G6, A6, #A6 played by violin II have much longer duration (four beats) and intentionally stagger the max amplitude. As mentioned above, the attack time in the final version is exaggerated. Accordingly, the high partials are played in proportion also longer. Figure 30 shows the full score of the first ti sound based on G2.

Figure 30: the full score of the first *ti* sound based on G2.

To summarize, the application of the first sound model can be generalized as following aspects: (1) transformation of attack, which involves the fundamental tone being presented as a spot-like sound together with noise element. (2) creation of inharmonic spectra. (3) treatment of high partials. (4) treatments of partials except the fundamental and high partials. These aspects are applicable for the analysis of the next sound models. I will focus on these viewpoints in the following analysis of the rest sound models.

5.1.4 Noise Elements at the Attack Point

From the example of the first sound model we have caught a glimpse of the treatment of the noise elements in the first part. The types of noise elements of all the 9 sound models in the first part can be classified into the following three categories:

1. Metallic sizzling sound. Due to the substantial use of nylon steel strings nowadays, the plucking sound of *qin*, especially on an open string, performs a metal quality. For applying this feature, I employ the metallic sizzling sound produced by instruments with strings (cello, double bass, harp and piano) and suspended cymbal at the attack point. For piano, harp and string instruments, the metallic sounds are mainly achieved by touching the string with metal or plastic objects after being plucked. The metallic quality shows up immediately when touching a string that still vibrates. All playing methods concerning the first category are listed in figure 31 (a).

2. Scraping sound. In general, in order to give the sound a metal quality, high-frequency bandpass filtered noise is preferred. The idea of using scraping sound starts from producing scraping or scratching sounds on harp and piano, since many high frequency noises will arise when scraping the strings of harp and piano. The playing method of scraping is then extended to percussion instruments. I choose

two membranophone and three idiophone instruments, namely bass drum, timpani, suspended cymbal, thunder sheet, tam-tam, to produce the scraping sound with various objects, such as coin, brush, or a piece of cymbal. The scraping sound made by percussion instruments may not be as close to the plucking noise of *qin* as the sound produced by a string instrument. Nevertheless, by adding scraping sounds on percussions to the attack point, the richness of the noise elements would be increased. Figure 31 (b) shows the playing techniques of different kinds of scraping sounds in the first part.

3. Percussive sound. Getting away from the effects that derive from the metal quality, I make an issue of the percussive quality of *qin*'s plucking sound. Owing to the contact of fingernail to the strings, the plucking sound of *qin* has a penetrating property, especially when playing loudly. Aiming at this characteristic, I use the playing methods of Bartok pizzicato on string instruments as well as striking the string of piano with hard mallet or a piece of plastic (see figure 31 (c)). The notes played by the two techniques are accompanied by a snapping sound and an impact noise respectively, increasing much of the percussive quality.

Instrument	Playing technique(s)
Cello & Double bass	touch the string with bow screw immediately after plucking
Harp	① play while holding the pedal between pedal slots ② touch the string with a metal tuning key after plucking
Piano	touch the string with a piece of metal immediately after playing the note
Suspended Cymbal	play with a coin laid on it

(a)

Instrument	Playing technique
Harp	slide up the wire string rapidly with the left-hand palm
Piano	scratch the indicated wire string rapidly with fingernail
Suspended Cymbal	scrape from center to edge rapidly with a coin

Thunder sheet	scrape with triangle beater
Tam-tam	scrape with middle-sized drum brush
Bass Drum	scrape with small-sized drum brush
Timpani	scrape the surface with a piece of cymbal that laid on it

(b)

Instrument	Playing technique
Strings	Bartok pizzicato
Piano	strike the indicated string inside piano with hard mallet, or with a piece of plastic

(c)

Figure 31: playing techniques of noise elements in the first part

(a) metallic sizzling sound (b) scraping sound

(c) percussive sound

5.1.5 Inharmonic Spectra of Sound Models 2 to 9

In sound models 2 to 9, the above mentioned formula $f_n = n^x * f_0$ is also used. I choose several different distortion coefficients. The distorted spectra (from the 1st to the 12th partial) used in the first part are illustrated in figure 32.

From figure 32 we can see five different spectra, which change with the fundamentals. Whether the spectrum is compressed or stretched depends on the fundamental pitches: fundamentals lower than the first sound model G2 have stretched spectra, while fundamentals higher than it have compressed ones. This arrangement prevents the partials from excessively jumping up and down caused by the change of the fundamental, thereby enables the partials of all the spectra to maintain a certain range. For example, the sound models 5 and 6, based on D3, are minor ninth higher than the former two models based on C2. However, due to the compression of spectra, based on D3, and the stretch of spectra based on C2, the distance of intervals of the two spectra is much decreased. Consequently, all the spectra used in part I are of high unitarity in pitch.[111]

Figure 32: distorted spectra in part I

Sound model number	1, 2	3, 4	5, 6	7	8, 9
Fundamental	G2	C2	D3	F2	A2
Distortion coefficient	0.9	1.1	0.85	1.15	0.9
Distorted value	-0.1	+0.1	-0.15	+0.15	-0.1

Figure 33: the symmetrical distorted value of the spectra

111 The spectrum based on A3 note of the ninth sound model is not used for instrumental synthesis

The extent of distortion ranges from -0.85 to +1.15. To be specific, the compressed and stretched spectra are all symmetrically distorted. According to the table in figure 33, the spectra based on G2 are compressed by 0.1, while the subsequent ones based on C2 are stretched by the same amount. The next pair of fundamentals is more compressed and stretched by 0.15. As a recurrence, the last two sound models have the same compressed value as the first one.

5.1.6 Analysis of Sound Models 2 to 9

Let us take a look back at the form of the nine sound models displayed in figure 17. It can be easily observed that except for the 7th sound model, every two models are based on the same fundamental, but different playing methods. This arrangement gives the opportunity to make a direct comparison between models with the unchanged fundamental, which can be grouped together. In the following text, I will briefly analyze the second to the ninth model and expound how they are applied into the orchestra based on the contrast of the two models in each group. Comparisons between groups can also be made if necessary. The coming up elaboration is no more as detailed as the first sound model, but lays emphasis on different aspects, aiming to find out distinct features of each model in the application. Since the comprehensive analysis of the first sound model is made in a former section, I will start with the second one.

The second model is *sanyin* G2 played by *gou*, which means to pluck the string inwardly with the middle finger. Compared with the first model, the only difference is the direction of plucking, which brings consequently a different distribution of energy in the spectrum. From figure 34 we can clearly see that high frequencies over 1500 Hz of the first model are stronger than that of the second one, especially for the formants, which are frequencies within the two square brackets and the ones marked with the arrow. Through further analysis I find out that it is also a matter of fact that the outward motion of plucking produces more energy in high frequencies than playing inwardly.

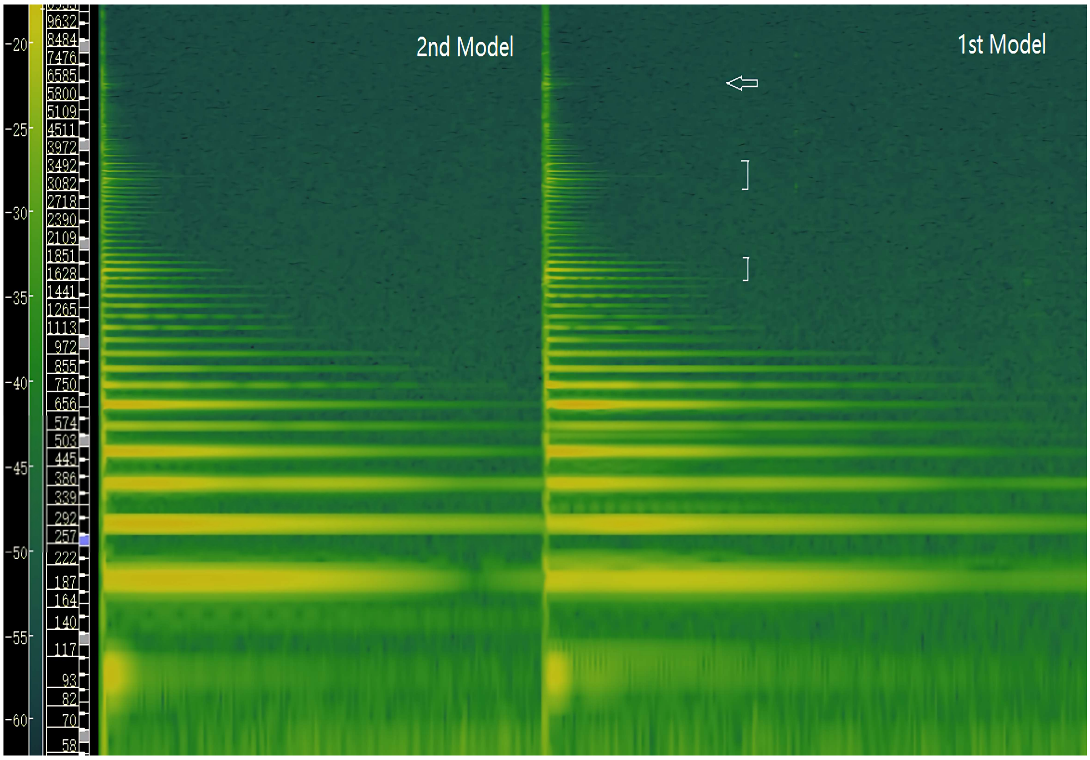


Figure 34: spectrograms of the first and the second model

Figure 35: high frequencies in the string part of the first (left) and second (right) model

In view of this feature, the second model has a different treatment of high frequencies in comparison to the first one. First, the high pitches played by strings are reduced and has a shorter duration. Components played by "sul ponticello" are also left out, remaining only the harmonics. The very high frequencies produced by sul ponticello accordingly disappear. Figure 35 shows the comparison of the two models concerning the high partials. Besides, in dealing with the noise elements, scraping sounds that can produce many high frequencies are used in the first model, while the combination of scraping sound on timpani with brush and striking the piano strings with hard mallet is employed in the second one. This combination has its own unique sound color, meanwhile producing much less high frequencies than the techniques in the first sound model.

(a) (b)

Figure 36: assignment of 1st to 7th partial in the first bar of sound model I (a) and II (b), partial numbers are marked

Apart from the different treatment of the high frequency components, the time of entries of some components are different in the second model. Unlike in the first model, partials played by wood and brass instruments are much more advanced in time. Figure 36 (b) shows that the 5th and 7th partials emerge in the first and second beat, and the 4th and 6th partials also come earlier than in the first model. Besides, since more instruments join the harmony, more emphasis is laid on the middle partials in the attack period. This can be also treated as compensation for the weakened high partials.

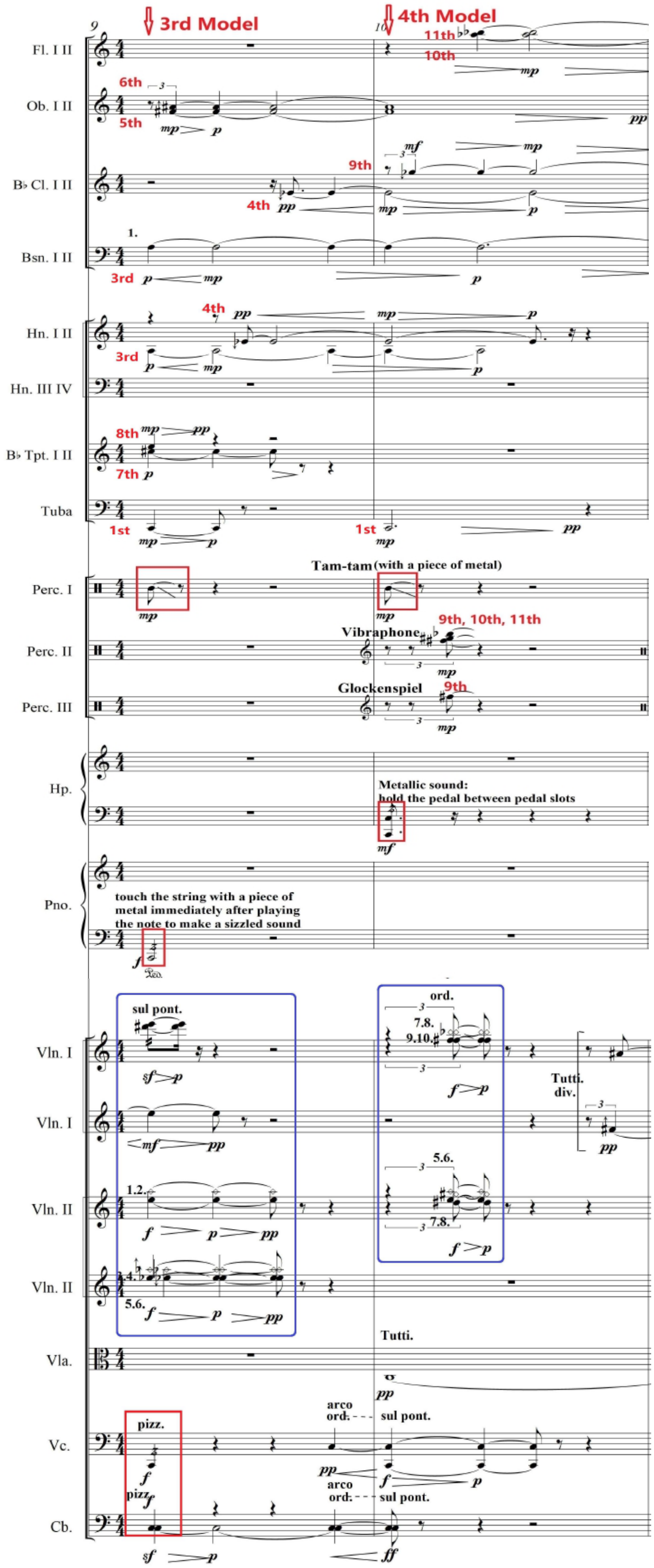
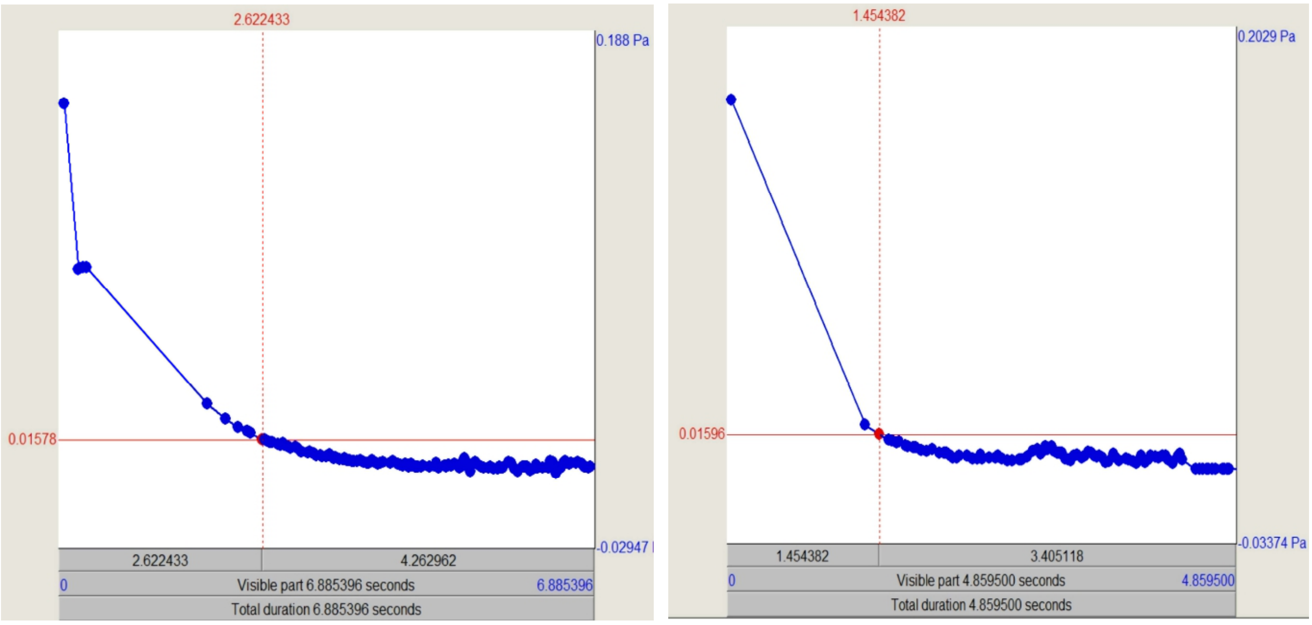


Figure 37: the first two measures of the 3rd and 4th sound model

The 3rd and 4th sound models are based on C and played by *mo* and *da* respectively, which are both plucked in an inward motion. In the application, the noise elements of these two models are composed dominantly by metallic sizzling sounds, which are used for the first time. The biggest distinction from the previous models is that the 3rd model no longer shows the whole ADSR envelope. The sustaining of the 3rd model is interrupted by the attack of the 4th one. Hence the two models share the same decay and release periods. Besides, the constructions of middle partials of these two models are different. In the case of the first and second sound model, the same partials (1st to 9th) are involved. By contrast, in the 3rd model, 1st to 8th partials are used (The 2nd partial in both the 3rd and 4th models are omitted due to the weak energy in the spectra), while in the 4th model, the 7th and 8th partial are replaced by the 9th, 10th and 11th partial. Since higher partials (9th, 10th, 11th) are doubled with Glockenspiel and vibraphone, played by hard mallet, is employed in the 4th model, a bright and penetrating sound can be achieved. Sul ponticello played by cello and double bass with the dynamic of forte adds more metallic sound. Therefore, the overall sound of the 4th model is more brilliant and glassier than the third one. Figure 37 shows the score of the first two measures of the 3rd and 4th sound model. Noise elements are marked in red blocks, while high partials are in blue ones.

Anyin (played on a stopped string) makes its debut then in the piece. The 5th sound model is based on *anyin* D3, which is played inwardly by the right-hand middle finger *(gou*) at the thirteenth stud (*hui* 徽) of the 6th string. The 6th sound model, conversely, is based on *sanyin* D3 played by the middle finger outwardly. The spectra of the two sounds will be firstly compared.

As is shown in the amplitude spectra of the two sounds displayed in figure 38, the sound of *sanyin* has a duration of 6.88 seconds, which is approximately 2 seconds longer than *anyin*. In addition, the two numbers on top of the spectra show the cut-off points of the fast decay after attack. After this point the curve begins to flatten. The cut-off points are at 2.62 second and 1.45 second respectively, indicating that the amplitude of *anyin* decays generally much faster than *sanyin*. Figure 39 shows the frequency spectra of the two sounds. It can be easily observed that frequencies over 1000 Hz in the spectrum of *anyin* are not only less than they are in the spectrum of *sanyin*, but have also much less energy. This feature of the *anyin* spectrum determines its timbre. The sound of *anyin* is more solid, dim and less resonant than *sanyin*, which is simply because the vibration of the string is restrained when stopping the string. From the main partial frequency spectrogram in figure 40 we can find that the 2nd, 3rd, and 4th partial of *anyin* are weaker than they are in the spectrogram of *sanyin*. Moreover, the 8th to 11th partials can be hardly observed in the *anyin* spectrogram. By contrast, they are clearly displayed in the *sanyin* spectrogram, which suggests their considerable loudness. This feature is also reflected in the spectrum of *anyin* in figure 39, where the amplitude of the components above the 7th partial has a sharp decline.



(a) (b)

Figure 38: amplitude spectra (amplitude (vertical axis) against time (horizontal axis)) of (a): *sanyin* based on D3 played by *ti* and (b): *anyin* based on D3 played by *gou* at the 13th stud.

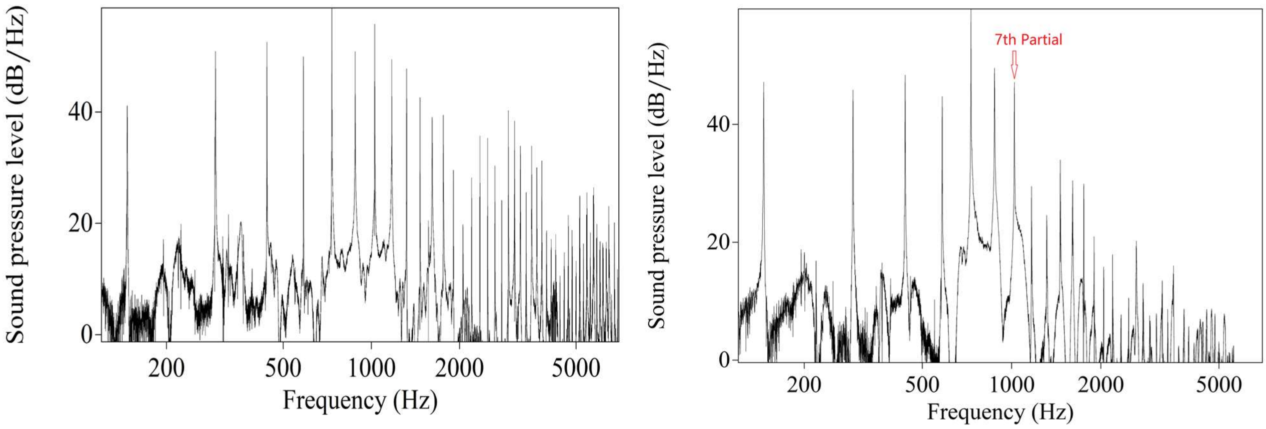


Figure 39: spectra (frequency against time) of *sanyin* based on D3 played by *ti* (left) and *anyin* based on D3 played by *gou* at the 13th stud (right).

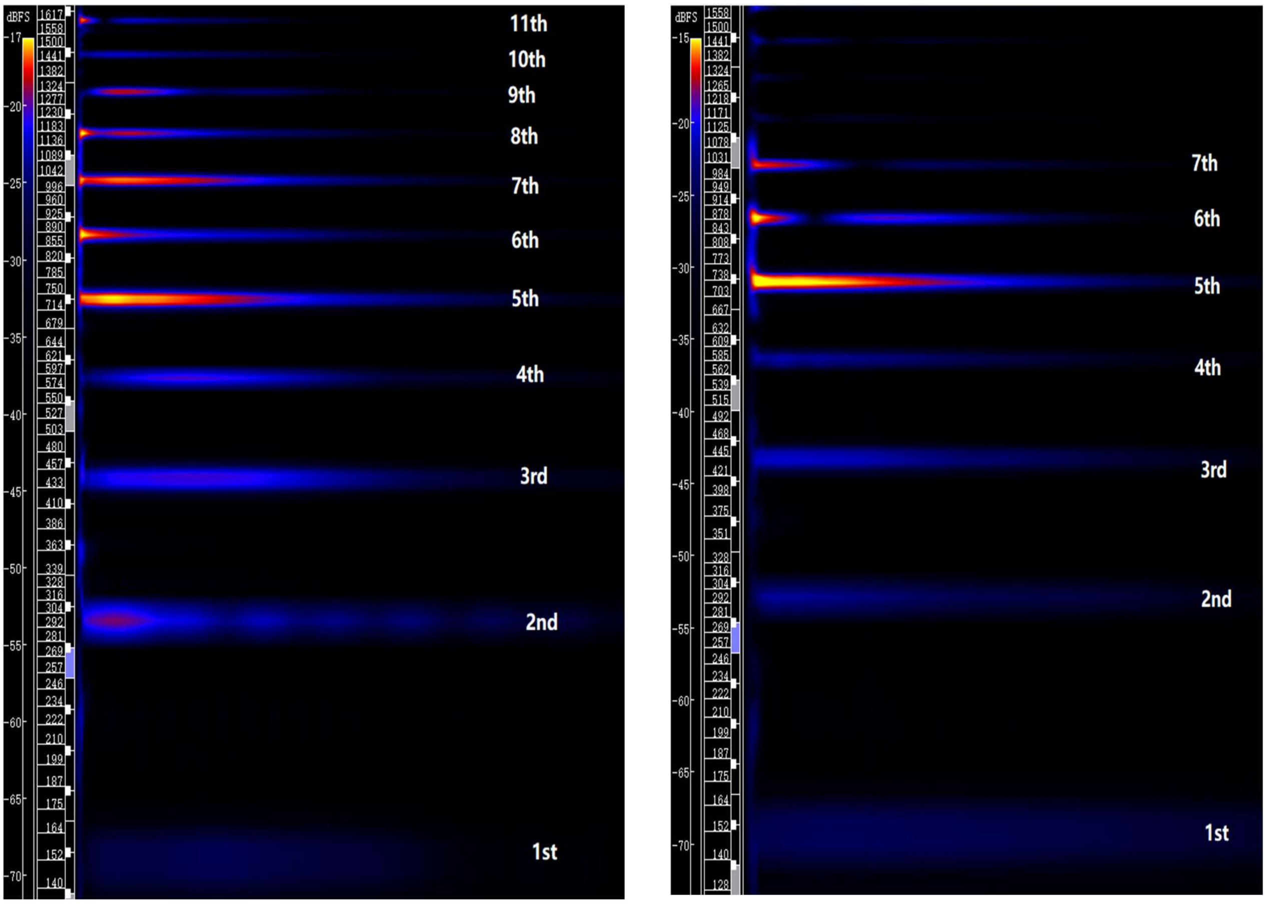


Figure 40: partial frequency spectrogram of *sanyin* based on D3 played by *ti* (left) and *anyin* based on D3 played by *gou* at the 13th stud (right).

All these contrastive features are implemented into the instrumental synthesis. Firstly, the fifth sound model (based on *anyin* D3) lasts for only six beats. This duration is much shorter than the previous models based on *sanyin* (even the shortest one lasts for 15 beats). Secondly, in order to give prominence to the high partials in the sixth model, the high partials are entirely omitted in the fifth one. Since the 8^{th} to 11^{th} partials are only salient in the *sanyin* spectrum, they are also exclusively used in the sixth model. Finally, as to the noise elements, the Bartok pizzicato doubled with marimba is used in the 5^{th} model, which restricts the high components and makes the attack point more solid. In the 6^{th} model, metallic sizzling sounds played by piano and harp together with scraping sound on thundersheet add more high frequencies and resonance to the overall sound.

The construction of the fifth model based on *anyin* is therefore much simpler. The partials are assigned somewhat strictly according to their respective loudness into the orchestra. In previous models, the low components are presented by brass and wood instruments in the attack period and are then handed over to strings in the decay. By contrast, due to their small energy in the spectrum, the 1^{st} to 4^{th} partials are directly played by ten string instruments gently in the fifth model. The 5^{th} to 7^{th} partials played by woodwinds stand out as a result. As the component with the strongest energy, the 5^{th} partial is played by more instruments than others. One oboe, one clarinet and two violins participate its integration. Higher partials and dynamics level at the attack period reoccur in the following 6th model. Figure 41 shows the score of the 5th and the first one and a half measure of the 6th sound model.

The 7th sound model (bar 18-21) based on *sanyin* F2 played by the thumb outwardly (*tuo*) is the only one that doesn't share the same fundamental with others, thus upsets the symmetrical structure. The assignment of partials, especially the entering time, is similar to the first model, therefore, no more details will be given here.

Figure 41: the 5th and the first one and a half measure of the 6th sound model, partial numbers are marked in red, noise elements are in blue.

The in-a-pair sound models then come back soon at the 8th one (bar 22). The 8th sound model is played by *mo* based on A2, while a new playing technique, namely *dacuo*, is involved in the 9th model. *Dacuo* refers to use the thumb and middle finger to pluck two strings at the same time. In the case of the 9th model, the two notes are A2 at the 9th stud of the first string and A3 at the 9th stud of the sixth string. The 8th and 9th model bear analogy with the 5th and 6th ones in some respects. For instance, the attack of the 9th model appears after 5 beats of the 8th model, which also interrupts the sustaining of the 8th model. Besides, the 8th model is also free of high frequencies played by string instruments. They are reserved for the 9th model in order to make a contrast. However, the noise elements which produce high frequencies are still used in the 8th model, considering that it is based on *sanyin* and has definitely more energy in high frequencies than a sound based on *anyin*.

Something other than the former ones of the 9th model is that instead of the normal contour of the decay and release, the 9th model has a reverse tendency, i.e., a dynamic crescendo. To be specific, except for the pizzicato, high partials and noise elements at the attack point, all the partials are played softly and gradually make a crescendo for 13 beats, ending therefore with a little climax. The attack transient even emerges once more during the crescendo process (the second time arises in bar 24), making the crescendo a sense of urgency.

Another important feature of the *dacuo* spectrum is that the phenomenon of beating is very apparent. Therefore, in the 9th model, emphasis is laid on presenting the beating. In fact, we can know from the spectral analysis that beating also exists in the decay period of some *qin* spectra. Since the following analysis of the second part (see 5.2) is mainly focused on the treatments of beating, I will elaborate the usage of beating in detail there.

5.1.7 Special Processing of the Decay Period

Apart from the amplitude variation, the frequency of partials also changes during the very short attack period in qin spectrum. Yang Fan has systematically analyzed the frequency variation of qin's partials in his book about the acoustics of *qin*. In one of his analysis based on *sanyin* C2 (65Hz), the fundamental tone emerges at 55Hz and finally levels out at 65Hz at approximately 100ms via a decrease by 45Hz.[112] The fluctuation in frequency is true for every partial in the spectrum. I employ this property in two models in the first part, not at the attack, but in the long-lasting decay period so as to leave space for the crowded attack. The frequency variation mainly assumes the form of glissando. Figure 42 shows the string section of the last three bars of the 4th model, in which three partials glide up slowly at different time points and for different durations (notes in the blocks). For violin and cello, the end of the glissando is exactly the components of the next sound model. The other fluctuation of frequency is in the decay period of the 7th model (see figure 43). These tiny elements in orchestration build up a certain sonority, which is more important than the individual colors.

Figure 42: frequency fluctuation in the last three bars of the 4th model

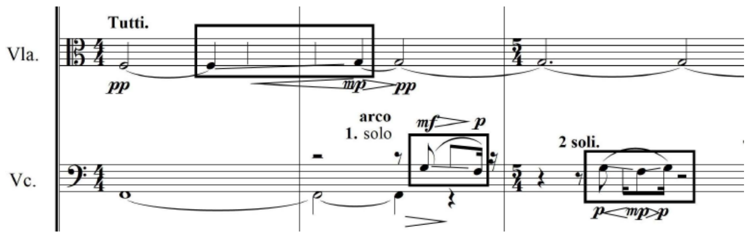


Figure 43: frequency fluctuation in the last two bars of the 7th model

112 Yang Fan: *Guqin zhendongti shengxuetexing yanjiu* 古琴振动体声学特性研究, Beijing 2015, pp. 101

5.2 Analysis of Part II

5.2.1 Beats in *Qin* Sound

Let us take a look at the spectrogram of *anyin* based on G2 in Figure 44. It is a non-ignorable fact that among the partials with stable bands, there are some components, which appear in the form of dashed lines. The spectrogram shows repeated dark bands, alternating with colored bands on a single frequency. The amplitude matches with brighter red bands (louder) and dark bands (softer) portions of the spectrogram. The different lengths of bands suggest namely how often the periods increase and decrease. This behavior is the evidence of beats, which is created by adding two harmonics with nearly equal frequencies. Beats are aurally perceived as the wobble in loudness. The phenomenon of beats can be generated by any two slightly different sine tones. Except for *qin*, beats also naturally exist in piano spectrum, where "phantom" harmonies can be found due to the longitudinal vibration of the string.[113] For sound synthesis purposes the property of beats of *qin* strings must be taken into consideration.[114]

After having compared a series of *sanyin* (open string) spectra with *anyin* (pressed string) spectra, it can be concluded that there are more beats in the *anyin* spectrum than in the *sanyin* spectrum. One example is shown in the figure 45, where the spectrograms of *sanyin* (left) and *anyin* (right) are both based on A2 (110 Hz). The beats are mainly in the range from 1400 Hz to 1900 Hz in the *sanyin* spectrogram, while in the *anyin* spectrogram, beats expand downward to around 700 Hz, not to mention the weak and unstable first and third partial.

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[113] B. Bank and L. Sujbert, "Generation of longitudinal vibrations in piano strings: From physics to sound synthesis," *J. Acoust. Soc. Am.*, vol. 117, no. 4, pp. 2268–2278, 2005.

[114] H. Penttinen, Jyri Pakarinen: "Model-Based Sound Synthesis of the Guqin", *The Journal of the Acoustical Society of America,* September, 2006

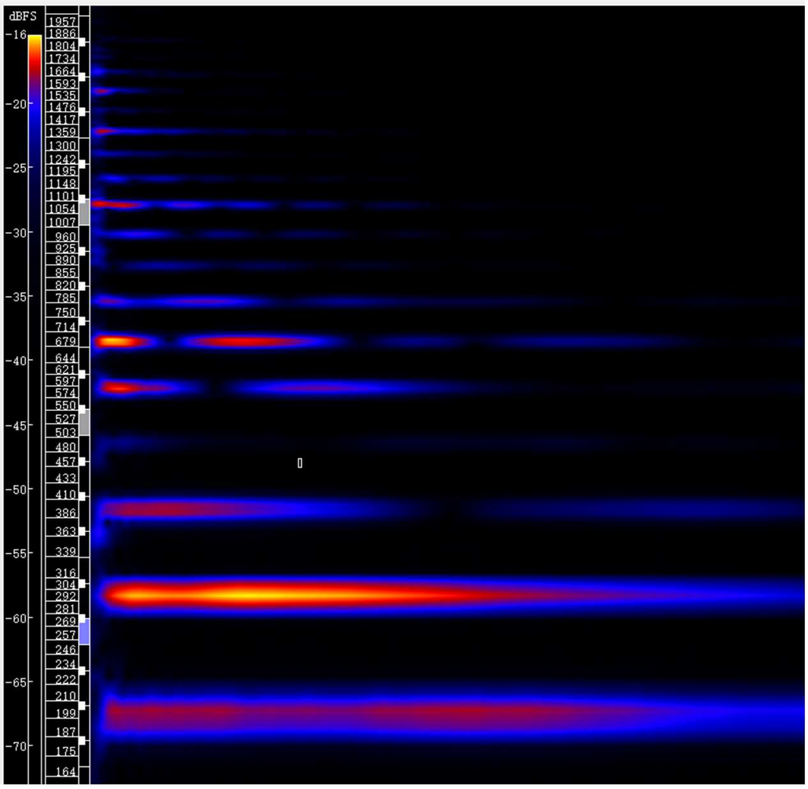


Figure 44: beats in *qin* spectrogram

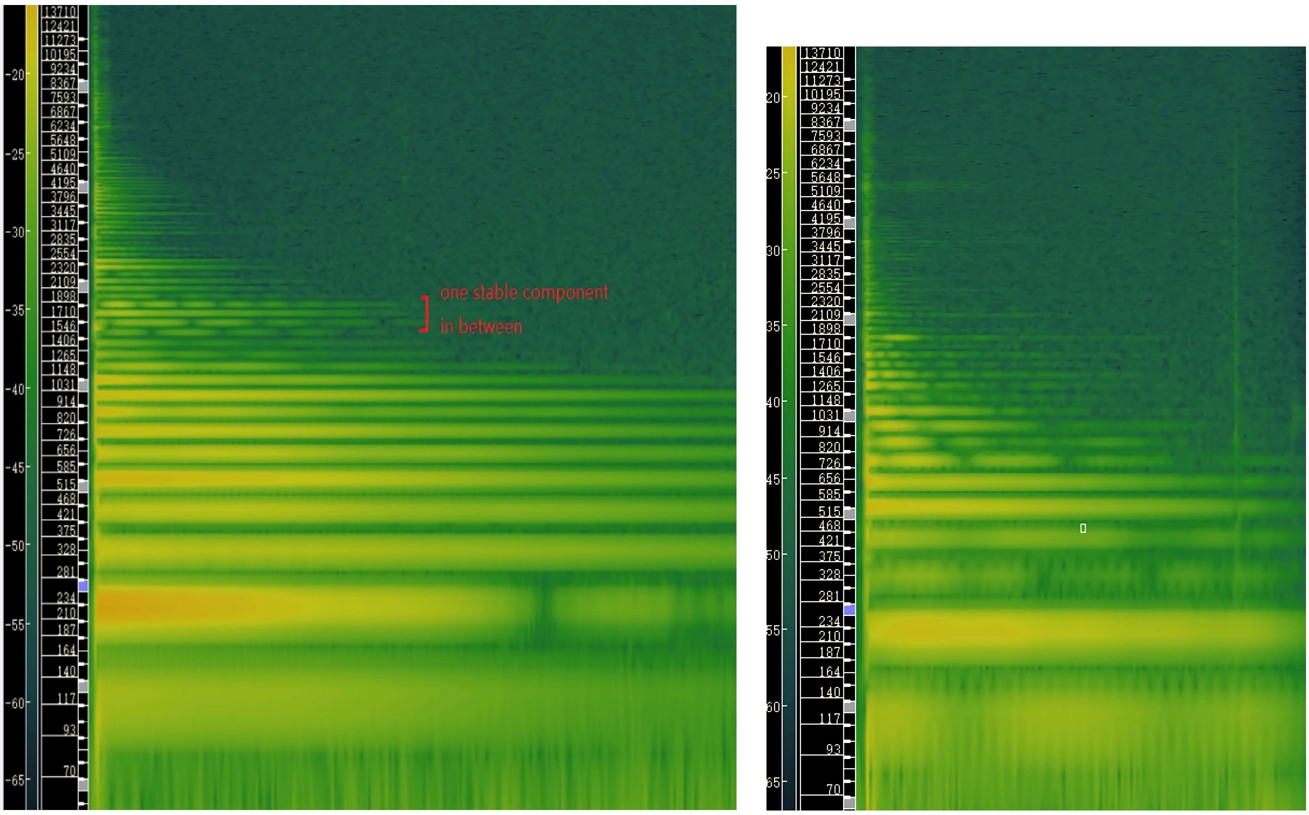


Figure 45: Spectrogram of *sanyin* (left) and *anyin* (right) based on A2 (110Hz)

When playing octave or unison by *sanyin* and *anyin* simultaneously, the overlapped partials or fundamentals interfere each other due to the slight difference in frequency, causing the beating as well.[115] In figure 46, the beating frequencies are distributed across a wide range from the fundamental to high frequencies around 1500 Hz in both cases. The speed of beats, namely the number of beats per second, depends on how big the difference between two frequencies is, which is also called beating frequency. The higher the beating frequency is, the faster the beats will be. In spectrograms in figure 44, 45 and 46, the speed of beats is indicated by the length of the dashed lines. We can easily figure out that each spectrogram contains beats in various speeds.

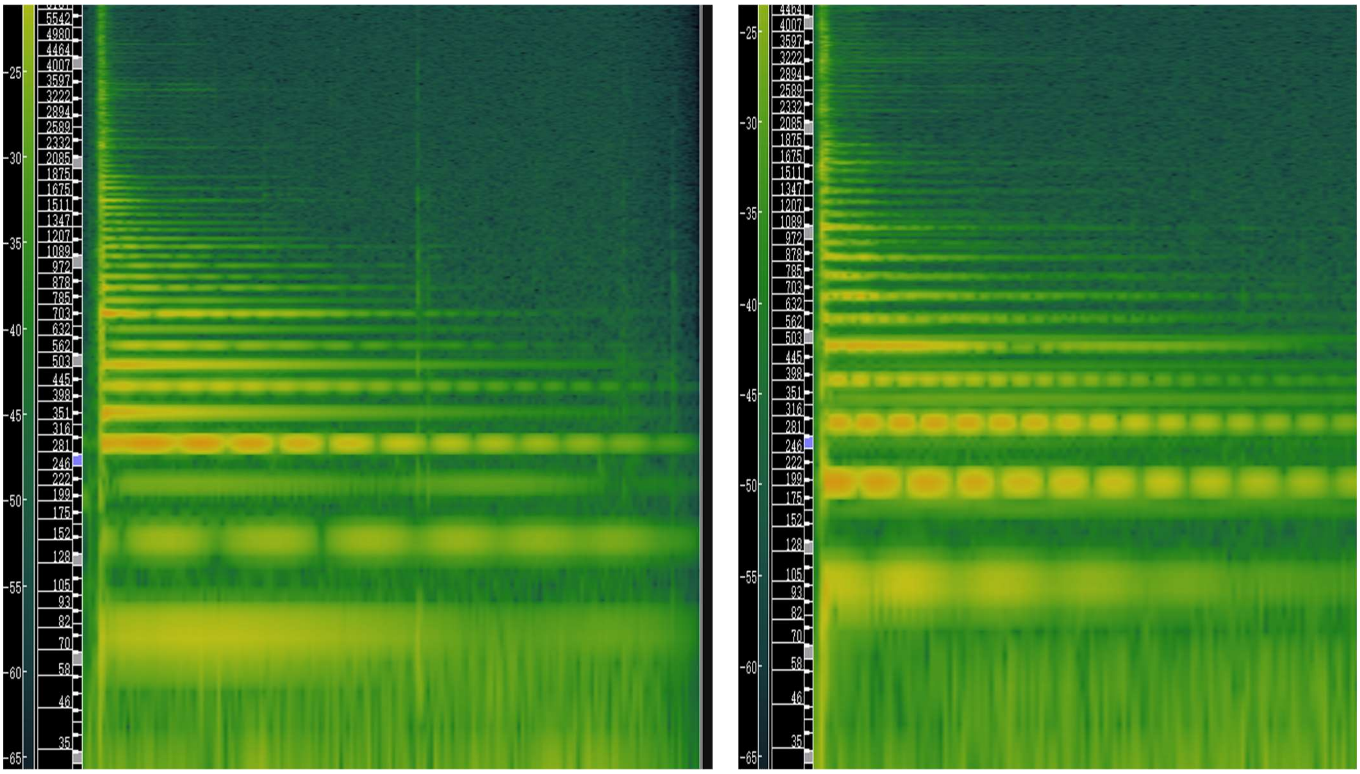


Figure 46: left: spectrogram of octave based on D2 (*sanyin*) and D3 (*anyin*)

right: spectrogram of unison based on G2 (*sanyin*) and G2 (*anyin*)

[115] The *dacuo* employed in the 9th model of the first part discussed in 5.1.6 is in the same situation.

5.2.2 The Application of Beats in *Vagueness*

The properties of beats in *qin*'s spectrum are taken full advantage in the second part (bar 27-59) of *Vagueness*.

As is discussed in the formal section, *anyin* spectrum has lower beating frequencies and a wider range of beats. This range expands downward to the very low partials, even to the fundamental in the spectrum of octave or unison played by *sanyin* and *anyin* simultaneously. The wide performing register of orchestra instruments is capable of covering the whole range of beats of *qin*. In the second part of the piece, the beats in single tone (*sanyin, anyin*) and octave, unison spectra are presented in turn. The part starts with very high harmonics played by the string section, and then follow the woodwinds and brass. During the process lower frequencies steadily join in and finally, all the orchestral sections play tutti. Figure 47 shows the entering order of beats played by different instrument combinations in the second part (bar 28-58). As can be seen from the diagram, beats lie in the high register up to 2500Hz at the beginning, then gradually cross over the middle register and down to 70Hz at bar 50.

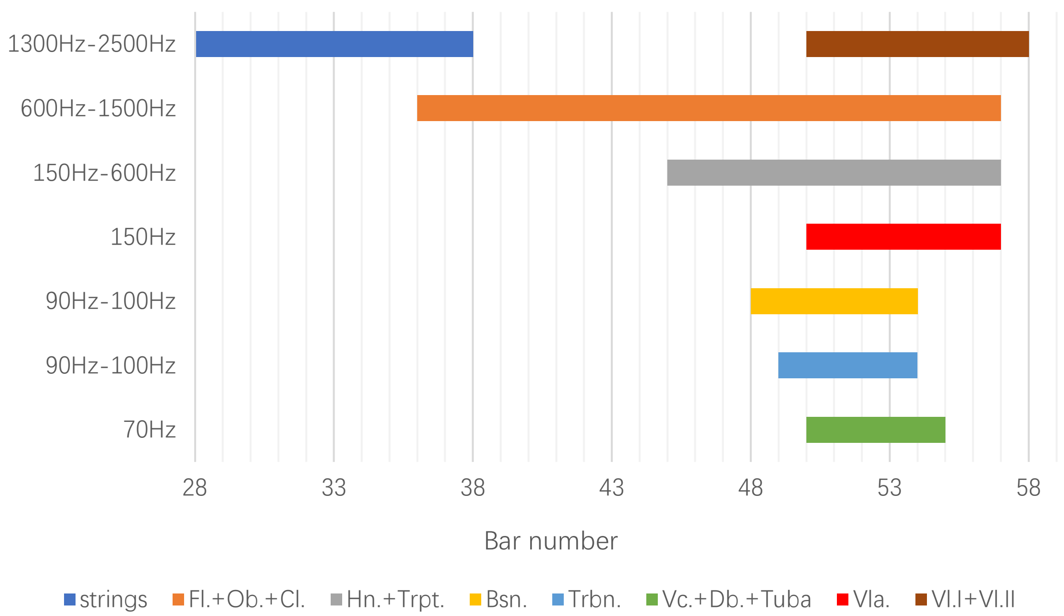


Figure 47: distribution of beats in the second part

A beat is aurally perceived as a periodic movement of increasing and decreasing, which maintains a steady rhythm. Based on this feature, orchestral instruments play repetitive pulses instead of static harmonic components from the *qin* spectra. For woodwinds and brass, crescendo and decrescendo are regularly made, producing waves in amplitude. Considering the fact that the beats in *qin*'s spectrogram have a wide diversity, the instruments play various rhythmic patterns, making the speed of beats differently. Figure 48 shows that woodwinds play steady sixteenth notes (metric) or different tuplets (extrametric) with constant crescendo and decrescendo. For strings, beats with higher speed, such as thirty-second notes or seven septuplet sixteenth notes, are played by harmonics. Due to the higher speed without regular dynamic change, the beats played by strings are perceived not as proper waves, but rather shimmering sounds (see figure 49). Note that long stable notes are mingled in the rhythmically beats. This treatment is also based on the feature of beats in the spectrogram (see the red marks in figure 45 (left)).

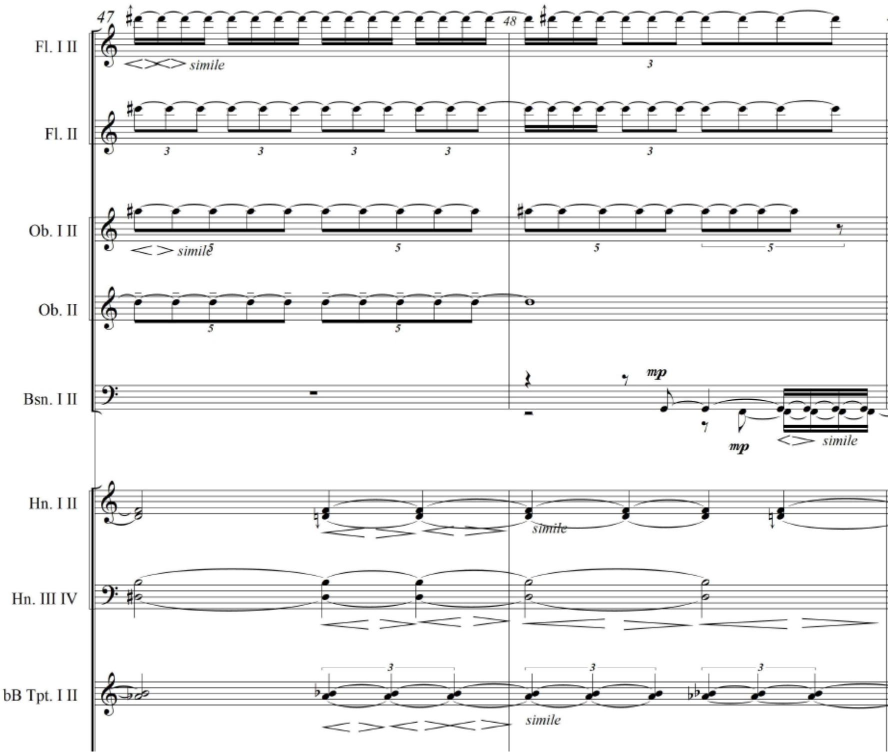


Figure 48: woodwinds and brass part in bar 47 and 48

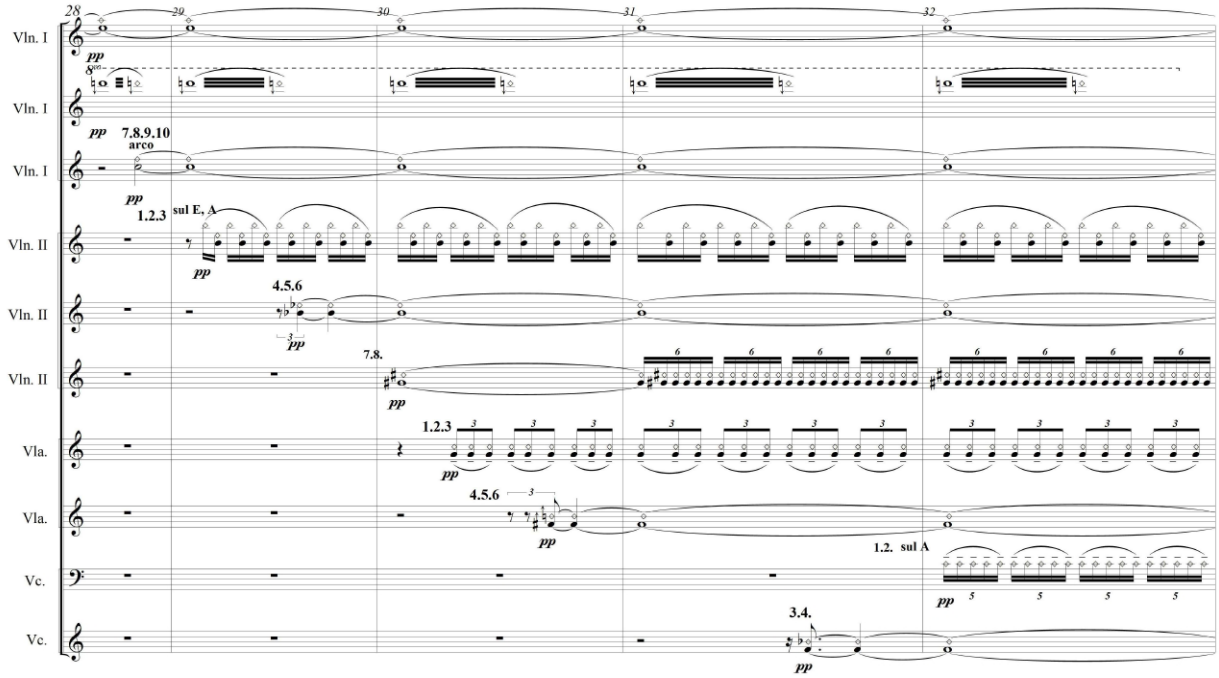
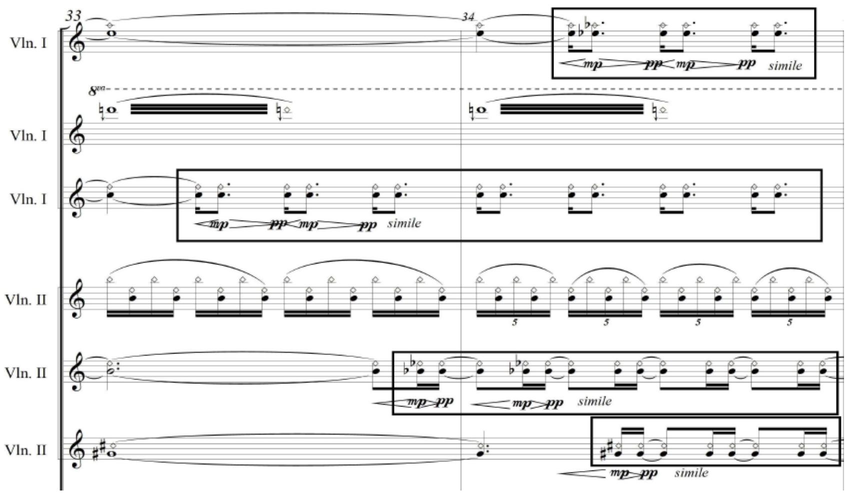


Figure 49: strings from bar 28 to bar 32

Something that is not a strict imitation of the beating spectra is that rhythm patterns with unequal lengths are also employed in both the string and the woodwind part. Figure 50 shows two examples (see the notes in the blocks). In the string part, the swings are played with crescendo and decrescendo, which is more pulsating and stand out among the stable beats. Woodwinds play pitch bending, presenting the uneven beats leisurely. Another type of variation can be found in the two passages in figure 51, where alternation between two notes replace the repeating single note.



a

b

Figure 50: examples of uneven beats in a: strings and b: woodwinds

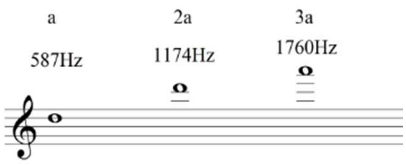
Figure 51: variation of beats (alternation between two notes)

The different rhythm patterns played by the orchestral instruments, which stem from the comprehensible mimesis of the beating spectrum of *qin*, form the massive polyrhythm. Moreover, the variations of the stable beats increase the rhythmic complexity. In comparison to the stability of the first part, the second part presents motional beats of the *qin* spectrum in the form of flurries or waves of notes.

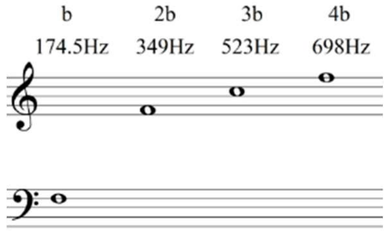
5.2.3 The Pitch Organization Based on Ring Modulation

In simple terms, beats are the result of the difference in frequency between two tones. It is easily associated with ring modulation, though they are not at equal terms. As is discussed in 4.1.3, ring modulation yields both summation and difference frequencies. Beating is one special case of difference tones. When the two frequencies are very close to each other, beats will arise. As two frequencies get farer away from each other, the beats will gradually speed up, till separate tones are perceived. Since ring modulation, as a notable spectral technique, not only generates complex combined tones through adding and subtracting frequencies of individual partials, but also has a correlation with beats, I employ ring modulation to make the pitch organization. It brings to the harmonic spectra of *qin* a more inharmonic content.

The detailed result of the ring modulation is illustrated in figure 52. I choose D5 (587 Hz) and F3 (174.5Hz) as fundamentals of spectrum 1 and 2. Up to the third and the fourth one, partials are involved respectively, which are numbered a, 2a, 3a and b, 2b, 3b, 4b. By adding and subtracting every two partials of the two spectra, in total 24 frequency values are modulated. As only several of them are low in frequency (a-2b, a-3b and a-4b), another two spectra (spectrum 3 and 4), which contain only two partials (including the fundamental) in each, are used. The two fundamentals of spectrum 1 and 2 are a thirteenth apart, which is exactly the same as they are in spectrum 3 and 4. Note that only four generated frequencies from spectrum 3 and 4, which are employed in the piece, are listed out. The other four ones are omitted.

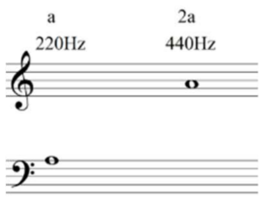


spectrum 1

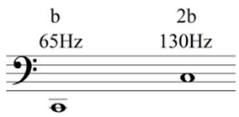


spectrum 2

summation and difference tones of spectrum 1 and 2



spectrum 3



spectrum 4

summation and difference tones of spectrum 3 and 4

Figure 52: process of ring modulation in *Vagueness*

All the modulated frequencies in figure 52 are ranked in descending order, making up a new inharmonic "spectrum" (see figure 53). The components arise from high to low in sequence in the second part, as is illustrated in figure 47. At the end, a huge sound mass of beats is achieved.

Figure 53: modulated frequencies in descending order in the second part

5.3 Covert Mimesis in Part V

To start with, I will give information about a *qin* playing technique called *daiqi* 带起. *Daiqi* is played by the ring finger of the left hand. After the left ring finger presses down a string, it plucks the same string to create a *sanyin*. Figure 54 shows the very distinctive spectrogram of *daiqi* based on G2 (87Hz). The 1st to the 9th partials are marked in red.

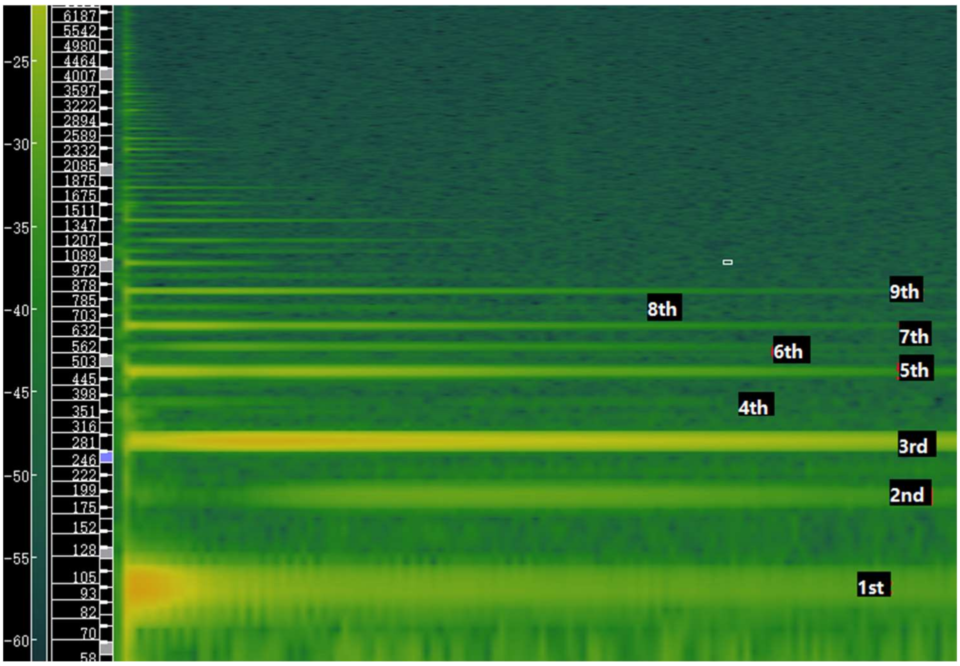


Figure 54: spectrogram of *daiqi* based on G2

From the spectrogram in figure 54 we can observe that the amplitude of the 1st, 3rd, 5th, 7th and 9th are considerable larger than the 2nd, 4th, 6th and 8th partials. In other words, the odd number partials are stronger than the even number partials (higher partials that are not marked out are also in line with this law). After having analyzed spectra of all *qin* playing techniques, it turns out that *daiqi* is the only technique with this characteristic spectrum.

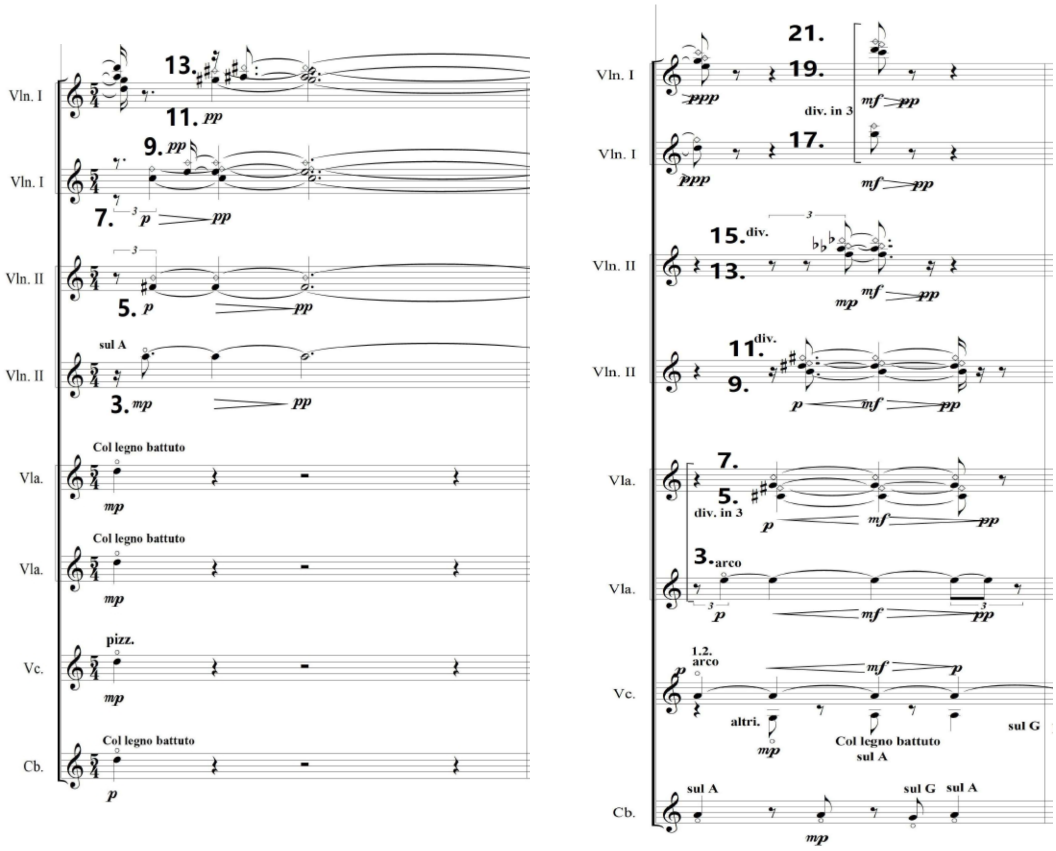


Figure 55: The first and last harmony in the fifth part using odd number partials

In the last part (fifth part) of *Vagueness*, first, second violins and violas divisi play harmonics very softly as a subtle background. The construction of the harmony is inspired by the *daiqi* spectrum. In order to lay stress on the odd number partials, the even number partials are filtered. Then, only odd number partials in the spectrum are left, which remind us of a square spectrum. Figure 55 shows the first harmony (score on the left) and the last harmony (score on the right) in the fifth part (partial numbers are marked on the score). In the first harmony, odd number partials from 3rd to 13th based on D4 are assigned to violins playing artificial harmonics. Violas are also involved constructing the last harmony based on the fundamental A3. More odd number partials, namely from 3rd to 21st partials are played in order, creating a richer and more colorful sound.

5.4 Summary

As is introduced in this chapter, various features of the *qin* spectra, such as the characteristics of attack, sustain and release period, are imitated and synthesized with orchestral instruments. To achieve the covert mimesis, many of the spectral music techniques are involved. It can be concluded from all the examples that it is certainly impossible to reproduce a *qin* sound with an orchestra through covert mimesis. Instead, the inner world of *qin* sound is revealed to a great extent. The properties of *qin* spectrum are treated as an inspiration for extending orchestra sounds. Nevertheless, the result keeps more or less coherence to the sound quality of *qin*. For instance, in the first part, we can still distinguish the attack-decay contour of *qin* spectrum. Through covert mimesis of the *qin* spectrum, the *qin* and the orchestra are hybridized in a more profound sense.

Chapter VI Analysis of Overt Mimesis Used in *Vagueness*

6.1 Introduction

In the following texts I will move forward on the overt mimesis of *qin*, which is mainly employed in the third (bar 60-103) and the fifth part of *Vagueness*. Compared with the onefold covert mimesis, overt mimesis incorporates all the features of *qin* that are auditorily identified, which specifically include the mimesis of *qin*'s timbre, ornaments and melody, temperament, and aesthetic features in *Vagueness*. The aim is to discover similarities and acoustic analogies of multifarious *qin* sounds by means of different playing methods and orchestration. I will give an insight to all the categories in detail.

The physical *qin* will be involved in the discussion of overt mimesis. In the third part of *Vagueness*, the *qin* serves as one of the many instruments in the orchestra and joins the orchestrated timbre of various *qin* playing techniques. Though well integrated into the orchestra, the *qin* still gives a clue to the prototype of the orchestrated sound. In the fifth part, a harmonic melody played by *qin* leads the correspondence of the orchestra. By including *qin* in the orchestra, the mimetic subject and object appear in the same time and space. The sound features of the mimetic object will be therefore easily clarified. The interaction between orchestra and the *qin* presents the mimesis in a more intuitive way. Meanwhile, the flavor and sounds of the instrument *qin* color the conventional orchestral sound.

6.2 Mimesis of *Qin*'s Timbre

6.2.1 Direct Mimesis

6.2.1.1 Mimesis of *Qin* Harmonics

As one of the basic three techniques of *qin*, the *fanyin* (harmonic sound) features prominently in *qin* music. It has a light, crispy and resonating quality. In the *qin* tablature *Cheng yi tang qin pu* 诚一堂琴谱, *fanyin* is described as "butterfly exploring flowers" and "dragonflies skipping the water".[116] *Qin* is capable of more than 100 harmonics at different positions. In *qin* music, passages consisting entirely of harmonics are very common. Moreover, the majority of *qin* pieces end with the coda, which normally contains one phrase, summing up the spirit of the entire piece. These codas are played all by harmonics. A passage of harmonics and the coda in the famous *qin* piece *Mei hua san nong* 梅花三弄 is quoted in figure 56.

Figure 56: quotes from *Mei hua san nong* 梅花三弄

Source: Xu Jian, Wang Di: *Guqin quji* 古琴曲集, Beijing, 2011, pp. 57, 62

[116] Guo Ping: *Guqin congtan* 古琴丛谈, Jinan, 2006, pp. 31

Reflecting the feature that *fanyin* are intensively focused in a passage in *qin* music, I employ *fanyin* fully in the fifth part of *Vagueness*. Harmonics are initially played by solo *qin* as a melody. As the mimesis of the timbre of *qin* harmonics, natural harmonics played by harp, pizzicato of natural harmonics played by violas, cellos, and double basses are interspersed in the static harmonic background of strings. Though less resonating, harmonics on harp and harmonic pizzicato on strings are very close to the timbre of *fanyin*. These harmonics echo with *fanyin* in the *qin* part, leading to changes between timbres of different instruments (*qin*, harp and strings). One example can be found in figure 57: the melody played by *qin* harmonics is taken over by harp doubling double basses and cellos at the last beats of bar 154 and 155. The solo harp plays the first beat of bar 156, and from the second beat on, the melody is back to *qin* (see the arrows on the score). The collage-melody keeps its timbral consistency, while having subtle variation.

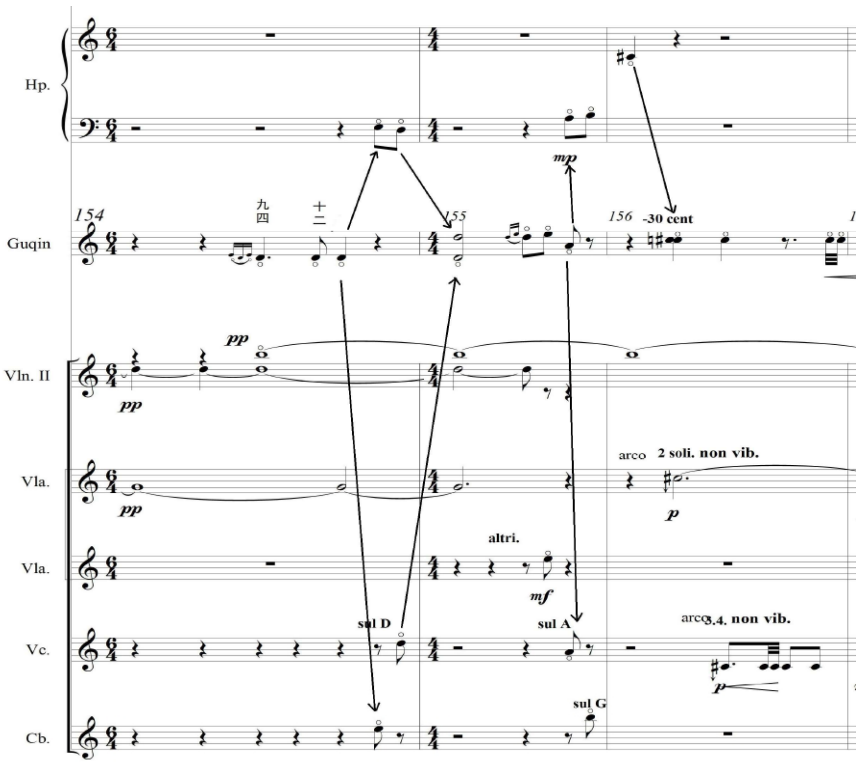


Figure 57: harp, *qin* and strings part, mm. 154-156

6.2.1.2 Mimesis of the Friction Noise of *Qin*

The left-hand techniques of *qin* mainly concern various kinds of glides. Though these techniques have very detailed divisions, the friction noise produced by the fingers gliding across the string is the common feature for all of them. I have discussed the noise element at the attack point caused by plucking in the former chapter. In comparison to that type of noise, the friction noise arises when gliding to another tone after plucking the same string, namely in the decay period of the sound. Therefore, the friction noise is prominent in terms of amplitude, since the amplitude of the gliding pitch component decreases drastically after the attack point, as we have known from figure 18. As the glide goes on, the pitch component gradually diminishes in amplitude, until it disappears. Something unique is that sometimes the glide continues even after the disappearance of the tone, i.e., the friction noise is produced exclusively.

Figure 58: quotes from *Xiao xiang shui yun* 潇湘水云

Source: Xu Jian, Wang Di: Guqin quji 古琴曲集, Beijing, 2011, pp. 181

The example in figure 58 is quoted from the master *qin* piece *Xiao xiang shui yun* 潇湘水云. Except for the first note in each measure, the rest notes are played by gliding to certain positions with the left hand. The glides are all accompanied by friction noise. Notes near the end of each glide are faint, sometimes not audible. The glides shown in figure 58 are produced by moving up and down among different sound positions, which can be summarized into five basic playing techniques, namely *shang* 上, *xia* 下, *jinfu* 进复, *tuifu* 退复, and *zhuang* 撞 (see the illustration of them in the table in figure 59). These techniques have only slight differences from each other. *Zhuang* is essentially a faster or a more solid movement of *jinfu* or *tuifu*. Unlike *jinfu*, *tuifu* and *zhuang, shang* and *xia* are played without returning to the original pressed note position. Through these five basic techniques, melody contour and rhythm can be achieved.

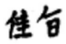
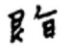
Character	Name of the technique	Explanation
上	shang 上	The left-hand finger presses down the string, gliding up to the marked position after the right hand plucks the string
下	xia 下	The left-hand finger presses down the string, gliding down to the marked position after the right hand plucks the string
	jinfu 进复	After the right hand plays a pressed note, the left-hand finger slides up to one pitch higher, then glides back to where it started.
	tuifu 退复	After the right hand plays a pressed note, the left-hand finger slides down to one pitch lower, then glides back to where it started.
立	zhuang 撞	"to bump". After plucking the string, the left-hand finger quickly glides up to the indicated note and then goes back. The movement should be fast.

Figure 59: main left-hand techniques concerning gliding

In the third part of *Vagueness*, from rehearsal mark C on, the noise produced by gliding on the *qin* string is imitated by all instrument groups. Extended techniques for bowing, blowing and percussions are extensively employed. Figure 60 shows the list of the chosen techniques in this part. It is noted that the chosen techniques all produce a sustained noise sound, which differs from the transient noise at the attack.

Woodwinds and brass	Air sound	✓ Air sound, with or without defined pitch ✓ For the brass: blow 3cm away from the tube to make the air rush sound
Strings	White noise	✓ Mute the strings with left-hand fingers, slow bow, sul pont. ✓ bow on the bridge at the angle of almost 90°C ✓ For Vla., Vc., Cb.: rub the fingerboard with palm
Percussions	Scraping sound	✓ scrape on the surface of Timp., B.D. with different objects, thunder sheet with drum brush, rub two pieces of sand paper
Piano	Scratching sound	✓ scratch the string with fingernail

Figure 60: techniques used for the mimesis of friction noise

The following example (figure 61) shows how the mimesis of gliding friction noise is employed in the piece. At the rehearsal letter C, *qin* firstly plays the technique *jinfu*. After two and a half beats, as the melody becomes indistinct, the music segues into the orchestra part. Strings and woodwinds play noise sounds successively in different rhythm patterns with accents (see figure 61). This process presents the specific characteristic of *qin* where sliding up or down doesn't stop even when the defined pitch disappears. Though a realistic friction noise of *qin* is hardly realizable for orchestra instruments, the leading *qin*, the rhythm and accents in the orchestra part are all suggestive of a representation of *qin*'s friction noise. In the following passages, more instruments including brass and percussion sections also join in the "unpitched gliding".

Figure 62 shows another way of instrumental combination. The beginning phase of gliding is replaced by the bass clarinet, which plays very softly as a hidden melody. The melody is accompanied by woodwinds' air sound and piano friction noise using the same rhythmic values, simulating the simultaneous friction noise. Sometimes the air sound in the woodwind part (e.g., the clarinet part in the block in figure 62) are played with faint defined pitch, suggesting the decaying of the gliding pitch.

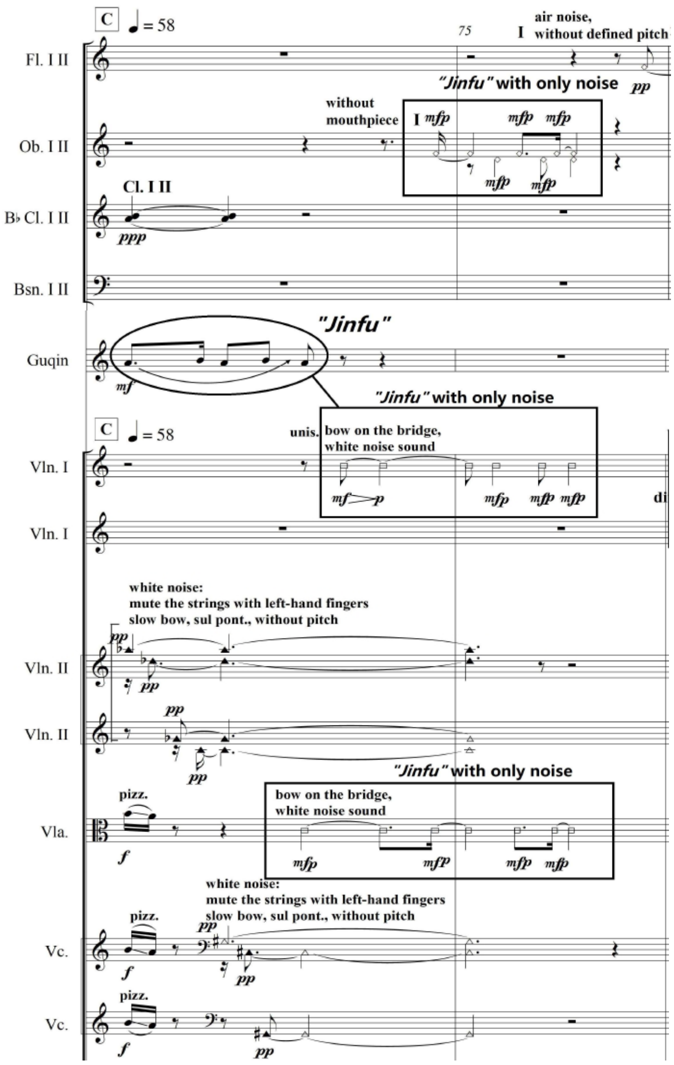


Figure 61: example 1 of the mimesis of *qin* gliding friction noise

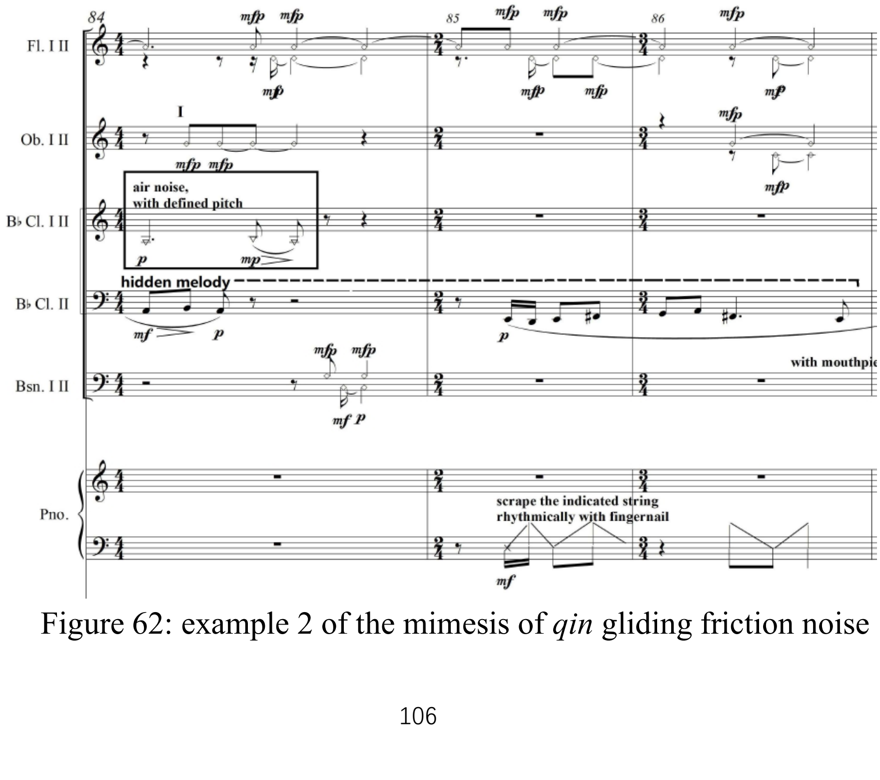


Figure 62: example 2 of the mimesis of *qin* gliding friction noise

6.2.2 Orchestrated

As is mentioned in 3.6, the playing techniques of *qin* are multifarious, which results in richness in tone color. In the historical repertoire, notes played by one technique appear rarely in succession. Instead, they are played alternately by various techniques. Particular attention is payed to the timbre of every single note. In the following passage (figure 63) from the *qin* piece *Hu jia shi ba pai* 胡笳十八拍, all the playing techniques are marked on top of the notes in red (specific strings and fingerings are indicated by the tablature under the notes). Among them are *anyin* and *sanyin*, which produce clear ringing sounds, gliding tones like *shang*, *xia* and *jinfu*, which bring a soft "whisper", and also *yan* 掩, *qiaqi* 掐起, which are more violent and solid than normal plucking. The range of timbre is extensively used. It can be also easily observed that adjacent notes are played by different playing techniques, which lead to the frequent and delicate change of timbre.

Figure 63: quotes from *Hu jia shi ba pai* 胡笳十八拍

As a result, the musical line of *qin* is perceived even not as monophonic, but as if it is cut and played by different instruments. This feature of the *qin*'s melody line reminds me of the pointillism or Klangfarbenmelodie promoted by Schoenberg and Webern, which refers to present a melody with isolated points of sound, rather than in a melody line by the same instrument. For example, in Webern's *Five Pieces for Orchestra*, op.10, Transformation between timbres formed by various instrumental combinations is stressed. In figure 64, the transformation happens already three times in the first two measures. The succession of different sound textures can be perceived as a single melody.

Figure 64: the beginning of Webern's *Five Pieces for Orchestra*

Due to the close association between the compositional technique Klangfarbenmelodie and the Chinese traditional *qin* melody, I apply the technique of Klangfarbenmelodie in composing the passage between rehearsal mark B and C in the third part. *Qin* playing techniques are presented by different orchestral instruments. The choice of orchestration is based on the timbral resemblance to the individual playing technique. All the chosen *qin* playing techniques can be divided into two categories: one is the plucking technique, which includes *anyin*, *sanyin*, *daiqi* , *zhuaqi*, *qiaqi*, *yan*, *tuichu*, 推出, *dayuan* 打圆, and *qia cuo san sheng* 掐撮三声.[117] The other is the technique

[117] *Dayuan* 打圆 means to play the same pitch alternatively on two different strings (either *anyin* or *sanyin*). *Qia cuo san sheng* 掐撮三声 needs to be played by both hands in tandem. The right and left

playing ornament, vibration and glissando, which include *quanfu* 全扶, *banfu* 半扶, *yin* 吟, *nao* 猱, *chuo* 绰, *zhu* 注, *tang* 淌 and *tuo* 拖. Since the timbral orchestration is more correlated with the plucking sound, I will only talk about the employment of the first category here. The second category will be discussed in the next section.

Fundamentally, the different plucking techniques in the first category are either played on the open string or on the pressed string, the general treatment of orchestration of *sanyin* and *anyin* should be firstly ascertained. According to Grey, timbre is multidimensional. The spectral distribution and temporal transition all affect the timbre.[118] However, for the sake of feasibility, the orchestrated timbre will focus on the most distinctive auditory feature that distinguishes one technique of *qin* from another. From the last chapter we have known about the most significant difference between *sanyin* and *anyin*'s spectrum: *sanyin* spectrum has much more higher frequencies than the *anyin* spectrum. This energy distribution of high frequencies leads to the perception of brightness.[119] When listening to the two types of sound, one may directly perceive that the *sanyin* is brighter than the *anyin*. Accordingly, the degree of brightness of orchestral instruments serves as a judge of orchestration.

I refer to Wessel's model of two-dimensional timbre space based on Grey's set of orchestral instrument timbres. It is interpreted as the brightness on the vertical axis and the onset transient on the horizontal axis (see figure 65).[120] In figure 65, the perceived timbre becomes more and more bright from the bottom to the top. On the one extreme of the vertical axis, trombone, trumpet plus trombone, oboe have a very bright sound, while on the other extreme, horn, cello play muted sul tasto and bassoon plus horn are

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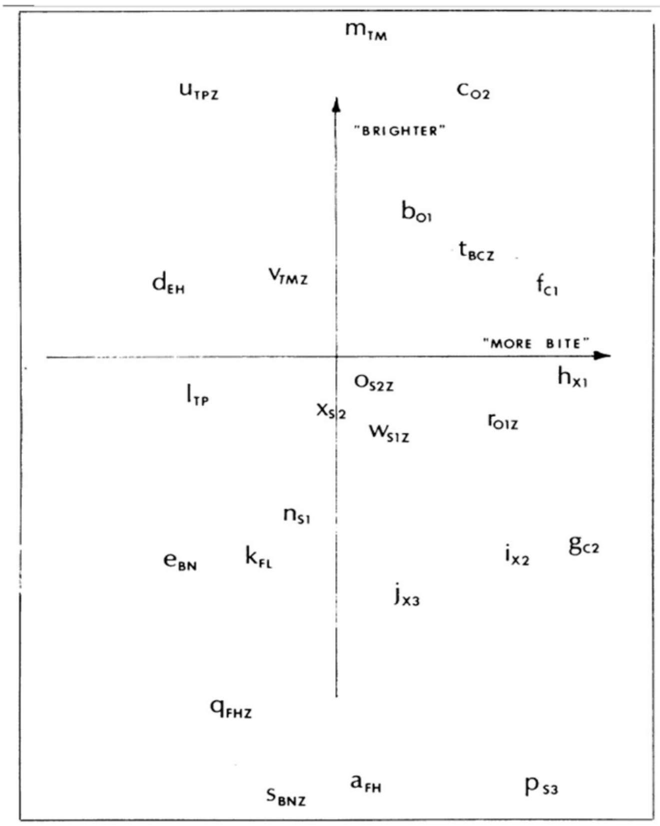
hands play the sequence of *cuo*, *yan*, *qiaqi* in sequence three times. Both of the two techniques are played with a few fixed rhythm patterns.

118 J. Grey (1977): "Multidimensional Perceptual Scaling of Musical Timbres". *Journal of the Acoustical Society of America, 61*(5), 1270–1277.

119 Almeida, A., Schubert, E., Smith, J. *et al.*: "Brightness scaling of periodic tones". *Atten Percept Psychophys* 79, 1892–1896 (2017)

120 David L. Wessel: "Timbre Space as a Musical Control Structure", *Computer Music Journal, Vol. 3, No. 2,* 1979, pp.45-52

soft and dull. For the several instruments that are not illustrated in Wessel's model, I consult other two three-dimensional timbral spaces raised by McAdams [121] and Lakatos[122]. Through comparing the spatial position of the instruments at the axis of spectral centroid[123], it is confirmed that harp and piano have relative low centroids (around the centroid of the horn). Violin has a relative high centroid but lower as trumpet, the centroid of clarinet is lower than the bowed strings.



Abbreviations: o1, o2 = oboes, FH =French horn, BN = bassoon, C1 = E-flat clarinet, C2 = bass clarinet, FL = flute, X1, X2, X3 = saxophones, TP = trumpet, EH = English horn, S1 = cello played sul ponticello, S2 = cello played normally, S3 = cello played muted sul tasto, FHZ = modified FH with spectral envelope, BNZ = modified BN with FH spectral envelope, S1Z = modified SI with S2 spectral envelope, S2Z = modified S2 with S1 spectral envelope, TMZ = modified TM with TP spectral envelope, BCZ = modified C2 with 01 spectral envelope, 01Z = modified 01 with C2 spectral envelope.

Figure 65： two-dimensional timbre space by David L. Wessel [124]

[121] S. McAdams: "Perceptual scaling of synthesized musical timbres: Common dimensions, specificities, and latent subject classes". *Psychological Research (1995) 58,* pp. 177-192

[122] S. Lakatos: "A common perceptual space for harmonic and percussive timbres". *Perception & Psychophysics* 2000, 62 (7), /426-1439

[123] Perceived brightness is strongly correlated with the spectral centroid. See the article *Does Timbral Brightness Scale with Frequency and Spectral Centroid?* (2006) by Schubert & Wolfe

[124] Source: David L. Wessel: Timbre Space as a Musical Control Structure

Based on all the above mentioned models of timbral space, instruments with more brightness will be used for orchestrating the *sanyin*, while *anyin* is played by instruments with more dullness. For other techniques in this part, most of them, such as *qiaqi*, *yan*, are based on *anyin*, few of them, such as *tuichu*, are based on *sanyin*. Figure 66 shows the set of the instrument combinations for presenting the *anyin* and *sanyin* employed in the passage from letter B to C. Each of the combinations is played in unison or octave.

Anyin: ① Fl./Cl. + Hn. + Harp ② B.Cl + Tuba +Vc. ③ Bsn.+ Vc./Hn.

Sanyin: ① Trbn. (con sord.) + Trpt. (con sord.) + bowed strings (sul pont.)/Bsn.

② Hn. (stopped with hand) + Trbn. + Trpt. +bowed strings (sul pont.)

Figure 66: the first set: orchestration of *anyin* and *sanyin*.

Figure 67 shows the instruments and playing methods for constructing the attack transient of *anyin*, *sanyin*, *zhuaqi*, *daiqi*, *qiaqi*, *yan* and *tuichu*, which forms the second set.[125] Among them, *qiaqi* and *yan* include more percussive noise and produce a more twanging and violent sound. The plucking noise of *zhuaqi* is also distinctly perceived, since it has a soft and hollow quality compared with normal anyin, which consequently gives prominence to the noise at the attack. The plucking noise is mainly played by string instruments, whose techniques vary from harmonic pizzicato to Bartok pizz, namely from a light to an intense effect, in respond to different *qin* techniques. For normal *sanyin* and *anyin*, the attack transient is also presented by short value notes, such as pizzicato at extremely high position of strings or percussion instruments (see figure 67).

Qin technique	Orchestral instrument	Playing method
anyin	Vla., Vc., Cb.	Pizzicato, pizzicato at extremely high position

[125] Since *dayuan* and *qia cuo san sheng* are actually the combinations of other techniques. The treatments of them are not listed once more in figure 76.

sanyin	Susp. Cymb., Pno,	Susp. Cymb.: scrape with triangle beater Pno.: strike on the low strings with fist (with pedal)
daiqi	Vl. II	harmonic pizzicato
zhuaqi	Vla., Vl.	Col legno battuto, pizzicato behind the bridge (sul E)
yan	Vla. + Fl.	Vla.: Bartok pizz. (dampen the string, percussive noise) Fl.: tongue ram
qiaqi	Vl.I +Vl. II	Pizzicato (dampen the strings with less finger pressure)
tuichu	Pno.	Strike the low strings with fist

Figure 67: the second set: orchestration for the adding attack transient

Any of the basic instrumental combinations in the first set and the corresponding attack transient in the second set contribute to the eventual orchestration of *qin* techniques, which are fixed to several possibilities. Thereby, each orchestrated *qin* technique also has its distinctiveness. Two examples of the orchestrated timbre in the third part are shown in figure 68, where the *qin* techniques (marked in red on top of the score) are played by corresponding instruments and articulations from the two sets in succession.

Figure 68: orchestrated timbre of *qin* in bar 64, bar 67

6.3 Mimesis of Ornaments and Melody of *Qin*

Qin music highly values the ornaments, which reflects the various techniques for playing vibratos, glissandi, and grace notes. The mimesis of the ornaments in *Vagueness* is mainly used in the third part. As is introduced in the former section, the involved techniques are *quanfu*, *banfu*, *yin*, *nao*, *chuo*, *zhu*, *tang* and *tuo*. *Quanfu* and *banfu* are played as grace notes. *Yin* and *nao* are two types of vibrato, which stand for small vibrato and large vibrato respectively. *Tang* and *tuo* are glissandos played by sliding slowly from one note to another. *Chuo* and *zhu* mean to slide quickly towards a note, which have the quality of the grace note.

(a) (b)

Figure 69: mimesis of ornaments of *qin*

The techniques for ornaments are straightforwardly imitated by orchestral instruments. *Quanfu* and *banfu* are played by piano while dampening the strings, in order to obtain a dryer sound (see the piano part in the left example of figure 68). The other techniques are freely played by strings, harp or wind instruments. Figure 69 shows some of the examples. In (a), double bass pizzicato doubling *qin* play *chuo* together, which is imitated by the harp playing *tuo* as the echo. The pitch bending of the harp is achieved by moving the drum stick laid vertically to the string after plucking. In (b), *yin* and *nao* are played unison by small and large vibratos simultaneously, creating a complex sonority of vibrato. Similar to other gliding techniques discussed in 6.2.1.2, *tang* and *tuo* are also accompanied with friction noise. The noise component is therefore taken into consideration. In figure 70, two of the first violins play the slow upward glissando (*tang*), while friction noise of *tang* is simulated by the second violins.

In *Vagueness*, melodies which are similar to the *qin* melody are involved in some places. For the piece, these melodies are not extraneous elements, but enlarge and extend the spirit of the original *qin* music. Except for the long harmonic melody played by solo *qin* in the fifth part of the piece (see 6.2.1.1), when listening to the succession of different timbres (see 6.2.2), the obscure melody can also be distinguished.

Figure 70: microtonality in the melody

In the oldest master *qin* piece *Youlan* 幽兰, the pressing position of the left-hand finger is often somewhere between two pitches according to the *qin* long-hand tablature. The deviation of the position produces microtones, embodying the unique flavor of this ancient piece. In respond to this feature, microtones are also used for building the "Klangfarbenmelodie" in the third part. Many *anyin*, as well as the ending pitch of the sliding are purposely slightly higher or lower than the equal temperament. For example, in figure 70, horns, trombone, 2 violins and also pizzicato of viola and cello are played 1/4 tone lower than B2 and B3. Since the players can never play exactly the same pitch, the impurity of tone will be generated, which adds the flavor of antiquity.

6.4 Mimesis of the Temperament of *Qin*

As is introduced in 3.7, *qin* uses both *San fen sun yi* temperament and just intonation for tuning. The open strings of *qin* in *Vagueness* are tuned according to the just intonation "Manjiao Tuning" recorded in *Qin xue ru men* (see figure 71). Notes played on the D, E, and A strings are slightly lower than they are in the equal temperament, since the open strings are 18, 14, and 16 cents in comparison to the piano keys.

Figure 71: *qin* tuning in *Vagueness*

In the fifth part of the piece, the *qin* plays melodies only by harmonics. As is known, the fifth partial is 14 cents lower than in the equal temperament. When playing the fifth partial on the second, third, fifth and seventh string, the resulting harmonics will be even much lower, namely -32 cents, -28 cents, -30 cents, -32 cents respectively, which are almost a quarter tone lower than in equal temperament. (see figure 72)

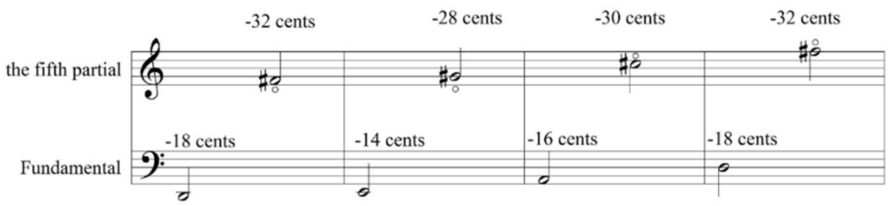


Figure 72: cents of the open strings and their fifth partials compared with equal temperament

Figure 73: mimesis of *qin*’s temperament by the orchestra

To correspond with the deviation caused by just intonation, the involved pitches #F, #G, and #C in the orchestra part are all played a quarter tone lower. Here the orchestra, normally having a different temperament than the *qin*, is consistent with *qin*’s just intonation. In the upper example, the lower #F, #G and #C played by *qin* are imitated by the same pitches in the orchestra, throughout also a quarter tone lower in the viola, cello and clarinet parts. The soft sustained notes played by violas, cellos and clarinets serve as the continuation of the light harmonics (see figure 73). The mimesis of symbolic pitches of *qin* tuned in just intonation brings consistency of the temperament between the orchestra and the *qin*, ensuring the coherence in temperament on the whole.

6.5 Mimesis of the Aesthetic Elements of *Qin*

As is already mentioned in the very beginning, the hybridity of *qin* and orchestra evokes the spirit of *qin* and Chinese music. As a notable aspect of the overt mimesis, the musical representations and artistic features are of high uniqueness, which are also reflected in *Vagueness*.

Qin has been played as a solo instrument and does not have a great volume. As is suggested by Taoism, *qin* music has the quality of introspection and meditation. The Confucianism also advocates the expression of calmed emotions in *qin* music. Correspondingly, in *Vagueness*, the orchestration of doubled wind and brass, as well as a limited number of strings is employed. It has the feature of a large ensemble piece, not only in terms of its size, but also concerning musical language. In the first and third part of the piece, the players are considered more as soloists, creating ensemble timbres. The individualities of the instruments in small groups can be easily heard while blending with each other. The fifth part is also accomplished by the instrumental ensemble including solo *qin*, harp, percussions and strings as background and echo. By contrast, in the second and fourth part, timbres are distinguished according to the orchestral instrument groups. Tutti passages are also involved. Consequently, the piece transforms between chamber and orchestral musical language, creating a careful balance between macro-and micro-manifestations of *qin*. Nevertheless, the whole piece is generally based on a peaceful and gentle musicality. Even in the second and fourth part, the orchestral force is not emphasized, but to pursue a temperate expression and the elegant taste, as a response to the *qin* ideology.

For *qin*, the "flavor" (*yun* 韵) is undoubtedly a key word. The flavor in *qin* music is embodied by the subtle touch of the left-hand finger techniques, which produce a variety of glissandi, vibratos and grace notes. As is discussed in 6.3, these ornaments are extensively involved in the piece. Besides, the constant changing of timbre among *sanyin*, *anyin* and *fanyin*, and also among other plucking techniques, add flavor to *qin* music. The third part of *Vagueness* concentrates on the succession of timbre variation, creating the sensitive "Klangfarbenmelodie". Also in the first part, the whole orchestra constructs the single plucking sound, yielding the delicate timbral structure. As a prominent feature, two adjacent notes at the same pitch are always presented by different colors. For example, a dry and wooden sound is followed by a sharp and metallic sound.

As is mentioned in 3.8, the "non-sounding" is a prominent feature of the *qin* aesthetics. The imperceptible or barely audible sounds coming after the pitch, continue for a while through sliding on the string by the left-hand finger, producing the noise of sliding. The non-sounding of *qin* is particularly involved in the third part, where very soft white noises are played by the orchestral instruments (see 6.2.1.2). Despite an abrupt disappearance of a pitch, the "silence" actually allows people to imagine the continuation of the pitch.

Qin tends to linger on one sound and encourages us to focus on the delicate change of every sound. The covert mimesis through spectral music techniques, which seems to be apart from the Chinese musical aesthetics, stresses also on a sound in the form of its microstructure. The dynamic change of partials in the *qin* spectrum is meant to be heard, which is compatible to the *qin* aesthetics.

Chapter VII Analysis of the Combination of Covert and Overt Mimesis

After having thoroughly analyzed various cases of covert and overt mimesis in *Vagueness*, in this last chapter, the application of mimesis relates to two particular perspectives of combining the covert and overt mimesis. The employment of covert mimesis of the *qin* spectrum discussed before rarely gives a clue to the cognition of the *qin* sound when listening to the result, whereas in the following two cases, except for revealing the inner quality of a sound, the mimetic result also has close relationships with overt mimesis. The examples can be found mainly in the fourth part (bar 104-144) of *Vagueness*.

7.1 Covert Mimesis with Definite Aural Similarity to *Qin* Playing Technique "*gunfu*"

The manipulation of the horizontal motion of the spectral contents (discussed in 4.1.5), namely the "phasing harmonic aggregates", is employed in the fourth part. For tracking the partials of the *qin* spectrum, I use the *Macaque* program that is embedded in *MaxScore.* In *Macaque,* the spectrum at any time point of *qin* sound can be directly transcribed into musical notation. The SDIF file of the *qin* sound required by *Macaque* is generated by SPEAR, in which the vague components below a certain amplitude threshold will be left out.

Figure 74 shows the spectral components based on *sanyin* F2 at the time of 1737.5 millisecond transcribed in *Macaque*. The 1st to the 12th partials are displayed in the bottom pane. In *Macaque*, a spectrum can be stretched or compressed in terms of frequency. When the stretch factor is 2, the spectrum stays the same (see figure 75 a). In the case of figure 75 b, the stretch factor is raised to 3.05, which results in a distorted spectrum. Note that the formula for calculating here is completely different from the one used in the first part of the piece (see 5.1.5).[126]

[126] The calculation requires the partial index, a pseudo-octave and the fundamental. See Georg Hajdu: *Macaque—A Tool for Spectral Processing and Transcription,* Proceedings of the Third International

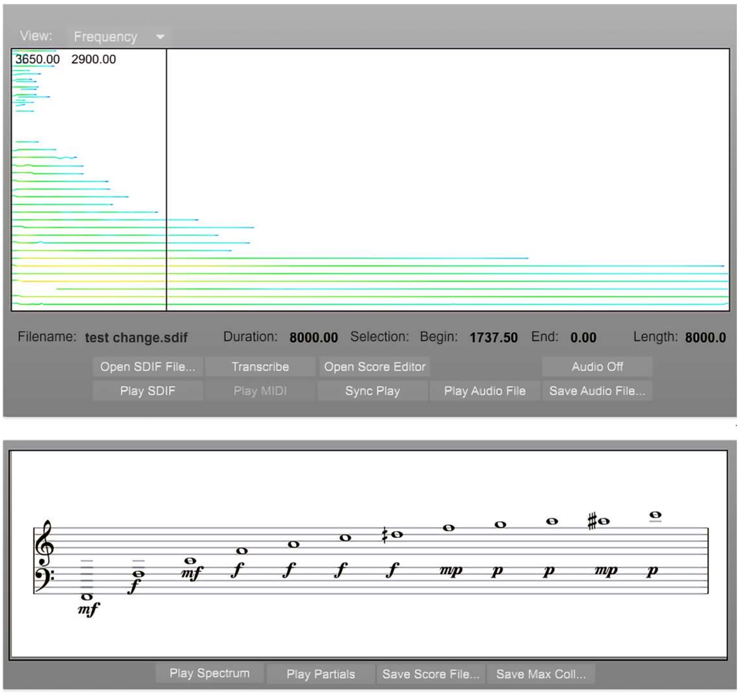
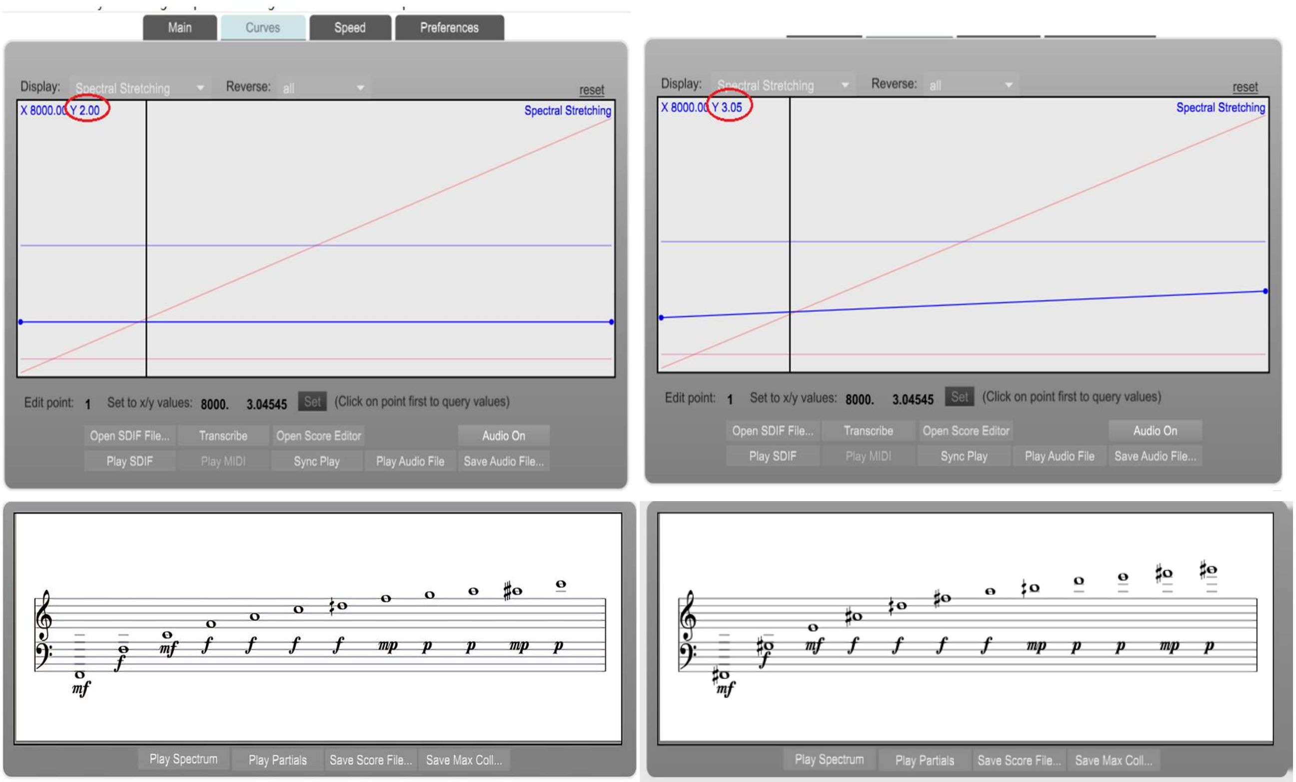


Figure 74: *sanyin* F2 at the time of 1737.5 millisecond in *Macaque*



a b

Figure 75: the same spectrum as in figure 74, when a: stretch factor = 2, b: stretch factor = 3.05

In the fourth part, the distorted spectra generated by *Macaque* are used for constructing the horizontal arpeggio. The stretched spectrum (from the 4^{th} to the 12^{th} partial) in figure 75 b is used in the horizontal movement of woodwinds from bar 104 to 113.[127] The downward motion starts from different partials in different rhythms (see figure 76). The 1^{st} to the 5^{th} partials are used for constructing the harmonic background played by brass and strings.

Figure 76: horizontal motion of the *qin* spectrum

From bar 113 to 120, the compressed spectrum based on *sanyin* F2 at the time of 537.5 millisecond is employed. The chosen stretch factor is 1.05. As is indicated in figure 77, the partials marked in red are played by woodwinds. From bar 121 to 133, the bassoons join the downward arpeggios. The spectrum involved is based on *sanyin* G2 at the time of 593.75 millisecond. Both the stretch factors of 3.05 and 1.05 are involved, together forming the spectrum in the woodwind part. (see figure 78).

[127] For the feasibility of playing, the microtones are changed to the nearest piano tone.

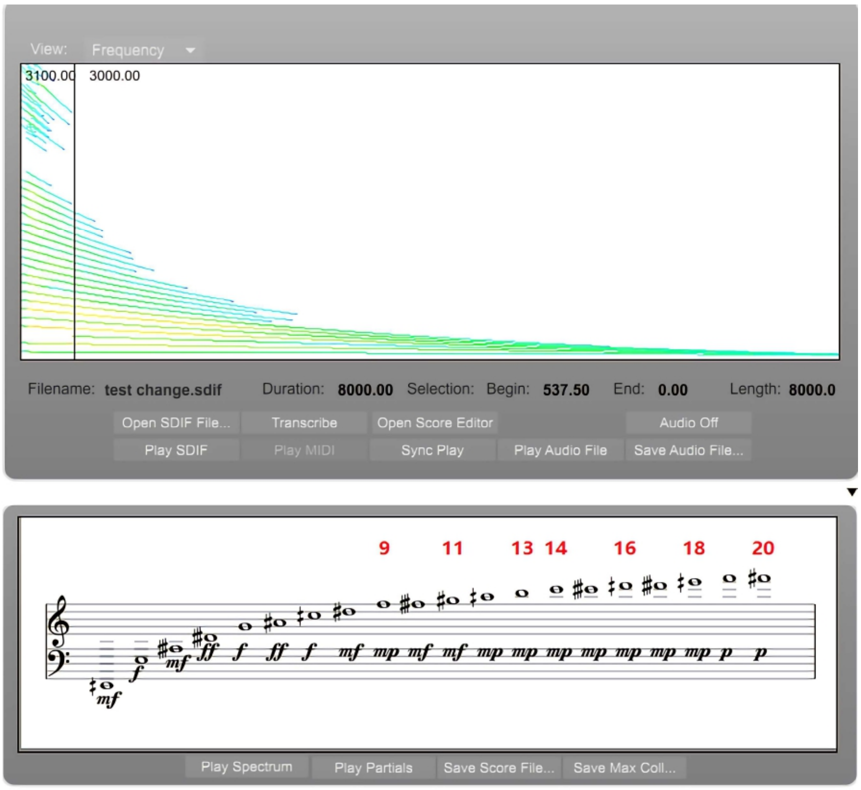


Figure 77: the compressed spectrum based on *sanyin* F2 at the time of 537.5 millisecond

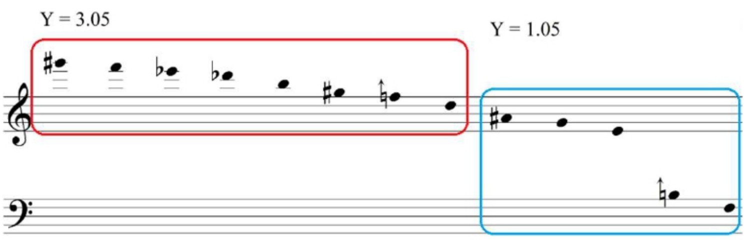


Figure 78: spectrum played by woodwinds from bar 121 to 133

In terms of the mimetic result, the up or down array of the spectrum happens to coincide with the perception of the *qin* playing techniques *gun* 滚 and *fu* 拂. *Gun* refers to plucking fast and outwardly over several strings in succession, normally from the 7th to the 1st string or from the 6th to the 1st string, while *fu* is plucked in the opposite direction. In practice, *gun* and *fu* are always combined (written as *gunfu*). When playing gun and fu, the finger runs rapidly from higher to lower and vice versa, producing the back-and-forth waves of sound. The famous *qin* piece to employ the *gunfu* technique is "*Liushui"* (flowing water, 流水). In a long passage of *Liushui*, *gunfu* is used for stimulating the movement of the flowing water.

The arpeggios played by orchestral instruments remind us easily of *gun* and *fu* of *qin*. At the beginning of the fourth part, flutes, oboes, and clarinets play descending arpeggio alternately, which suggests the *qin* technique *gun*. After a while, horns join the steady flow, playing valve glissando running up and down, suggesting the *gunfu* technique. Violas, cellos and harp also play up-and-downwards arpeggios with crescendo and decrescendo. Later, woodwinds slow down and fade out, while the strings run up from lower to higher register, suggesting the *fu* technique. Like the *qin* piece "*Liushui*", the whole part can be also associated with flowing water. From the long stream with ripples to the vastness of water, and then back to the gurgling of spring water, the water sounds are constant in flux.

7.2 Mimesis of the *Song Ci* "*Nian Nu Jiao"* and the *Qin* Playing Technique "*wu*"

The scene of flowing water, which can be vividly presented by *qin* technique *gunfu*, is also involved in Chinese literature. For example, "*Nian nu jiao - Chibi huaigu*" (*念奴娇・赤壁怀古*) by Su Shi 苏轼[128], a famous literary piece of *Song Ci* 宋词[129], depicts the swollen river while cherishing the past. The first three phrases of *Nian nu jiao* have four, three, and six characters respectively: "*Da jiang dong qu, lang tao jin, qian gu feng liu ren wu*" 大江东去，浪淘尽，千古风流人物, which is translated as "The endless river eastward flows, with its huge waves are gone all those Gallant heroes of bygone years".[130]

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[128] Su Shi (1037-1101), outstanding Chinese poet in Song Dynasty (960-1127)

[129] *Ci* 词 is a poetic form, a type of lyric poetry. *Ci* form of poetry from the Song Dynasty is called *Song Ci.*

[130] Tran. by Xu Yuanchong in *Song Ci San Bai Shou* 宋词三百首, Beijing 2007

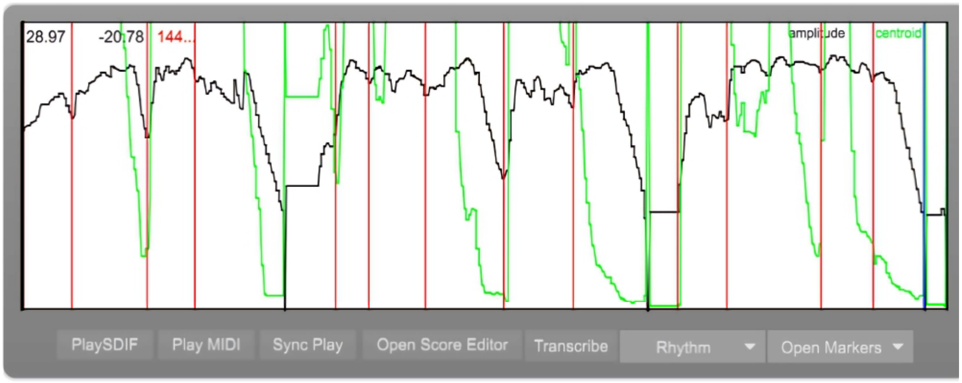

Figure 79: markers added to the SDIF file of the first three phrases of NNJ

At the beginning of the fourth part, elements from the recording of the first six phrases of *Nian nu jiao* (NNJ) are used in the string part. The SDIF file of the first three phrases is generated in *Macaque*. Markers are firstly created at the beginning of each syllable, (see figure 79, the markers are the red vertical lines in the bottom pane. The off marker at the end is in blue), which decides the temporal structure. By choosing the rhythm in the drop-down menu at the lower right corner, the rhythm patterns of the file can be derived (see figure 80, quarter note equals 65). Moreover, the pitch classes of the salient partials of the file can be also transcribed into notation (see figure 81, rhythms are left out).

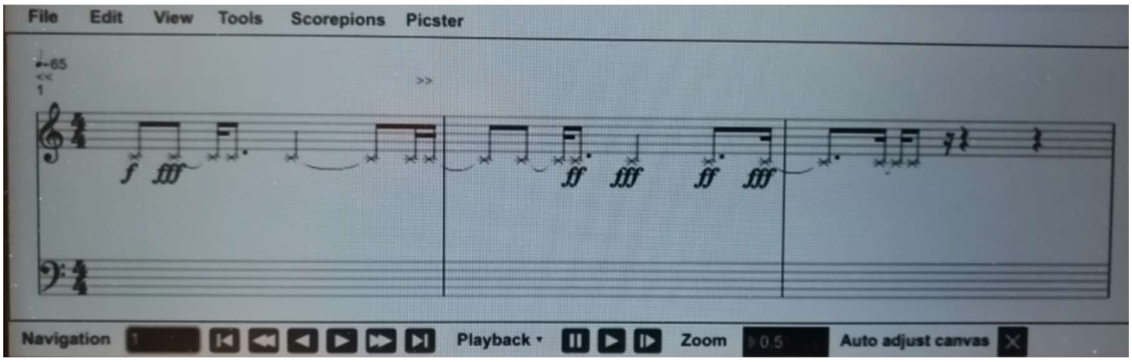

Figure 80: the rhythm pattern of the first three phrases of NNJ

Figure 81: the pitch classes of the salient partials

Figure 82: mimesis of the first phrases of NNJ and *qin* technique *wu*

The transcription of rhythm and salient partials then combines with glissandos going up and down, which can be treated as the mimesis of both the intonation of Chinese language and the *qin* playing technique *wu* 忤. As is well known, Mandarin is pronounced with different tones, which either rise or drop. The *qin* playing technique *wu* refers to glide up several positions after plucking a pressed note. The end point is not strictly controlled. Consequently, the Chinese language and the *qin* technique *wu* have a similar effect, which can be simulated by the glissandos played by orchestral instruments. In the string section of the fourth part, notes chosen from the pitch classes of the salient partials generated by *Macaque* serve as the starting points, leading an up or downward glissando. The duration of notes, which corresponds to the duration of the

Chinese characters, is defined by the ones indicated in Figure 80. Unlike the duration, the pitches do not strictly follow the order of salient partials. The three elements corporately yield the mimesis of the poem *Nian nu jiao* and also the *qin* playing technique *wu.* (see figure 82, note values are marked on top of each note)

Following the same procedure, the next three phrases of *Nian nu jiao* are also analyzed and combined with pitch glissando. The result is also played by the strings. No more details will be given here.

The above example is also intendeds to demonstrate the combination of overt and covert mimesis. As a whole, the string section articulates not only the mimesis of *qin* technique wu, but also the *Song* poem *Nian nu jiao*. The mimesis is extended to other art forms, giving the context that is explicitly correlated with the representation of flowing water in the fourth part. The duration and the starting pitch of each character in *NNJ*, are exposed by the sound analysis through *Macaque*, which is apparently a process of covert mimesis, while the glissando enables the aural similarity to the mimetic objects, suggesting the overt mimesis.

Summary

Reflecting García Canclini's definition of cultural hybridity that is quoted at the beginning of the first chapter, the old Chinese instrument *qin* and western orchestra, which represent two musical identities from distinct cultures, are combined and synthesized with each other, creating a new musical entity. As is suggested by Burke's third stage of the process of cultural hybridity, the element of Chinese *qin* is not simply inserted, but is well merged with the western orchestra, forming a coherent musical language.

As for the realization of the cultural hybridity, the mimetic discourse is significantly engaged in the research as the key to decoding the composition. Through the pluralistic mimesis that is generally divided into covert and overt mimesis, the *qin* is presented in multiple dimensions including its features in the spectrum, timbre, playing techniques, ornaments, melody, temperament and aesthetic elements, instead of focusing on one or a few particular aspects in previous cases about musical hybridity. This approach affords to look at the hybridity in its high complexity and diversity. Particularly, the spectral music is endowed with a special sense, namely the pure covert mimesis. In *Vagueness*, it associates with other compositional techniques based on *qin*'s characteristics and brings correspondence with them in some perspectives, such as microtonality and the nuance of timbre. The analytical part demonstrates explicitly the application of covert, overt mimesis, and their combination in the composition. With the aid of the two basic types of mimesis, not only the external characters that exist through overt mimesis, but also the mysterious inner world of the sound can be revealed through covert mimesis.

All the above perspectives concerning cultural hybridity and mimesis answer the research question of how to apply the Chinese instrument *qin* to western orchestra, which is raised at the very beginning of the dissertation.

Artistic research is not only a reflection, but also a creative process. By employing Frayling's model for artistic research, the artistic practice is well combined with research. In my research, the orchestral composition itself functions as a code for understanding and creating knowledge. Philosophical and aesthetic thoughts concerning hybridity, mimesis, and also *qin* specifics are well linked and serve as the theoretical insights which force the artistic innovation. I believe that the whole artistic research project, as a practice-led research, brings certain inspirations and new approaches. The created general tool of "pluralistic mimesis" can be treated as a compositional method to realize a high degree of cultural hybridity for further composition in the similar topic with hybrid elements. The subdivisional mimetic aspects in the hierarchical clustering can be also flexibly used in any combinations. At least, the discussion on cultural hybridity is useful for composers to deal with the disparate cultural elements and understand various cultural identities.

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