ACADEMY OF PERFORMING ARTS IN PRAGUE

MUSIC FACULTY

MASTER'S THESIS

Prague, 2017

Yuk Bun, Wan

ACADEMY OF PERFORMING ARTS IN PRAGUE

MUSIC AND DANCE FACULTY

Art of Music

Composition

MASTER'S THESIS

NUMERICAL SYSTEM IN SPATIAL MUSIC COMPOSITION- FOCUS ON ANCIENT CHINESE YIN YANG AND WU XING NUMERICAL SYSTEM

Yuk Bun, Wan

Thesis advisor: doc. Mgr. MgA. Michal Rataj, Ph.D.

Examiner: odb. as. MgA. Luboš Mrkvička, Ph.D. & Dr.Hubert Ho

Date of thesis defense: 1.6.2017

Academic title granted: MgA.

Prague, 2017

D e c l a r a t i o n

I declare that I have prepared my Master's Thesis, Dissertation independently on the following topic:

Numerical system in spatial music composition -Focus on ancient Chinese Yin Yang and Wu Xing numerical system

under the expert guidance of my thesis advisor and with the use of the cited literature and sources.

Prague, date: ....
Signature of the candidate

Warning

The use and public application of the findings of this thesis or any other treatment thereof are permissible only on the basis of a licensing contract, i.e. the consent of the author and of the Academy of Performing Arts in Prague.

User's Log

By signing below, the user attests that he/she has used this thesis solely for study purposes, and he/she declares that he/she will always cite the thesis appropriately among the sources used.

Name	Institution	Date	Signature

Abstract

Wan Yuk Bun**: Numerical system in spatial music composition -Focus on ancient Chinese *Yin Yang* and *Wu Xing* numerical system**

This thesis is concentrated on the research of different numerical devices in ancient Chinese numerical systems such as the *Wu Xing* sequence and related features, in order to generate diverse compositional materials for music composition by the result of trigram(s) (*Gua*/掛).

My overall approach is to develop the methods, which can then give us the freedom to choose different compositional materials by generating very different compositional material such as pitch classes and chords by the result of *Bagua (*八掛*)*. Instead of John Cage's change operation, which only obeys the certain results generalize entire piece automatically, the composer has more initative. Hence, we can select the most appropriate materials for the music composition and have better control of the compositional process. Although the mentioned elements are very simple, the numerical relationships between them can be very complex. Although this offers an attractive potential for their application in the creation of a new compositional materials, we need to settle the complication of the process and avoid the mistake of calculations. Referring to this issue, we can use several means to contribute the generating process correctly: application of computer for calculation, avoidance of using complicated formulas in the systems, and cross-checked by another person.

Key words: algorithmic composition, sound diffusion, Chinese numerical system, compositional technique, electroacoustic composition

Contents

Introduction:

Algorithmic composition is the technique of using algorithms (or, at the very least, formal sets of rules) to create music.[1] The notion of applying algorithmic approach to compose music dates back in the history as early as the ancient Greeks. Ptolemy and Plato wrote about this practice and their theories were invoked by writers on music throughout the Medieval Ages and beyond, including Shakespeare and Milton.[2]

There are more modern examples, as well, of algorithmic composition without the use of the computer. For instance, Roy Howat suggests that some of Debussy's pieces can be divided into sections that reflect the golden ratio, commonly by using the numbers of the standard Fibonacci sequence.[3] Furthermore, Ernő Lendvai analyzes Béla Bartók's works as being based on two opposing systems, that of the golden ratio and the acoustic pitch class.[4] Also, I would like to mention one of the most influential composers to make extensive use of chance in composition was an American composer, John Cage (1912-1992), who used *Yi Jing* as a tool to compose since he got a copy of *Yi Jing* from Christian Wolff in early 1951. It became a tool to compose by using 64 possibilities. The first result by "consulting *Yi Jing*" was *Imaginary Landscape No.4 for 12 radio receivers* and *Music of Changes for Piano*. The *Yi Jing* became a very important tool for him to compose. He used it in practically every work composed after 1951.[5]

Throughout history, countless composers have taken advantage of algorithmic composition. In my opinion, the use of algorithmic composition approach is a very efficient and direct way for composing. I learned about algorithmic composition in 2010. I was studying Music Composition at Janáček Academy of Music and Performing Arts in Brno (JAMU) under the tutelage of MgA. Omar Rojas Ph.D. Thanks to him, I have had the chance to know how to employ different numerical systems (e.g. Fibonacci sequence and Mayan Numbers) to build/generate pitch classes, chords, rhythmical patterns, ostinatos and so on. Those methods were

---

[1] Gilberto dos Santos Agostinho Filho. 2016. *Randomness in music: an overview of the current possibilities*. Master Thesis. Music and Dance Faculty of the Academy of Performing Arts in Prague

[2] Grout, Donald Jay and Claude V. Palisca. 1996. A History of Western Music. 5th ed. W. W. Norton & Company: New York., p84

[3] Roy Howat. 1983. *Debussy in Proportion: A musical analysis.* Cambridge University Press.

[4] Lendvai, Ernő.1971. *Béla Bartók: An Analysis of His Music.* London: Kahn and Averill.

[5] Richard Kostelanetz. 1973. *John Cage***.** Köln: M. DuMont Schauberg.

really impressive to me and a short time later, it became the main tool for me to write music.

Two years later, I stumbled upon an article about *Wu Xing* (五行, five elements) and *Yin Yang* (陰陽) for divination purpose[6], which is an ancient Chinese numerical system. A short time later, I tried to create compositional materials by using this numerical system. The result was even better than I expected and it seemed to me that, it was very promising and could be very powerful tools for music composition. In my point of view, algorithmic composition approach can be a very power tool for composition. As a result, I continued to study this system since the first year of my master degree study in 2015; meanwhile, I found that the *Bagua (八掛*/eight trigrams) with *the three-coin method* is extremely close related to the *Wu Xing* sequence and *Yin Yang* system. It can also provide the indeterminate sequence order of *Wu Xing* for generating compositional materials. It was a very influential discovery and it was also a groundbreaking progress of this system. I found, as I tried to apply it to my composition process, it worked very effectively and comprehensively. I believe this is the best method for me, as I am attracted to the ability it helps me to prepare the compositional materials efficiently as well as organize the overall structures; moreover, this system can generate several different materials by using the same result of *Bagua*. It gives me the freedom to pick the most suitable materials for the compositional process.

The main difference between the methods and approach of change operation by Cage and the ones I propose, combining the system of *Wu Xing* sequence, *Yin Yang* and *Bagua* for composing, is we can take advantages of both rationality and sentiment. A remarkable feature of this method depends on the same result of *Bagua* - it can generate several different materials (e.g. pitch classes and chords) or formal structures of the piece. Eventually, we can "choose" the most suitable materials and forms between them for my composition freely instead of chance operation by John Cage, which need to absolutely follow the result(s) and automate to complete the whole piece.

There are three main different from the method I propose and the approach John Cage used to compose are:

1. John Cage used 2 trigrams (a hexagram with 64 possibilities) to generate elements or regulations to compose. In my system, we use only 1 trigram (8

[6] Richard Rutt. 1996*. The Book of Changes (Zhouyi) A Bronze Age Document*. Richmond: Curzon.

possibilities).[7]

2. John Cage didn't use any content from *Yi Jing*, he was only using those possibilities as a tool of random decision-making in order to generate compositional materials and process. In my system, we use the content of trigram and relationship between *Yin Yang*, *Bagua* and *Wu Xing* to construct and create rules and material.[8]
3. Cage obeyed completely the result of *Yi Jing*, as he said, "I use chance operations instead of operating according to my likes and dislikes. I use my work to change myself and I accept what the chance operations say. The *Yi Jing* says that if you don't accept the chance operations you have no right to use them. Which is very clear, so that's what I do."[9] He just absolutely followed the results from *Yi Jing* and directly applied it to his compositions. However, my method can generate several different compositional materials by the same result; therefore, we have the flexibilities to "pick" the most suitable material for my composition freely. I may define my method as "*semi-indeterminacy method*."

Although my already-created system is able to construct the ostinato, rhythmical patterns, forms and melodies, due to the space constraints of this thesis my writing will only focus on the construction of compositional materials (e.g. pitch classes and chords) over the system as well as how to apply a spatial approach to electroacoustic music (site-specific diffusion) based on the previously-described ancient Chinese numerical system.

Wu Xing and *Yin Yang* are very simple elements; nevertheless, the numerical relationships between them can be very complex. This offers an attractive potential for their application in the creation of a new compositional materials.

In order to more deeply explore the potential topics, I will divide my work into two larger sections. The first, containing Chapters II and III, will focus on the construction of a harmonic and melodic system. The second one, Chapters IV and V, apply the numerical system into the spatial and electronic composition.

The first chapter will provide some basic concepts of *Yi Yan* (陰陽) as well as principles of the ancient Chinese numerical systems-*Wu Xing* sequences and *Bagua (八掛);* moreover, I will introduce "***the three-coin method***" for generating the

---

[7] Stefan Kostka. 2006. *Materials and Techniques of 20th Century Music" (Third edition).* University of Texas at Austin.

[8] James Pritchett. 1993. *The Music of John Cage*, Cambridge University Press.

[9] Richard Kostelanetz. 1988. *Conversing with Cage*. New York: Limelight Editions. p 215

Gua[10] (掛, trigram).

The second chapter will explain how to construct pitch classes by using *Gua* with *Yin Yang* and *Wu Xing* Sequence.

After I've demonstrated how to build up the pitch classes in the previous chapter, we will focus on make use of the *Bagua, Wu Xing* and the *Yin Yang* to build up chords in the third chapter.

In the chapter four, I will skip the music creation, towards to the digit effect processing in order to demonstrate how the numerical system works on electroacoustic materials. I will concentrate on utilizing the Wu Xing numbers to construct the parameters for timbres of sounds (such as EQ, dynamic and compressors).

The aim of the last chapter focuses on refining my sound diffusion system using the *Bagua*, *Yin Yang* and *Wu Xing* series. The end result will be a more powerful musical tool to achieve the desired spatial effect and "poetic mood."

1.1 Introduction of *Yin Yang* (陰陽/兩儀) and *Wu Xing* (五行)

Before I explain the application of ancient Chinese numerical system to composition, I would like to briefly introduce those complex systems for us to have basic concepts about the meaning of those materials and how it works in my compositional system.

***Yin Yang* (陰陽/兩儀)**：

In my numerical system of composition, *Yin Yang* is an essential element. It is the concept used to explain how interconnected and interdependent between two contrary forces in the natural world. It can represent elements such as Subtraction vs. Addition as well as Upward/Ascending vs. Downward/Descending.[11] It plays the role of "giving direction" in my composition system. For instance, if I apply *Yin* for generating, the direction will go downward or descending. Likewise, if I apply *Yang*, the direction will go up or ascending. In order to have a more clear idea of this concept, please refer to the practical example 1-1, which is taken from the chapter

[10] Lin Yutang (林語堂). 1973. *Chinese-English Dictionary of modern usage*. Chinese-English Dictionary of Modern Usage, Hong Kong Chinese University.

[11] Taylor Latener and Rodney Leon. 2005. *The Illustrated Encyclopedia of Confucianism, Vol. 2*. New York: Rosen Publishing Group. P.869

2.3 below:

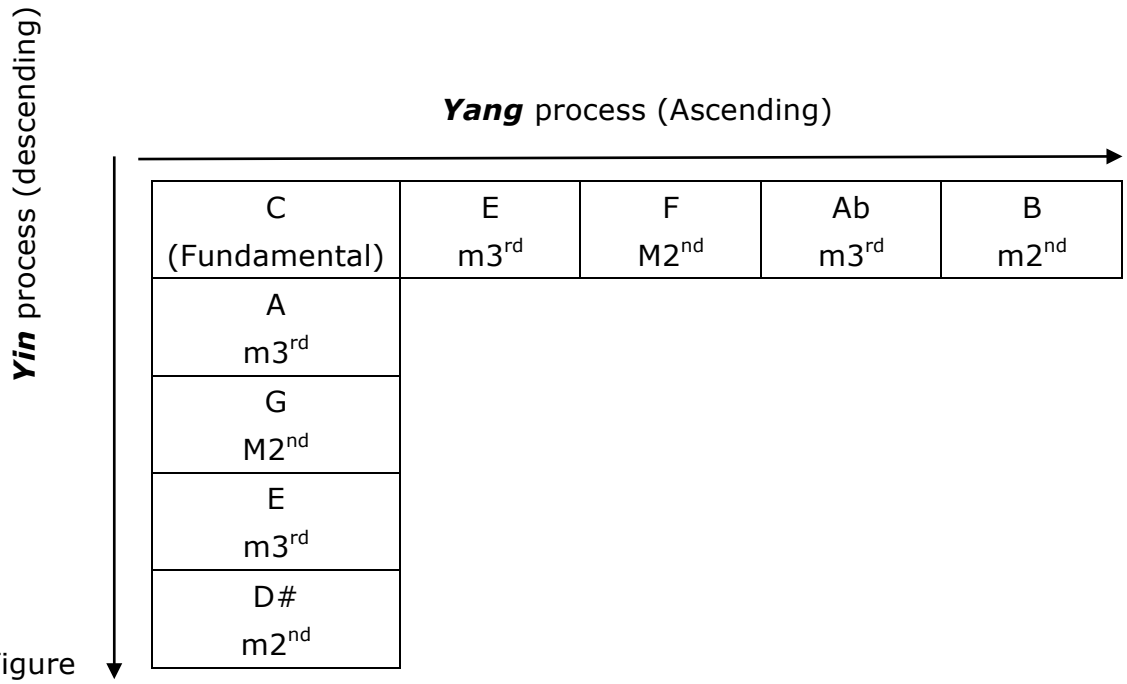


Figure 1-1

We have already had some basic ideas of the *Yin Yang.* In the next chapter, I will discuss an idea that interconnected with *Yin Yang*: *Wu Xing.* This notion and its sequences are very important to my system for composition.

***Wu Xing* (五行):**

In terms of *Wu Xing* sequence, it provides different numbers from each element (***Sheng*** and ***Cheng digit)*** for my composition system. It is impossible to translate the meaning from Chinese to English of *Wu Xing* perfectly. *Wu* (五) is mean Five. *Xing* (行) could mean element, phases, movement, agent, process, stage, and step. It is a traditional concept of ***Tao*** (道) from the ancient times. It is a five-fold conceptual scheme which diffusely applies to many different fields such as medical, *Feng Shui* (風水)[12] and Chinese fortune telling. Regarding the system theory of *Wu Xing*, the nature is support and balance by five elements/*Qi*(氣).[13]

Mutual generation and conquest

There are two different ways to make the order of those elements. The first order of

[12] *Feng Shui* is a Chinese philosophical system of harmonizing everyone with the surrounding environment. It is closely linked to Taoism

[13] Dr Zai, J. 2015 *Taoism and Science: Cosmology, Evolution, Morality, Health and more.* Ultravisum.

those elements are: Water (水), Fire (火), Wood (木), Metal (金), and Earth (土). This order of presentation is known as the "Mutual conquest/overcoming interaction" (*xiangke* 相剋). The second order is "Mutual generation" (*xiangsheng* 相生): Wood, Fire, Earth, Metal, and Water. Those elements not only can affect human being's destiny, but the harmony of universal is also affected by those elements.[14]

The diagram below is the explanation of the interactions between the *Wu Xing*. The "destructive" or "conquering" cycle is represented by red arrows inside the circle, while "generative" cycle is indicated by gray arrows going clockwise on the outside of the circle.[15]

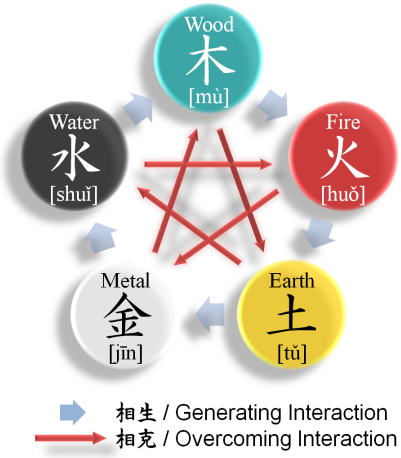


Diagram 1-1

Mutual conquest order

Lo Shu Square[16] arranged *Wu Xing* in serials. The priority is from "Mutual overcoming" order of *Wu Xing*, which I mentioned above. The order is Water, Fire, Metal, Wood, and Earth.

Sheng Digit (生數) is the first serial of the elements, which matches them from 1 to 5. The numbers order follow the Mutual overcoming order of *Wu Xing* below:

1	2	3	4	5
Water	**Fire**	**Metal**	**Wood**	**Earth**
水	火	金	木	土

[14] Elizabeth Rochat De La Vallee. 2009. *Wu Xing, Five element.* Redwing Book Co.

[15] The diagram 1-1 for this example is taken from the article "*Wu Xing*" from Wikipedia.

[16] ***Lo Shu Squar***e is the unique normal magic square of order three (every normal magic square of order three is obtained from the ***Lo Shu*** by rotation or reflection). ***Lo Shu*** is part of the legacy of the most ancient Chinese mathematical and divinatory (***Yi Jing***) traditions.

Cheng Digit (成數) is the second serial pairing with the *Wu Xing* between 6 and 10. Also, the numbers order follow the Mutual overcoming order of *Wu Xing* below:

1	**2**	**3**	**4**	**5**
6	**7**	**8**	**9**	**10**
Water	**Fire**	**Metal**	**Wood**	**Earth**
水	火	金	木	土

Finally, we have two different numbers for each element below:

1,6	**2,7**	**3,8**	**4,9**	**5,10**
Water 水	**Fire** 火	**Metal** 金	**Wood** 木	**Earth** 土

***Mutual generation* order**

The second order is the Mutual generation (*xiangsheng* 相生): Wood, Fire, Earth, Metal and Water.[17]

Same as Mutual conquest, we use the numbers ***Sheng Digits (***from 1 to 5) for these elements:

4	**2**	**5**	**3**	**1**
Wood	**Fire**	**Earth**	**Metal**	**Water**
木	火	土	金	水

We also have ***Cheng Digit (成數)*** for numbers between 6 and 10 as Mutual conquest does:

4	**2**	**5**	**3**	**1**
9	**7**	**10**	**8**	**6**
Wood	**Fire**	**Earth**	**Metal**	**Water**
木	火	土	金	水

[17] Elizabeth Rochat De La Vallee. 2009. *Wu Xing, Five element.* Redwing Book Co.

Hence, there are two numbers for each element below:

4,9	**2,7**	**5,10**	**3,8**	**1,6**
Wood 木	**Fire** 火	**Earth** 土	**Metal** 金	**Water** 水

Those two sequences are fundamental and one of the most important element/component for my numerical system of composition. I will explain how to use it in order to general compositional materials in more detail in chapter 4 and 5. In the following chapter, we will learn about a concept, which is based on *Yin Yang* and close related to *Wu Xing: Bagua.*

1.2 Introduction of Bagua (八掛)

Bagua (eight symbols/trigrams) is an essential element for my system. It provides opportunities to automate the compositional process and create compositional materials. The oldest information about *Bagua* is from *Yi Jing* (易經－the book of changes), it is one of the Chinese classic[18], the text commonly used for divination. Bagua represents the fundamental principles of reality in Taoist cosmology. It explained the relationships between sun, moon, and earth (***Yin*** and ***Yang***). It is one of the most important components of *Fung Shui* and divination. Also, it is widely influenced to medical, mussel art and music in ancient China. Each trigram consists of 3 lines, each line calls "*Yao*"(爻)[19]. It is the basic continuous/solid line (___) represents *Yang* (陽), the creative principle, on the other hand, the broken/open line (_ _); represents *Yin* (陰), the receptive principle. Any combination of three lines from these makes a *Gua* (卦－trigram)[20]. *Bagua* and their definitions below:

Symbol/ *Gua*:	**乾 Qián** ☰	**兌 Duì** ☱	**離 Lí** ☲	**震 Zhèn** ☳
Nature:	**Heaven/Sky (天)**	**Lake/Marsh (澤)**	**Fire (火)**	**Thunder (雷)**

[18] Refers to the Chinese texts which originated before the imperial unification by the Qin dynasty in 221 BC, particularly the "Four Books and Five Classics"

[19] Lin Yutang (林語堂). 1973. Chinese-English Dictionary of modern usage. Chinese-English Dictionary of Modern Usage, Hong Kong Chinese University.

[20] Wilhelm, R. & Baynes, C. 1967 The I Ching or Book of Changes. Princeton University Press.

Element:	金 **Metal**	金 **Metal**	火 **Fire**	木 **Wood**

Symbol/ *Gua*:	巽 **Xùn** ☴	坎 **Kǎn** ☵	艮 **Gèn** ☶	坤 **Kūn** ☷
Nature:	**Wind (**風**)**	**Water (**水**)**	**Mountain (**山**)**	**Earth (**地**)**
Element:	木 **Wood**	水 **Water**	土 **Earth**	土 **Earth**

Regarding eight different symbols, we can generate different compositional materials and process by converting their elements into numbers such as pitch classes and chords. The example 1-2 below is taken from chapter 2.2.
☰☷☰☷ equal to numbers: 3,2,3,1 (*Sheng* digit)

C (Fundamental)	Eb m3rd	F M2nd	Ab m3rd	B m2nd

Example 1-2

1.3 Introduction of 'The three-coin method' (金錢占)

Originally, during the Zhou dynasty (周朝 BC 1046-256) consulted *Yi Jing* by putting a turtle shell to the fire in order to get certain crakes for *Gua*. Later on, ancient Chinese made use of yarrow stalks for the consultation because of easier access materials. Nowadays, the most popular method of consulting *Yi Jing* is the three-coin method, it is said that it was invited by *Guiguzi* (鬼谷子) during the early warring states period（BC 403-340).

The original method used the hexagram (two set of trigram/*Gua*) for the consultation; however, my system only requires a trigram; therefore, the three coins are thrown three times instead of six times. While throwing the coins, the purposes (such as asking for pitch classes and chords) are held in mind. It is also possible to just let the *Bagua* decide the result for us without asking. The trigram (*Gua*) is built from the bottom up, so the first line (*Xia Gua*下掛) is the bottom one, the Third line the top one (*Shang Gua*上掛).[21]

[21] *www.organicdesign.co.nz*. Retrieved 2015-09-03 *I Ching / Divination - Organic Design*.

Changing lines

The changing line can play a very important role once if we have the same note for a pitch class or chord that was generated by *Gua* via the system. I will explain it specifically in a later chapter. Throws with all tails or all heads are considered changing lines. A changing line is a line that changes from *Yin* to *Yang* (all heads) or from *Yang* to *Yin* (all tails). The notation of *Yau* are: ×⚋ and ×⚊ represent changing *Yin* and changing *Yang* respectively.

Three tails: ×⚋
Two tails one heads: ⚊
Two heads one tails: ⚋
Three heads: ×⚊

Also, we can determine the line by calculation. To calculate the lines from the coins thrown, values are assigned to the coins' sides. Tails equals a value of 2, heads a value of 3. The values of the three coins are added to get the total to determine the line. There are four possibilities:[22]

Coins	Total	Type	Line	Line Type
0 heads + 3 tails	6	*Yin*	×⚋	Changing broken line
1 heads + 2 tails	7	*Yang*	⚊	Unchanging solid line
2 heads + 1 tails	8	*Yin*	⚋	Unchanging broken line
3 heads + 0 tails	9	*Yang*	×⚊	Changing solid line

We have already discussed the principles of *Yin Yang*, *Wu Xing* and *Bagua* in this chapter. Afterwards, we will start to explore how to apply those principles construct pitch classes.

[22] *Eclectic energies:* https://www.eclecticenergies.com/iching/introduction.php

2. Construction pitch classes by using the *Bagua* with *Yin Yang* and *Wu Xing* Sequence

In the following chapter, I will discuss how practically the above-mentioned traditional Chinese numerical systems are applied toward music material in the compositional method. First of all, I deal with *Bagua* to see how random operations are used to construct intervals, than we follow with the solutions for duplicated notes in the pitch class by the generation.

2.1 Transfer of the result of Bagua into integral interval system

First of all, transfer the integrals from the result of the trigrams (*Gua)* into intervals is essential. In the conventional integral system, intervals are measured in the semitone. For example, the interval between C (0) and G (7), a perfect fifth, is seven semitones. As a result, the sequence of *Wu Xing* Mutual conquest order with *Sheng* and *Cheng* digit values will be the table below:

Sheng Digit	½ T	T	m3	M3	P4
Intervals	1	2	3	4	5
Cheng Digit	3T	P5	m6	M6	m7
Intervals	6	7	8	9	10

2.2 Building pitch classes by *Bagua, Sheng* digit (生數) and *Yang* (陽)

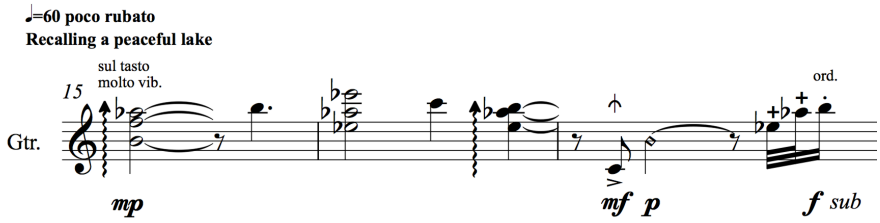
Initially, we need to get the *Sheng* digit from *Wu Xing* sequence of the *Bagua*'s result by using the three-coin method (review chapter 1.3). If a five-note pitch class is desired, after that we consult *Bagua* and we get the result of four trigrams (*Gua*) below: ☲☵☲☵ regarding the *Bagua* system, those are Metal, Fire, Metal, and Water (review the table of *Bagua* in the 1.3). Next, we can transfer those elements into *Sheng* digit: 3, 2, 3, 1. So as to simplify the explanation in the later sub-chapter, I are going to use these numbers for the rest of examples in this chapter.

Second, The numbers need to be converted to intervals: 3, 2, 3, 1 equals minor 3rd, Major 2nd, Major 3rd and minor 2nd. Let C note as the fundamental and make use of

"*Yang*" which represents up, raise, sky, ascending[23] to build up the five-note pitch class is: C, Eb, F, Ab, B and in the order from the fundamental is C, Eb, F, Ab, B. This pitch class is employed in example 2-1, which is the first miniature of my piece "*five miniatures for guitar solo*" (bar 15-17). I used the pitch class freely in this composition.

Yang process (Ascending).

C	Eb	F	Ab	B
(Fundamental)	m3rd	M2nd	m3rd	m2nd



Example 2-1 Y.B. Wan: Five miniatures for guitar solo (2015), the 1st miniatures mm.15-17

2.3 Building pitch classes by *Bagua, Sheng* digit and *Yin* (陰)

The principle of *Yin Yang, Yin* means night; earth; down; descending, sink; negatives;[24] as a result, to build up pitch classes with *Yin* means by using the intervals transfer from *Sheng* digit with descending direction.

I use the same result of those trigrams in chapter 2.2 as an example**:** 3,2,3,1 equals minor 3rd, Major 2nd, minor 3rd and minor 2nd with the fundamental as C. But this time, we use the other direction (*Yin*/descending) as below:

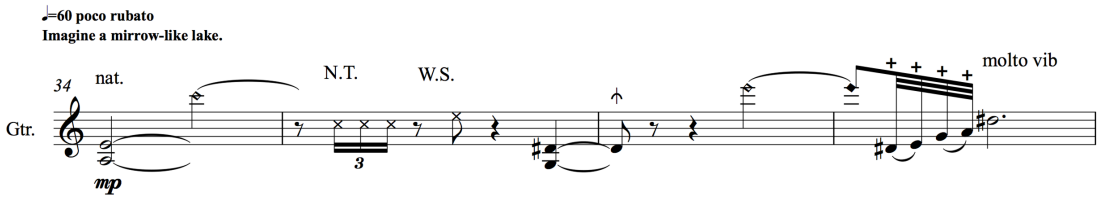
[23] [25] Elizabeth Rochat De La Vallee. 2009. *Wu Xing, Five element.* Redwing Book Co.

Yang process (Ascending).

Yin process (descending)

C (Fundamental)	E m3rd	F M2nd	Ab m3rd	B m2nd
A m3rd				
G M2nd				
E m3rd				
D# m2nd				

In the order from the fundamental is: C, D#, E, G, A. In example 2-2 I used this pitch class to compose a guitar miniature.



Example 2-2 Y.B. Wan: Five miniatures for guitar solo (2015), the 1st miniatures mm.34-37

2.4 Building pitch classes by *Bagua, Cheng* digit (成數) and *Yang* (陽)

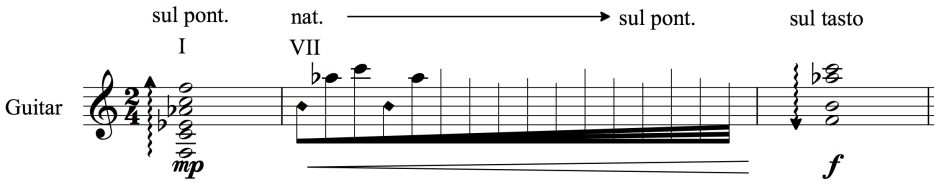
The principle of the method by using *Cheng* digit is exactly same as generated pitch classes by *Sheng digit* in 2.2, the only different is make use *Cheng* digit (2nd serial of *Wu Xing's* numbers which between 6 and 10) instead of *Sheng* digit (1st serial of Wu Xing's number, from 1 to 5). Let's use the same trigrams as the example above: ☰☳☰☲, which equal to Metal, Fire, Metal, and Water.

Transfer it into *Cheng* digit are 8,7,8,6 when we convert it into intervals are: minor 6th, perfect 5th, minor 6th and tritone (augmented 4th Diminished 5th). Let C is the fundamental:

Yang process (Ascending).

C (Fundamental)	Ab m6th	Eb P 5th	B M6th	F 3T

The pitch class with order from C is: C, Eb, F, Ab, B. This pitch class was used by me is seen in example 2-3.



Example 2-3 Y.B. Wan: Five miniatures for guitar solo (2015), the 4th miniatures mm. 1-3

2.5 Building pitch classes by *Bagua Cheng* digit and *Yin* (陰)

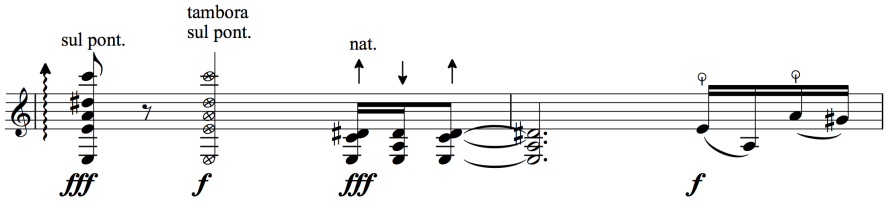
Likewise, I can also apply the *Cheng* digit to generate the pitch class with the *Yin* direction. 8, 7, 8, 6 equals minor 6th, perfect 5th, minor 6th and tritone as I mentioned in the above example. Therefore, the pitch class in the *Yin* direction is:

Yang process (Ascending).

Yin process (descending)

C (Fundamental)	Ab m6th	Eb P5th	B m6th	F 3T
E m6th				
A P5th				
C# m6th				
G 3T				

The pitch class with order from C is: C, C#, E, A, G.



Example 2-4 Y.B. Wan: Five miniatures for guitar solo (2015), the 2nd miniatures mm.15-17

2.6 Combination of *Sheng* digit and *Cheng* digit with *Bagua*, *Yin* and *Yang* to build up pitch classes

Already discussed is how to build up the pitch classes with *Sheng* and *Cheng* digit individually. In this section, I will to focus on how to combine both *Sheng* and *Cheng* digit together to generate a pitch class in order to increase the numbers of notes in a pitch class. I have found several methods to combine them together and will explain them one by one.

One can use the example as above sections: ☰☳☰☵, which equal to Metal, Fire, Metal, and Water. Their *Sheng's* numbers are 3,2,3,1 and Cheng's numbers are 8, 7, 8, 6. Now, when we transfer it into intervals equals minor 3rd, Major 2nd, minor 3rd and minor 2nd and 8, 7, 8, 6 equals minor 6th, perfect 5th, minor 6th and triton.

i. *Sheng*, *Cheng* digit order

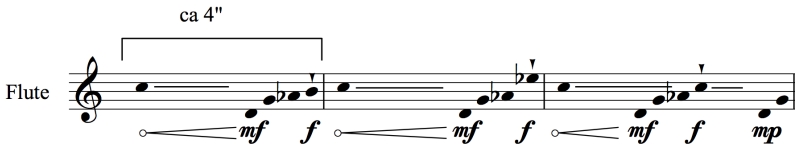
***Yang* direction:**

The first method is simply put *Sheng* digit and *Cheng* digit together: 3, 2, 3, 1, 8, 7, 8, 6. Convert them into intervals are: minor 3rd, Major 2nd, minor 3rd, minor 2nd and 8, 7, 8, 6 equal to minor 6th, perfect 5th, minor 6th and tritone. Let C is fundamental and follow the direction of *Yang*, the pitch class will be:

Yang process (Ascending).

C (Fundamental)	Eb m3rd	F M2nd	Ab m3rd	B m2nd	G m6th	D P5th	B M6th	F 3T

Here there are two duplicated notes, "B" and "F", as a result a seven-note pitch class is generated: C, D, Eb, F, G, Ab, B. In example 2-5, it will be used to illustrate how this pitch class works.



Example 2-5 Y.B. Wan: Five miniatures for flute solo (2014), the 1st miniatures mm.1-3

***Yin* direction:**

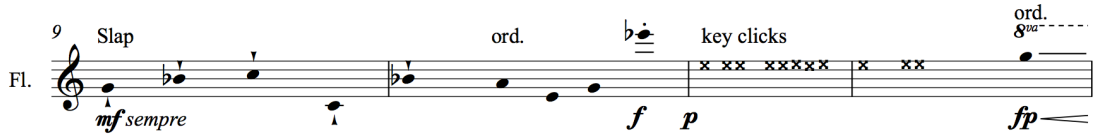
On the other hand, I can build up the pitch class in *Yin* direction:

Yang process (Ascending).

Yin process (descending)

C (Fundamental)	Eb m3rd	F M2nd	Ab m3rd	B m2nd	G m6th	D P5th	B M6th	F 3T
A m3rd								
G M2nd								
E m3rd								
Eb m2nd								
G m6th								
C P5th								
E m6th								
Bb 3T								

I have two duplicated notes here, E and G. As a result, I have generated a five-note pitch class: C, Eb, E, G, A, Bb. This pitch class is used in example 2-6.



Example 2-6 Y.B. Wan: Five miniatures for flute solo (2014), the 1st miniatures mm. 9-12

ii. *Cheng*, *Sheng* digit order:

***Yang* direction:**

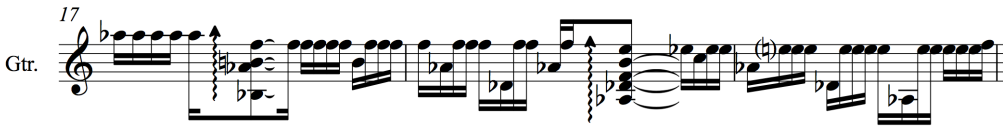
I can shift the order from *Sheng, Cheng* to *Cheng, Sheng* for the 2nd method, which means the order of numbers are: 8,7,8,6 (*Cheng*) 3,2,3,1 (*Sheng*). Converted it into intervals are minor 6th, perfect 5th, minor 6th, tritone, minor 3rd, Major 2nd, minor 3rd, and minor 2nd; Hence, the pitch class formed with the *Yang* direction will be:

Yang process (Ascending).

C (Fundamental)	Ab m6th	Eb P5th	B M6th	F 3T	Ab m3rd	Bb M2nd	Db m3rd	E m2nd

The Ab is duplicated here, so we have an eight-note pitch class: C, Db, Eb, E, F, Ab, Bb, and B. Example 2-7 shows how this pitch class works.

EXAMPLE 2-7 Y.B. Wan: Five miniatures for guitar solo (2015), the 4th miniatures mm.17-19



***Yin* direction:**

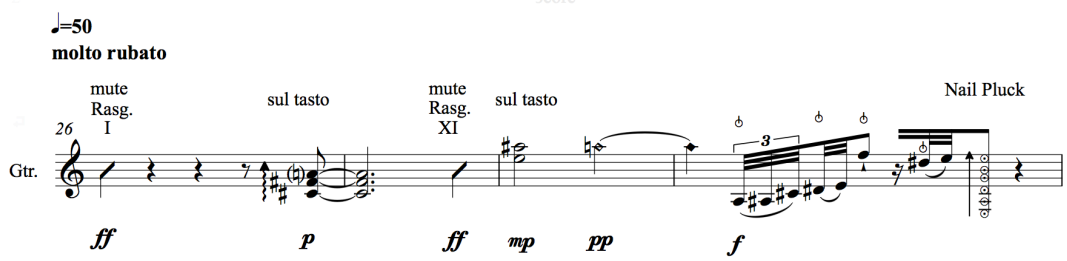
Yang process (Ascending).

Yin process (descending)

C (Fundamental)	Ab m6th	Eb P5th	B M6th	F 3T	Ab m3rd	Bb M2nd	Db m3rd	E m2nd
E m6th								
A P5th								
C M6th								
F# 3T								
D# m3rd								

C# M2nd
A# m3rd
A m2nd

A and C are repeated; therefore, the seven-note pitch class is: C, C#, D#,E,F#,A,A#. In example 2-8 describes how I applied this pitch class to compose a guitar solo piece.



Example 2-8 Y.B. Wan: Five miniatures for guitar solo (2015), the 1st miniatures mm.26-29

iii. Alternating the *Sheng* and *Cheng* digit order

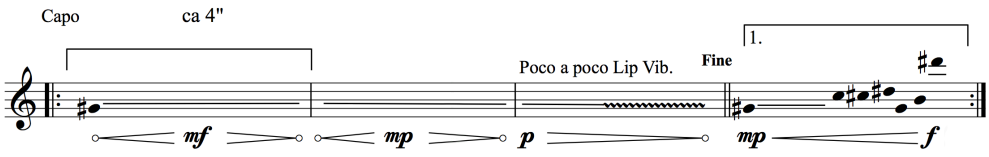
In *Yang* direction:

The other method, which can increase the numbers of notes in a pitch class, is alternating the *Sheng* and *Cheng* digit together. In other words, the order should be the 1st *Sheng* digit, the 1st *Cheng* digit, the 2nd *Sheng* digit, the 2nd *Cheng* digit etc. 3,8,2,7,3,8,1,6. Convert them into intervals with *Yang* direction will be:

Yang process (Ascending).

C (Fundamental)	Eb m3rd	B m6th	C# M2nd	G# P5th	B m3rd	G# M6th	A m2nd	D# T3

The B note is repeated and G# as well as the enharmonic the Eb and the D# is generated here, so here is a six-note pitch class: C, C#, D#, G#, A, B. This pitch class is used in example 2-9.



Example 2-9 Y.B. Wan: Five miniatures for flute solo (2014), the 2nd miniatures

mm.1-4

***Yin* direction:**

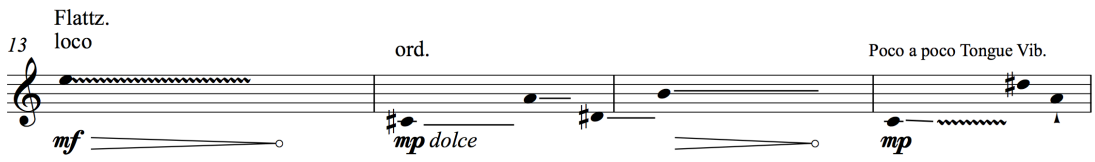
One can also generate the other pitch class by the same principle in *Yin* direction:

Yang process (Ascending).

Yin process (descending)

C (Fundamental)	Eb m3rd	B m6th	C# M2nd	G# P5th	B m3rd	G# M6th	A m2nd	D# T3
A m3rd								
C# m6th								
B M2nd								
E P5th								
C# m3rd								
E M6th								
D# m2nd								
A T3								

The notes E, A, and C# are duplicated. Hence, there is a six-note pitch class: C, C#, D#, E, A, B. Example 2-10 illustrate the used of this pitch class.



Example 2-10 Y.B. Wan: Five miniatures for guitar solo (2015), the 2nd miniatures mm.13-16

iv. Alternate the *Cheng* and *Sheng* digit order

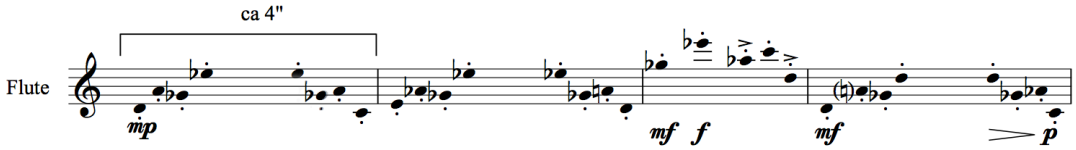
In *Yang* direction:

The Cheng and Sheng digit are 8,7,8,6, 3,2,3,1. Concert it into intervals will be:

Yang process (Ascending).

C (Fundamental)	Ab m6th	Eb P5th	C M6th	Gb 3T	A m3rd	B M2nd	D m3rd	Eb m2nd

Eb and C are duplicated here, so there is a seven-note pitch class:
C, D, Eb, Gb, Ab, A, and B. In my opinion, the sound of this pitch class can very lyrical and poetic in a wind instrument. (Example 2-11)



Example 2-11 Y.B. Wan: Five miniatures for flute solo (2014), the 3rd miniatures mm.1-4

In *Yin* direction:

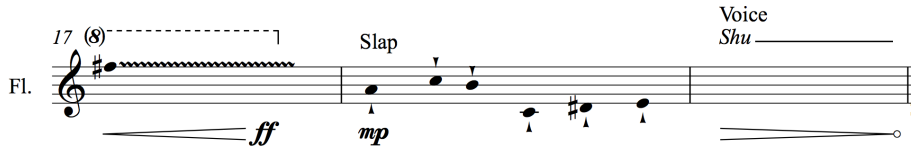
Yin process (descending)

Yang process (Ascending).

C (Fundamental)	Ab m6th	Eb P5th	C M6th	Gb 3T	A m3rd	B M2nd	D m3rd	Eb m2nd
E m6th								
A P5th								
C M6th								
F# 3T								
D# m3rd								
C M2nd								

B
m2nd

C is duplicated three times here, as a result, there is a six-note pitch class: C, D#, E, F#, A, B. In example 2-12 will be used to illustrate how this pitch class works in a flute solo piece.



Example 2-12 Y.B. Wan: Five miniatures for flute solo (2014), the 3rd miniatures mm.17-19

2.7 Solutions for avoiding generate (a) repeated note(s) in the pitch class

As has been illustrated in the previous examples, the trigrams generate repeated note(s) in the pitch class occasionally. In order to use the system fully as well as more precise to build up pitch classes by the trigrams, we need to avoid generating duplicated note(s). I have found several methods to settle this problem.

i Use of changing line(s):

Changing line (review 1.3) means the result of three heads or three tails. The *Yau*[25] indicates with a cross before the line: ×⚊ ⚊ or ×⚋ (*Yin* and *Yang* accordingly). For example, if I have the result: ䷀ it's original element was metal and the numbers of *Sheng* and *Cheng* are 3 and 8 (Sheng and Cheng digit accordingly), while I convert the changing line from *Yang* to *Yin*, the trigram will become: ䷊ and it's element is fire. Meanwhile, the numbers of *Sheng* and *Cheng* change into 2 and 7. Hence, I can convert the different numbers convert to different intervals in order to generate the different notes.

If there is no changing line in the trigram, one must use the other two solutions below.

[25] Lin Yutang (林語堂). 1973. *Chinese-English Dictionary of modern usage*. Chinese-English Dictionary of Modern Usage, Hong Kong Chinese University.

ii Shift the *Cheng* number to *Sheng* or the opposite operation

In order to avoid generating duplicated notes, I can simply change the *Cheng* number to *Sheng* number or in opposite way. For example, the pitch class below was generated by *Cheng* digit in *Yin* direction:

C (Fundamental)
E m6th
A P5th
C M6th
G# 3T

Here the "C" is repeated; hence, the need to change the 8 to 3 (from *Cheng* to *Sheng* digit), the numbers are: 8,7,3,6. As a result, the new pitch class would be:

C (Fundamental)
E m6th
A P5th
F# m3rd
C 3T

C (Fundamental)
E m6th
A P5th
F# m3rd
F m2nd

The "C" is duplicated, so we need to change the "6" to "1" in order to have a different note.

Finally, we didn't change any result from *Bagua*, but also can have a new pitch class without any duplicated note: C, E, F, F#, A

iii Yin to *Yang* or *Yang* to *Yin*

The last method is to change the direction for avoiding generate a repeated note. I will use the pitch class from chapter 2.7-ii as an example, the numbers are 3,2,3,1,8,7,8,6.:

C (Fundamental)
A m3rd
G M2nd
E m3rd
Eb m2nd
G m6th
C P5th
E m6th
Bb 3T

Here have G, C, and E is duplicated. So the direction needs to change here to *Yang* from the "Eb"

C (Fundamental)				
A m3rd				
G M2nd				
E m3rd				
Eb m2nd	B m6th	F# P5th	D m6th	G# 3T

Ultimately, we have a nine-note pitch class with no repeated note: C, D, Eb, E, F#, G,

G#, A, B. We have discovered how to build up a pitch class by using *Wu Xing* sequence, *Yin Yang* and *Bagua* with different methods. In the following chapter we will emphasis on how to generate the 'vertical' element (chords) for composing music by the same principle.

3. Chords build over the Wu Xing sequence by Bagua with Yin Yang and Wu Xing Sequence

In this chapter, I focus on how to build up chords by using *Bagua* from *the three-coin method*. I will use the same elements as building pitch class. Those are: *Bagua*, *Wu Xing* and its sequences, *Sheng* and *Cheng* digit.

3.1 Building chords by *Bagua, Sheng* digit and *Yang*

First of all, I would like to show how to build a chord through *Bagua* and *Sheng* digit and *Yang's* concept. Generally speaking, the more trigrams (*Gua*) used for generating, the more notes there can be in a chord. In order to make the description as clear as possible, I would use the simplest examples and using only two trigrams for building a triad chord.

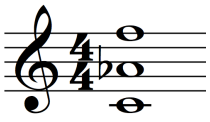
Initially, a pitch class for building chord is needed. The five-note pitch class below is taken from chapter 2.4: C, Eb, F, Ab, B. We will use the same pitch class as an example for the entire chapter 3.

We can convert the pitch class into numbers by their order:

Yang's direction

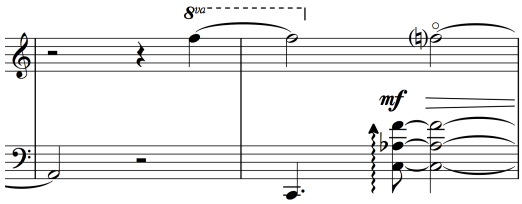
1	2	3	4	5
C	Eb	F	Ab	B

After that, the three-coin method can be used to generate *Bagua.* For instance, the result is: ☲☳ those are Metal and Fire (review *Bagua* in chapter 1.3). Next, I can transfer those elements into *Sheng* digit: 3, 2. *Yang* means positive,[26] therefore, the additive method is used to generate the chord. Any note of the pitch class can be used as the fundamental note. In this example, I let the first note "C" / number "1" as the fundamental note, 1+3 = 4(Ab) and 1+2=3(F);
Thus the triad chord: C, Ab, and F



This chord is used in example 3-1.

[26] Elizabeth Rochat De La Vallee. 2009. *Wu Xing, Five element.* Redwing Book Co.



Example 3-1 Y.B. Wan: Falling petals fill the atmosphere obscuring the moon for Harp solo (2015), mm. 5-6

3.2 Building chords by *Bagua, Sheng* digit and *Yin*

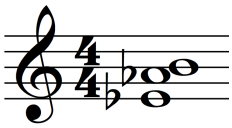
Regarding to the same principle, I can involve the *Yin. Yin* represents positive;[27] thus, the subtractive method can be used to process the chord. Let the second note "Eb" number "2" as the fundamental note as above, 2-3 = -1 and 2-2= 0;
It is clearly seen that I need to convert the table into minor:

Yin's direction

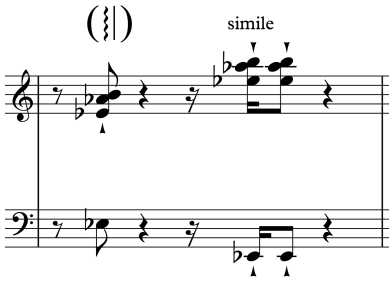
←

Yin	1	-3	-2	-1	0
Yang	1	2	3	4	5
Notes	C	Eb	F	Ab	B

Thus we have a triad chord: Eb, Ab, and B



In example 3-2 I had used this chord to compose a harp solo.



EXAMPLE 3-2 Y.B. Wan: Falling petals fill the atmosphere obscuring the moon for Harp solo (2015), m. 42

[27] Elizabeth Rochat De La Vallee. 2009. *Wu Xing, Five element.* Redwing Book Co.

3.3 Building chords by *Bagua, Cheng* digit and *Yang*

Now, I will use the same principle applied to *Cheng* digit to construct a chord. As was seen in the introduction, *Cheng* digit is numbers between 6-10; hence, the extension of the table is necessary.

The compilation of table extension by *Yang*

I can extend the table by their attribute (*Yin* or *Yang*) and follow the direction to continue the order of numbers:

***Yang's* direction**

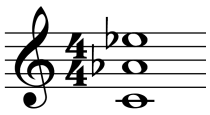
First roll	1	2	3	4	5
Extension	6	7	8	9	10
Pitch class	C	Eb	F	Ab	B

Likewise, I can even extend bigger values for the need of generation:

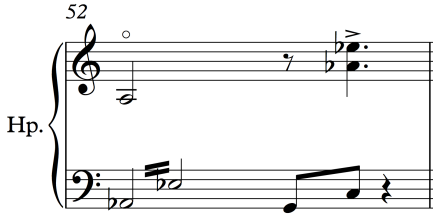
First roll	1	2	3	4	5
Extension 1	6	7	8	9	10
Extension 2	11	12	13	14	15
Pitch class	C	Eb	F	Ab	B

To use the same example of *Bagua*: ☰☲ those are Metal and Fire, which means their *Cheng* digit are 8 and 6. Let the first note "C" number "1" as the fundamental note, 1+8 = 9(Ab) and 1+6=7(Eb);

Thus the triad chord is: C, Ab, and Eb



This chord is employed in example 3-3



Example 3-3 Y.B. Wan: Falling petals fill the atmosphere obscuring the moon for

Harp solo (2015), m. 52

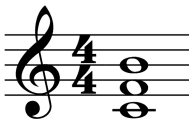
3.4 Building chords by *Bagua, Cheng* digit and *Yin*

Finally, I will apply the *Yin* to process a chord with *Cheng* digit. The extension of the table by *Yin* will be:

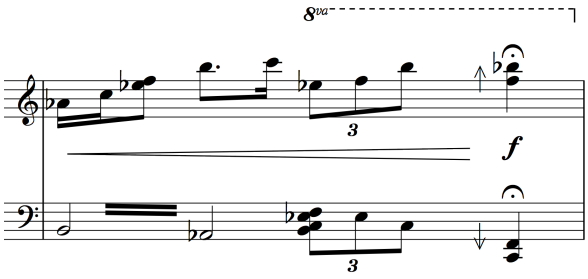
***Yin's* direction**

First roll	1	2	3	4	5
Extension 1	-4	-3	-2	-1	0
Extension 2	-9	-8	-7	-6	-5
Pitch class	C	Eb	F	Ab	B

Let the first note "C"/ number "1" as the fundamental note and then use the subtractive method for the generation: 1-8 = -7 (F) and 1-6=-5(B);
Thus the triad chord is: C, F, and Bb



In example 3-4 will be used to illustrate how this chord works.



Example 3-4 Y.B. Wan: Falling petals fill the atmosphere obscuring the moon for harp solo (2015), m. 56

4. Application of the *Wu Xing* numbers to construct parameters for controlling timbres and structure:

I have discussed how to build pitch classes and chords in the last two chapters. This chapter will skip the music creation and move towards to the digital effect processing in order to demonstrate how to apply the *Wu Xing* sequence in the electroacoustic composition. It will concentrate on to make use of *Wu Xing* sequence to construct the parameters for changing sounds' timbres (such as EQ, dynamic, and pan).

To illustrate the method simply; I will use the following compositional example - Y.B. Wan: No title for fixed media, 2015. In this example, I use only two kinds of materials for compositing, which are basic components for music composition: "fast attack" gestural materials and textural materials that sound continually with relatively longer durations. Since the length of the piece is two minutes only, I needed to minimize the materials in order to avoid too many ideas in this short piece. In my opinion, four gestural materials and four textural materials are suitable for composing the piece.

Gestural materials:
There are four different "fast attack" gestural materials (G) below:
G1: Fast Glissando on the harp in the low register. (CD track 1)
G2: Fast Glissando on the harp in the high register. (CD track 2)
G3: Winding sounds of a music box (CD track 3)
G4: A hit on a metallic surface (CD track 4)

Textural materials:
Those textural materials (T) durations are between 40 and 56 seconds. All of them were recorded in the open spaces:
T1: It was recorded in a marketplace. (CD track 5)
T2: On a tram in Central, Hong Kong (CD track 6)
T3: City center with noise from construction, transports, passers-by and traffic light. (CD track 7)
T4: Conversation between two people on a ferry. (CD track 8)

4.1 Applying *Wu Xing's* sequence to construct parameters of timbres

One can apply *Wu Xing* sequence in order to control the timbres of the materials by changing the parameters. There are a number of processors and filters can change the colors of sounds; nonetheless, so as to make the explanation clear, I will only use several the most common and basic effects for the examples. Those are: reverb, equalizer (EQ), pan, distortion, volume (output), and phaser.

First of all, different materials need to be generated from the original recording for the composition. I will generate five new tracks from each gestural material with different timbres and qualities by changing the parameters.

G1:

In terms of G1, EQ and distortion are applied. I will use the "*Mutual Conquest*" order (review introduction) with both *Sheng* and *Cheng* digit for mapping the parameter. Thus: EQ: 1, 2, 3, 4, 5 and distortion: 6, 7, 8, 9, 10. After that, those numbers for the parameters need to be matched. For the EQ, I define five points in the frequency, those are: 50, 200, 800, 3200 and 12800. The vales are four times bigger than the previous one in order to equalize the parameters. We put 10 dB louder for each point with medium Q/bandwidth to achieve a more significant result; therefore, the five different EQ for "G1" will be:

New materials	G1-i	G1-ii	G1-iii	G1-iv	G1-v
Frequency enhanced	50 Hz	200 Hz	800 Hz	3200 Hz	12800 Hz

For the distortion, I can just simply use the amount of the distortion (%) to match the *Cheung* numbers (6, 7, 8, 9, 10); thus the amount of each "G1" will be:

New materials	G1-i	G1-ii	G1-iii	G1-iv	G1-v
Amount of distortion	60%	70%	80%	90%	100%

Finally, I have five new materials from the original G1:

New materials	G1-i (CD track 9)	G1-ii (CD track 10)	G1-iii (CD track 11)	G1-iv (CD track 12)	G1-v (CD track 13)

Frequency enhanced	50 Hz	200 Hz	800 Hz	3200 Hz	12800 Hz
Amount of distortion	60%	70%	80%	90%	100%

Likewise, one can apply the same principle and notion to generate new materials from G2 to G4 below:

G2:

Audio effects: Pan, volume and EQ

Wu Xing Sequences: Combine *Sheng* and *Cheng* in Mutual conquest order (refer to the table below) for the pan and volume. Mutual Generation is used for the EQ.

New materials	G2-i	G2-ii	G2-iii	G2-iv	G2-v
Pan	6	2	8	4	10
Volume	1	7	3	9	5
EQ	4	2	5	1	3

* *Sheng* digit ; *Cheng* digit

Converting the numbers into parameters' control:

Pan	1	2	3	4	5	6	7	8	9	10
	R100	R80	R60	R40	R20	L20	L40	L60	L80	L100
Volume	10%	20 %	30%	40 %	50%	60 %	70 %	80 %	90 %	100 %
EQ (Hz)	1	2	3	4	5					
	50	200	800	3200	12800					

Finally, use those references to generate the new materials:

New materials	G2-i (CD track 14)	G2-ii (CD track 15)	G2-iii (CD track 16)	G2-iv (CD track 17)	G2-v (CD track 18)
Pan	L20	R80	L60	R40	L100
Volume	10%	70%	30%	90%	50%

Frequency enhanced	3200 Hz	200 Hz	12800 Hz	800 Hz	50 Hz

G3:

Audio effects: Reverb and pan

Wu Xing Sequences: Retrograde Mutual conquest, *Cheng* digit for reverb and *Sheng* number for pan.

Reverb	10	9	8	7	6
Pan	5	4	3	2	1

Converting the numbers into parameters' control:

Reverb (mix)	1	2	3	4	5	6	7	8	9	10
	10%	20 %	30%	40 %	50%	60 %	70 %	80 %	90 %	100 %
Pan	1	2	3	4	5	6	7	8	9	10
	R100	R80	R60	R40	R20	L20	L40	L60	L80	L100

Base on the table above, new materials can generated from the recording G3:

New materials	G3-i (CD track 19)	G3-ii (CD track 20)	G3-iii (CD track 21)	G3-iv (CD track 22)	G3-v (CD track 23)
Reverb	100%	90%	80%	70%	60%
Pan	R20	R40	R60	R80	R100

G4:

Audio effects: EQ

Wu Xing Sequences: Retrograde Mutual conquest of *Sheng* digit (5, 4, 3, 2, 1).

Referring to the transformation between numbers and EQ in the previous examples, the new materials are:

New materials	G4-i (CD track 24)	G4-ii (CD track 25)	G4-iii (CD track 26)	G4-iv (CD track 27)	G4-v (CD track 28)
Frequency enhanced	12800 Hz	3200 Hz	800 Hz	200 Hz	50 Hz

Similarly, I will apply the same method to the textural materials T1- T4 in order to make the sounds more interesting by changing the timbre of the track[28]; nonetheless, since the duration of the textural materials are way longer than the gestural materials, I would change the parameters within the track instead of generate new materials.

T1:

Audio effects: Reverb and volume

Wu Xing Sequences: Mutual Generation order, *Sheng* digit for the reverb and *Cheng* digit for the volume.

Intervals: The total duration of the recording is 48", 48/5=9.6; therefore each section's length is 9.6 seconds. So as to make the changing of parameters smoothly, we use 1.6" fading between each section and fading out of volume from 43.5".

T1 (CD track 29)						
Section		1	2	3	4	5
Time (second)		0-9.6	9.6-19.2	19.2-28.8	28.8-38.4	38.4-48
Reverb	S.D.	4	2	5	3	1
	Mix.	40%	20%	50%	30%	10%
Volume	C.D.	9	7	10	8	6
	Output	90%	70%	100%	80%	60%

*S.D. = *Sheng* Digit; C.D. = *Cheng* Digit

T2:

Audio effects: Distortion

Wu Xing Mutual Conquest with *Sheng* digit and the first *Cheng*

[28] Audio channel

Sequences: digit (6)

Intervals: The duration of the recording is 56, but I will use the first 48" only, 48/6 = 8; as a result, the duration of each section is 8 seconds. I spend 1.6" fading between each section and fading out of volume from 48" to. 56" to make the track sounds fluent.

T2 (CD track 30)							
Section		1	2	3	4	5	6
Time (second)		0-8	8-16	16-24	24-32	32-40	40-48
Distortion	S.D + C.D	1	2	3	4	5	6
	Amount	10%	20%	30%	40%	50%	60%

T3:

Audio effects: Volume, pan, and phaser

Wu Xing Sequences: Mutual conquest combines *Sheng* and *Cheng* digit for the volume (review the G2-volume), the Mutual generation with *Cheng* digit for the pan as well as retrograde Mutual conquest with *Sheng* digit for the phaser.

Intervals: The length of this recording is 40", 40/5 = 8. As a result, the duration of each section is 8 seconds. In contemplation of creating the dramatic effect, we will not use the fading between sections except the volume because of the technical reason.

T3 (CD track 31)						
Section		1	2	3	4	5
Time (second)		0-8	8-16	16-24	24-32	32-40
Volume	S.D.	1	7	3	9	5
	Output	10%	70%	30%	90%	50%
Pan	C.D.	9	7	10	8	6
	L/R	L80	L40	L100	L60	L20
Phaser	S.D + C. D	50%	40%	30%	20%	10%
	Mix	5	4	3	2	1

T4:

Audio effects: Pan and distortion

Wu Xing Sequences: Mutual generation with *Sheng* digit for the pan and retrograde Mutual conquest with *Sheng* digit for the distortion.

Intervals: The duration of this track is 40”, 40/5 = 8, the duration of each section of T4 is 8 seconds. In order to make the track sounds very smoothly, two seconds are used for fading between sections. At the end of this section, the fade out of the volume will be even longer (from 35”-40”)

T4 (CD track 32)						
Section		1	2	3	4	5
Time (second)		0-8	8-16	16-24	24-32	32-40
Pan	S.D.	4	2	5	3	1
	L/R	R40	R80	R20	R60	R100
Distortion	S.D.	5	4	3	2	1
	Amount	50%	40%	30%	20%	10%

4.2 Applying the *Wu Xing's* sequence and *Bagua* to design the formal structure*:*

Now, there are twenty-four “new” materials for the music composition, this section will describe how to cooperate with the *Wu Xing*’s sequence and *Bagua* to construct the form and decide the order of each materials appearing.

Initially, the piece is starting with both G1-i and T1. After that, a *Bagua* is generated by the three-coin method: ☷ which represents the Earth (5,10). The length of the piece is two minutes (120”), now there are 2 different numbers here and one can choose either *Sheng* or *Cheng* digit freely for constructing the form; furthermore, I should build up the relationship between the numbers here 120 (seconds) divide by

5 (*Sheng* digit) equals 24. So, I can put G1-i to v to the composition in the interval of 24 seconds (0, 24, 48, 1:12 and 1:36):

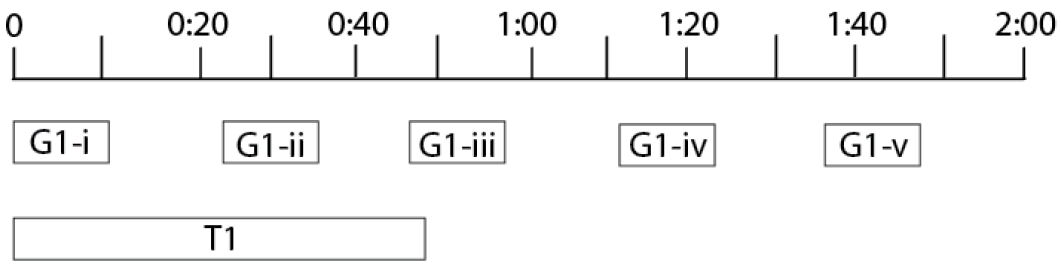


Diagram 4-1

The other *Bagua* is generated for G2: ☲ it acts for the fire, (2,7). Next, I use the Mutual conquest *Sheng* digit to build up the intervals for G2: 1, 2, 3, 4, 5 multiply 7 (*Cheng* digit of fire) = 7, 14, 21, 28, 35. Thus the G2-i to G2-v will be arranged as below (at 7", 14", 21", 28", 35"):

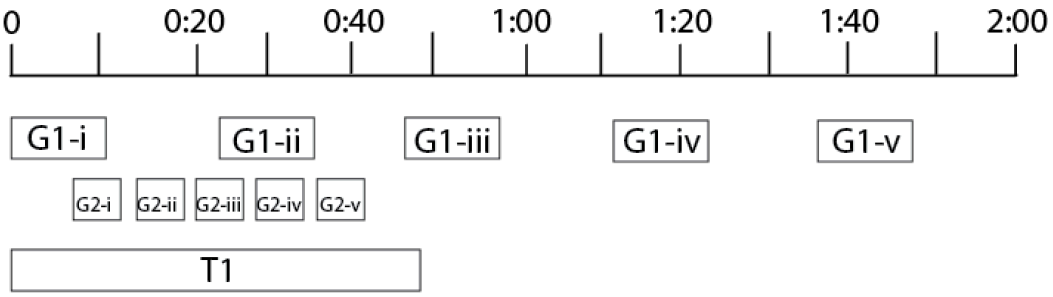


Diagram 4-2

In terms of T2, wIe will put it after G2-i in order to develop the dynamic and harmonic texture growing. We have the *Bagua* ☷(the earth: 5, 10) again, so we will put it 5 seconds (*Sheng* digit) after G2-i:

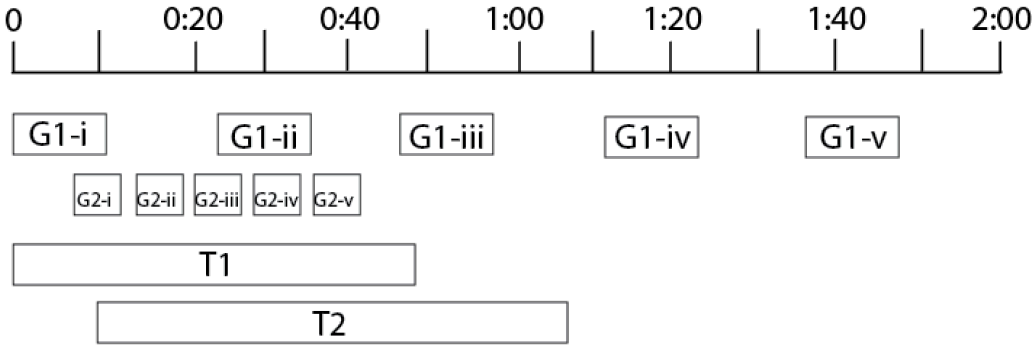


Diagram 4-3

Then, I need to arrange the position of G3. I have the Bagua ☷ which equals earth (5,10). Consequently, the interval between G3-i and G3-v is 5 seconds. I will put it

next to the T2 for developing and enriching the musical idea, I will make the relationship between the *Sheng* and *Cheng* digit to decide where the G3i-v start: 5/10 = ½ (half), so, G3 starts in the middle of T2

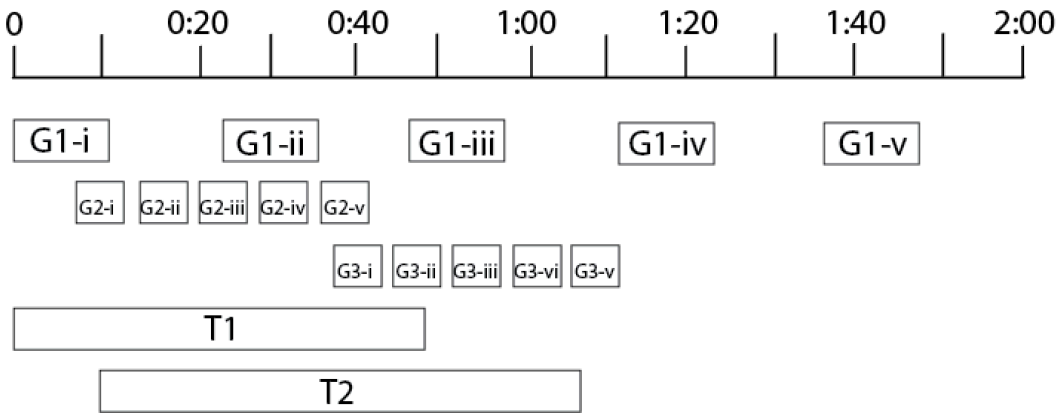


Diagram 4-4

I have the *Bagua* ☲ it acts for the fire, (2, 7) for T3, hence the T3 will start 2 seconds after the G3:

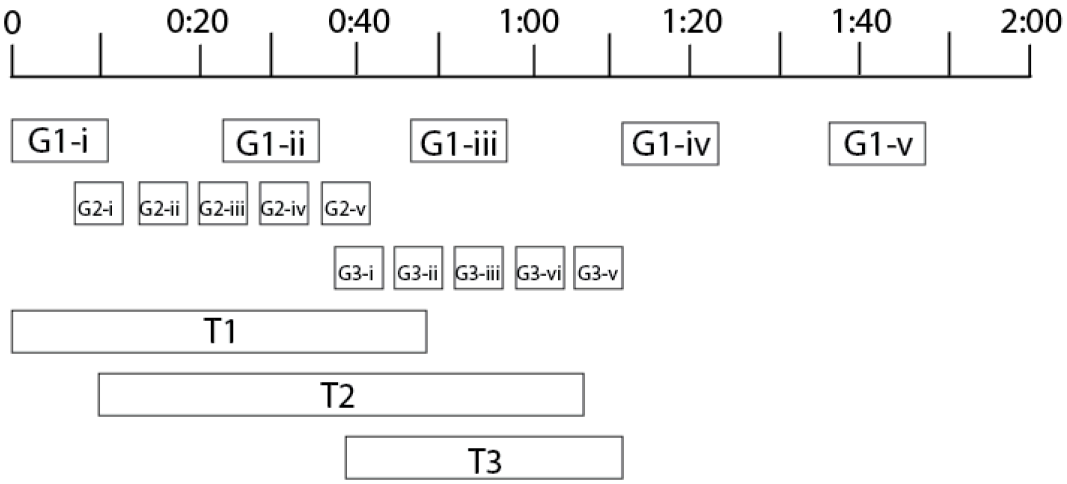


Diagram 4-5

G4 follows the T3 and we have the *Bagua* for it: ☵ which represent water (1,6). So, I will use the *Sheng* digit (1) to decide puting the G4 a second after T3 is started. In order to avoid the piece sounds mechanic, I will apply the Mutual conquest with *Sheng* digit to create an uneven interval for G4. The intervals between G4-i and G4-v are 1”,2”, 3”, 4”, and 5”:

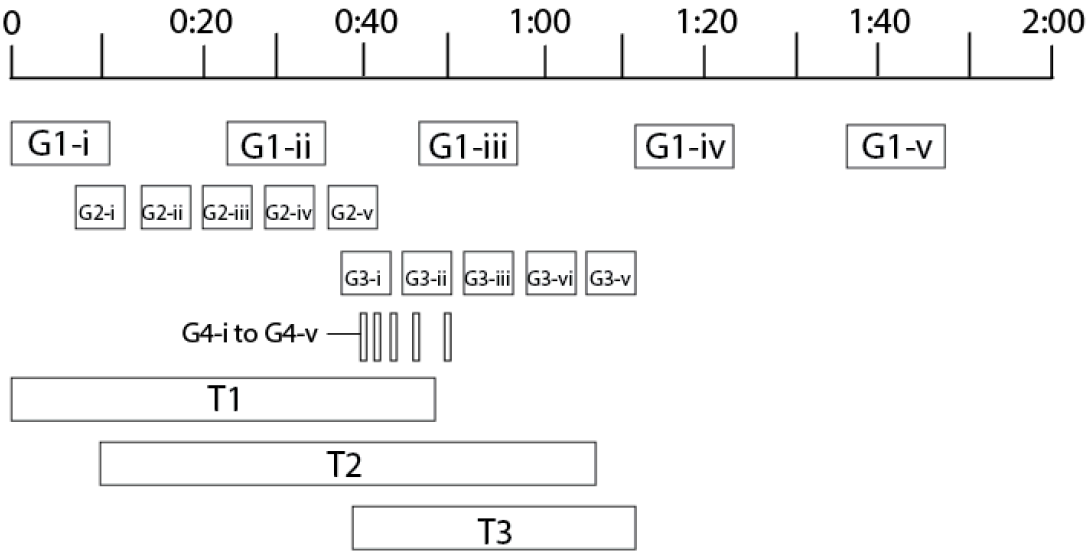


Diagram 4-6

The last material we have is T4, the *Bagua* ☳ which is equivalent to earth (5,10) was generated. I will use the *Cheng* digit (10) to decide the position of T4. It will be 10 seconds after G4-v:

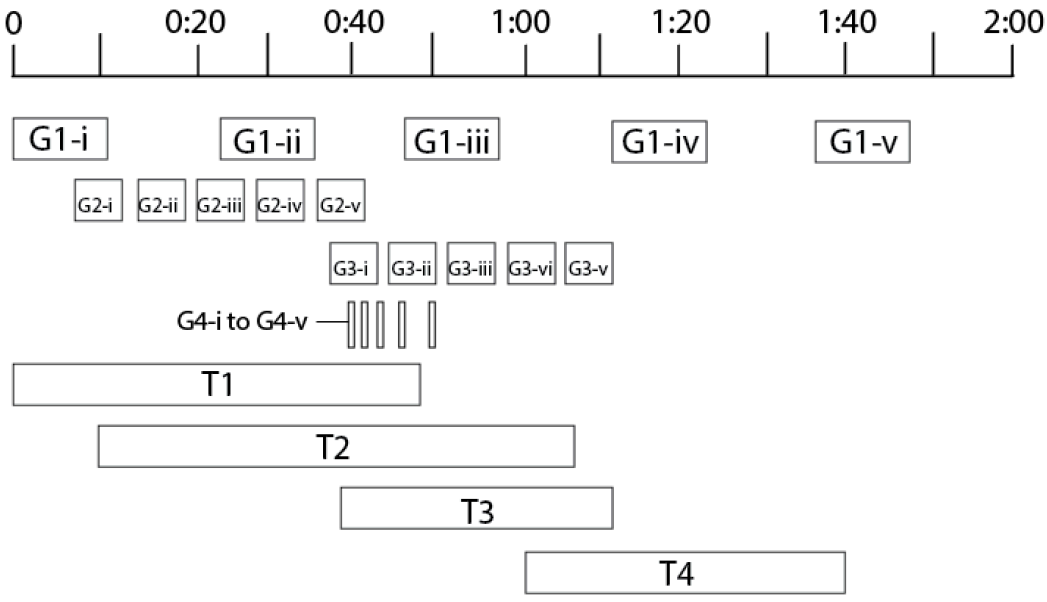


Diagram 4-7

Refer to the diagram, it is clearly seen that one can't complete the piece with the expected duration (2 minutes) and only a few materials will sound at the end of the piece, we need fulfill three tasks: to fill the gap here, extend the piece until 2:00 plus generate a new textural layer to support the gesture materials.(G1-v)

I can apply the concept of *Yin* here with the T1. Let's say the original T1 is *Yang*, I need to make it becomes *Yin* by reversing it and put it at the end of the piece so as to make the piece ending efficiently; moreover, I can make the structure more coherent since the beginning and the end are the same elements (G1 and T1). The long fading out is applied to make the piece ending naturally:

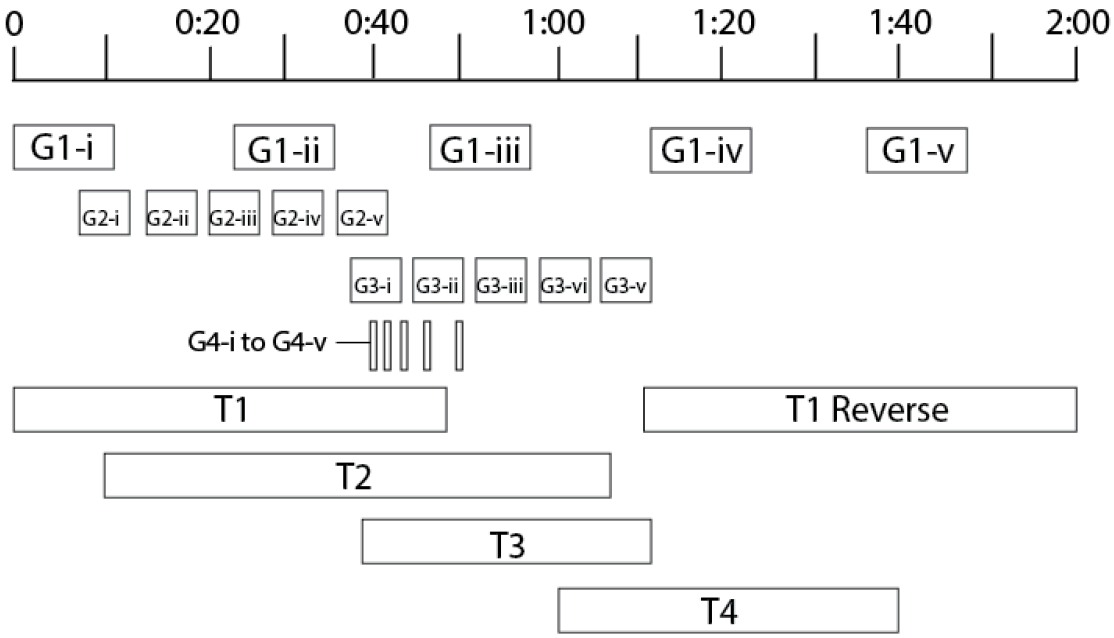


Diagram 4-8
(CD track 33)

After it is clear how to compose an electroacoustic piece, it is time to think about how to "perform" it in a concert. The following chapter will discuss how to create the sound diffusion with the numerical system.

5. Strategy of the spatial sound diffusion using *Yi Yang, Wu Xing* and *Bagua*:

This chapter will focus on refining my diffusion system by using the *Yin Yang* and *Wu Xing* numerical system cooperated by different trigrams in order to achieve the desired spatial effect and "poetic mood."

I will use a piece of mine: *Yomi* (黃泉, 2015/ CD track 38, stereo version), fixed media for the 10.1 multichannel system (Front left, Front right, Front left center, Front right center, Side left, Side right, Black left, Black right, Back left center, Back right center, and LFE/subwoofer) as an example for this chapter. In order to get the desired spatial effect vividly, I need to apply the *Cardinal Direction (方位) of Bagua* to control the sound diffusion of the piece.

As I mentioned in the beginning, the *Bagua* is an essential tool in the majority of *Feng Shui* schools. The *Bagua* used in *Feng shui* can appear in two different versions with different orders and directions of trigram: the Earlier Heaven *Bagua* which was invented by *Fu Xi(伏羲)*, used for burial sites and the Later Heaven Bagua, used for the residences. In my spatial system, I use the Earlier Heaven Bagua.

Based on the *Fu Xi* "Earlier Heaven" *Bagua* (*伏羲先天八卦*) order and theory, each trigram has their own "*Cardinal Direction"*. Diagram 6-1 represents the position of *Fu Xi* "Earlier Heaven" *Bagua.*[29]

Northwest ☶ 艮 **Gèn**	**North** ☷ 坤 **Kūn**	**Northeast** ☳ 震 **Zhèn**
West ☵ 坎 **Kǎn**		**East** ☲ 離 **Lí**
Southwest ☵	**South** ☰	**Southeast** ☴

[29] Xiaochun Sun, Jacob Kistemaker. 1997. *The Chinese Sky During the Han*. Koninklijke Brill, Leiden, The Netherland.

巽 **Xùn**	乾 **Qián**	兌 **Duì**

Diagram 5-1

The duration of *Yomi* is about 5:30; it consists of two textural stereo tracks[30] that sound constantly (only a few pause in it) and two gestural mono tracks.

Tracks	Start from	End	CD track no.
Stereo track 1 (S1)	0:06	5:04	34
Stereo track 2 (S2)	2:39	3:43	35
Mono track 1 (M1)	0:00	5:30	36
Mono track 2 (M2)	0:07	5:21	37

According to the nature of the piece, it can divided it into four sections:

Climax: 2:40-3:26

Sections	I	II	III	IV
Time (0:00)	0:00-2:00	2:00-3:26	3:26-3:55	3:55-5:30

Firstly, we need an "Omni"[31] stereo track to play through so as to create the stability. The first stereo tracks (S1) will play this role.

Afterward, I need to organize those "unstable" sounds' locations and motions for the spatialization. I can use the three-coin method to generate *Bagua* as we have done from the pervious chapters to spatialize the materials poetically in the concert space. In order to create the dramatic effect in the climax, all tracks move circularly though the entire piece except the S2 will move linearly during the climax section.

[30] Audio channels

[31] Omni: in all directions.

5.1 Section I:

M1:

The *Bagua* can be consulted where to place the first mono track (M1) started in section I. I have the result ☲; refer to the *Cardinal Direction* of Earlier Heaven *Bagua*, M1 should start from the south (behind). Now, I need the other trigram to indicate where is the destination: ☴ **-** Southeast. So, M1 should end there.

Now, I have both the starting and ending points; afterwards, I need to get the duration and direction of the rotation. In section I, the dynamic is soft as well as the harmonic texture is thin plus very atmospheric sounds are used, a slow rotation of sounds is appropriate; hence, I can spend the entire length of section I for the motion (two minutes/120seconds) for the rotation from South to Southeast (315 degrees).

In terms of the direction, I can apply *Yang* to M1. Regarding to the theory of *Yin Yang,* the direction of *Yang* should be clockwise.[32] (See diagram 6-2)

Trigram	Duration (seconds)	Direction	Direction of rotation (*Yin Yang*)
☲	120	West (starting)	Clockwise
☴	/	East	/

M2:

For the second mono track (M2), I can employ the same method to generate the starting and ending points. The M2 contains a lot of gestural sounds, in the other words, this track is more kinetic than the M1; consequently, I can decide more points instead of only two. I can also apply *Yin* and *Yang* alternatively with different duration to make it flowing fluently with the sound diffusion:

Trigram	Element	*Sheng* and *Cheng* digit	Direction	Direction of rotation (*Yin Yang*)
☵	Water	1,6	West (starting)	Clockwise
☲	Fire	2,7	East	Anticlockwise

[32] Arnold Keyserling & R.C.L. 2010. *Yin* and *Yang* http://www.chanceandchoice.com/course-overview/yin-and-yang/

☳	Wood	3,8	Southwest (Ending)	/

I can use the *Sheng* digit as a ration to construct the duration of each point: 1:2:3 in 2 minutes/ 120 seconds

Trigram	Duration (seconds)	Direction	Direction of rotation (*Yin Yang*)
☲	20	West (starting)	Clockwise
☱	40	East	Anticlockwise
☳	60	Southwest (Ending)	/

The track will stay in the southwest at the end with the during 60 seconds. Diagram 5-2 illustrate how different tracks move in section I

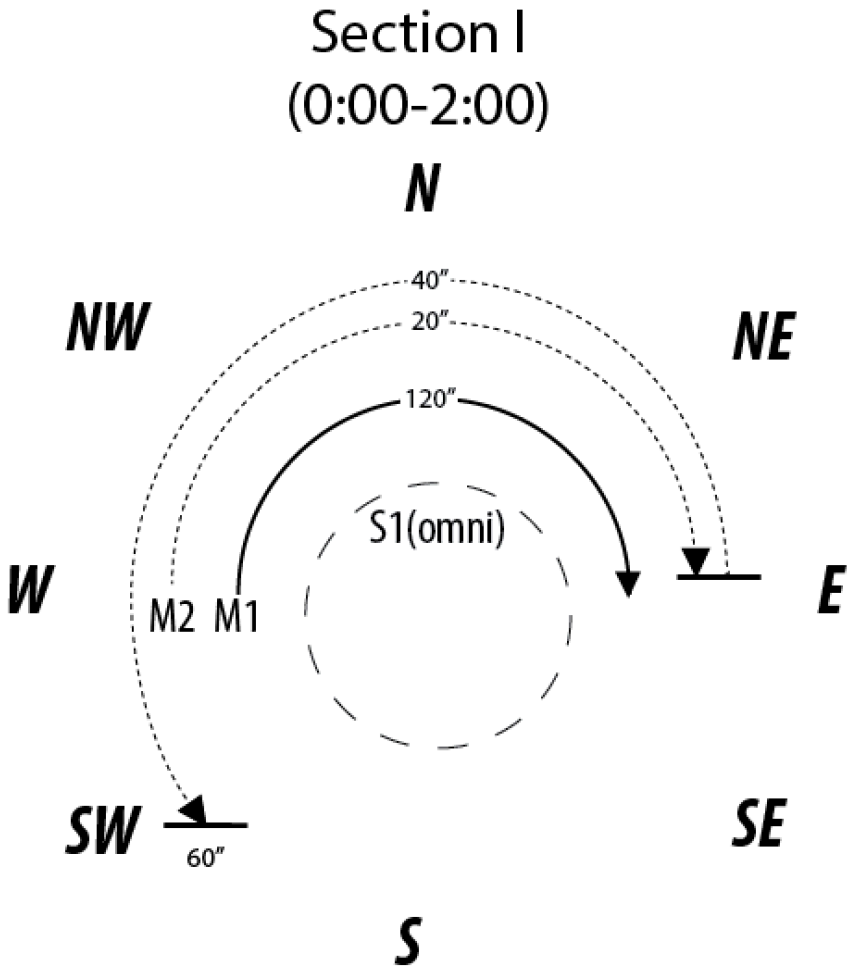


Diagram 5-2

5.2 Section II (climax)

Because the climax is in this section; thus, I will generate more trigrams in order to create more points for the sounds' movement to produce a dramatic effect.

M1:

Trigram	Element	*Sheng* and *Cheng* digit	Direction	Direction of rotation (*Yin Yang*)
☰	Metal	4,9	South	Clockwise
☲	Fire	2,7	East	Clockwise
☶	Earth	5,10	Northwest	Anticlockwise
☰	Metal	4,9	South	/

Duration: 4 : 2 : 5 : 4 (*Sheng* digit) in 1:36 (96")

Trigram	Duration （second)	Direction	Direction of rotation (*Yin Yang*)
☰	26	South	Clockwise
☲	12	East	Clockwise
☶	32	Northwest	Anticlockwise
☰	26	South	/

(See Diagram 6-3)

M2:

Trigram	Element	*Sheng* and *Cheng* digit	Direction	Direction of rotation (*Yin Yang*)
☶	Earth	5,10	Northwest	Clockwise
☰	Wood	3,8	Southwest	Anticlockwise
☵	Water	1,6	West	Clockwise

☳	Wood	3,8	Northwest	Anticlockwise
☰	Metal	4,9	South	/

Duration: 5：3：1：3: 4 (*Sheng* digit) in 1:36 (96")

Trigram	Duration （second)	Direction	Direction of rotation (*Yin Yang*)
☳	30	Northwest	Clockwise
☰	18	Southwest	Anticlockwise
☲	6	West	Clockwise
☳	18	Northwest	Anticlockwise
☰	24	South	/

(See Diagram 6-3)

S2:

The second stereo track (S2) plays a very important role to support the piece growing towards the climax smoothly. The sound diffusion strategy can be used to make it distinctive. S2 will move inside the circle instead of moving around the circle as M1 and M2.

Trigram	Element	*Sheng* and *Cheng* digit	Direction
☵	Water	1,6	West
☱	Metal	3,8	Southeast
☷	Earth	5,10	North
☳	Wood	4,9	Northeast
☵	Water	1,6	West

Duration: 6：8：10：9: 6 (*Cheng* digit) in 1:36 (96")

Trigram	Duration （second)	Direction	Direction of rotation (*Yin Yang*)
☳	15	West	Bottom right
☲	19	Southeast	Top left
☵	25	North	Right
☶	22	Northeast	Bottom left
☳	15	West	/

Diagram 5-3 demonstrates the movements of different tracks in section II (climax).

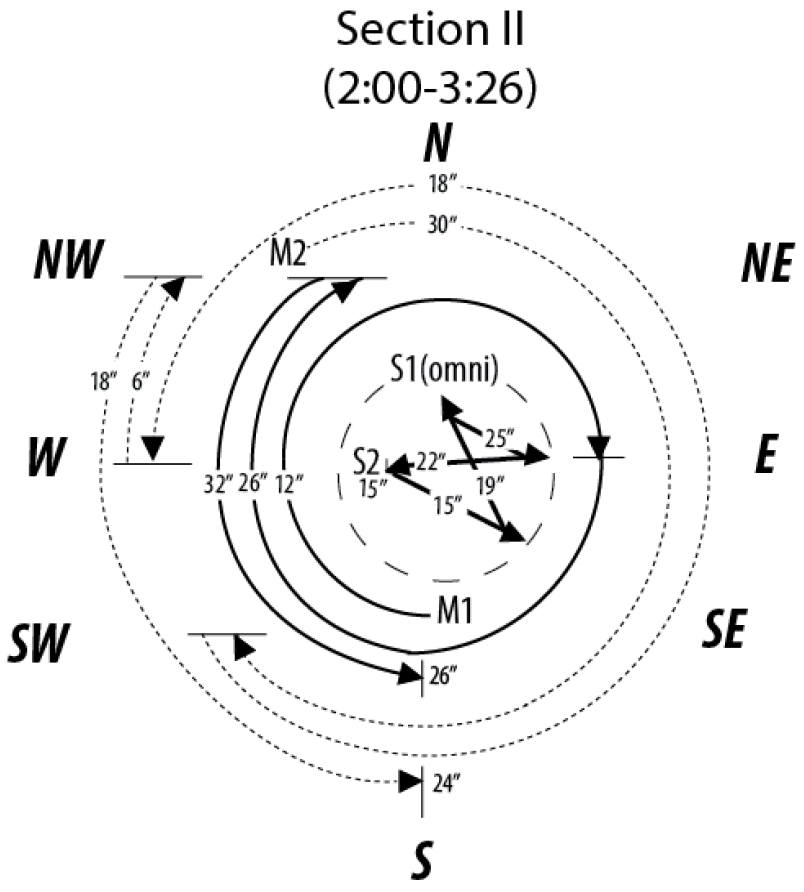


Diagram 5-3

5.3 Section III

The duration of section III is only 29 seconds; therefore, fewer trigrams are needed than in section II so as to make this section stable.

M1:

Trigram	Element	*Sheng* and *Cheng* digit	Direction	Direction of rotation (*Yin Yang*)
☶	Earth	5,10	Northwest	Anticlockwise
☲	Wood	3,8	Southwest	Anticlockwise
☷	Earth	5,10	North	/

Duration: Since the length of this section is 29 seconds, and the sum of *Cheng* digit is very close. (10 + 9 + 10 = 28); so, I will switch the *Cheng* digit to second directly, the only thing I need to do is add "1" second to the destination (North) in order to fit the duration of this section:

Trigram	Duration （second)	Direction	Direction of rotation (*Yin Yang*)
☶	10	Northwest	Anticlockwise
☲	9	Southwest	Anticlockwise
☷	10+1	North	/

M2:

Trigram	Element	*Sheng* and *Cheng* digit	Direction	Direction of rotation (*Yin Yang*)
☲	Wood	3,8	Southwest	Anticlockwise
☰	Metal	4,9	South	Anticlockwise
☵	Water	1,6	West	/

Duration: 3:4:1 in 29 seconds

Trigram	Duration （second)	Direction	Direction of rotation (*Yin Yang*)
☲	11	Southwest	Anticlockwise
☲	14	South	Anticlockwise
☲	4	West	/

Diagram 5-4 shows the moving directions of each track in section III.

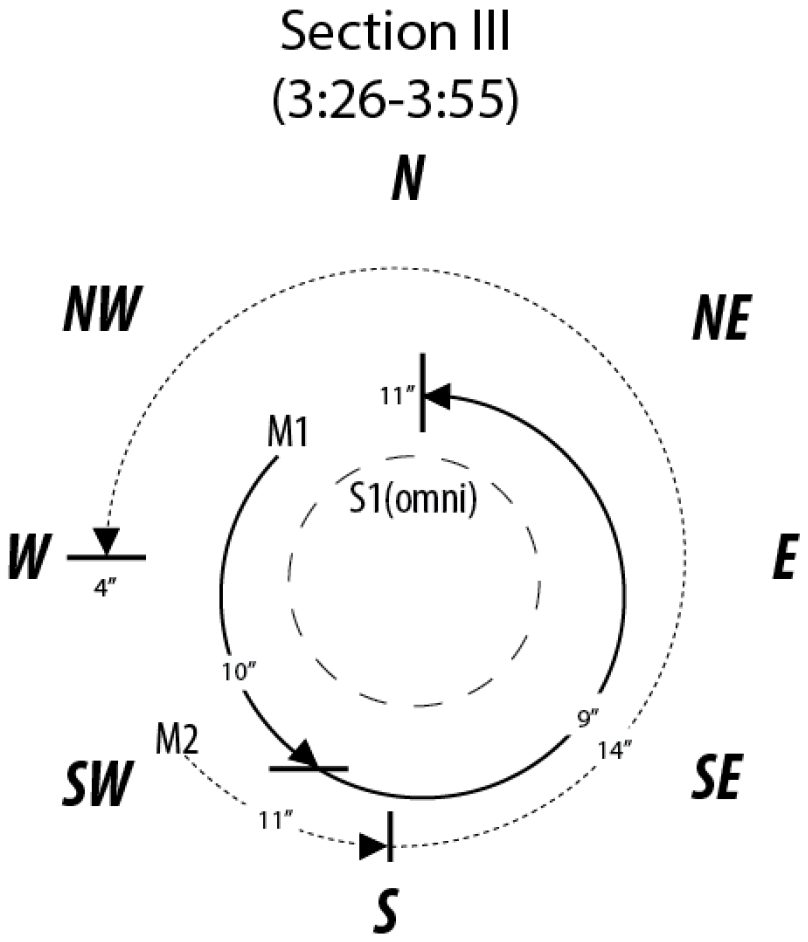


Diagram 5-4

5.4 Section IV

This section is the recapitulation/coda of the piece, regarding to the notion of Charles Burkhart, a coda is required to "look back" on the main body, allow

listeners to "take it all in", and "create a sense of balance."[33]; thus, we can use the same parameters from the "intro"(section I) but make it in the opposite direction. For instance, the direction was from west to east in section I, we will make it from east to west; also, the motion was clockwise, we will turn it to anticlockwise.

M1:

Duration: the duration of this section is 1:45 (105"), one can use the all the duration for the motion as section I did.

Duration (Seconds)	Direction	Direction of rotation (*Yin Yang*)
105	East (Starting)	Anticlockwise
/	West (Ending)	/

M2:

Duration: it was 1:2:3 in section I, I need to retrograde those number 3:2:1, the length of this section is 1:45 (105 seconds), thus the duration will be:

Duration (Seconds)	Direction	Direction of rotation (*Yin Yang*)
52.5	East (Starting)	Anticlockwise
35	West	Clockwise
17.5	Northeast (Ending)	/

Diagram 5-5 illustrates the directions and movements of each track in section IV.

[33] Charles Burkhart. 2005. *The Phrase Rhythm of Chopin's A-flat Major Mazurka, Op. 59, No. 2" in Stein, Deborah*. Engaging Music: Essays in Music Analysis. New York: Oxford University Press.

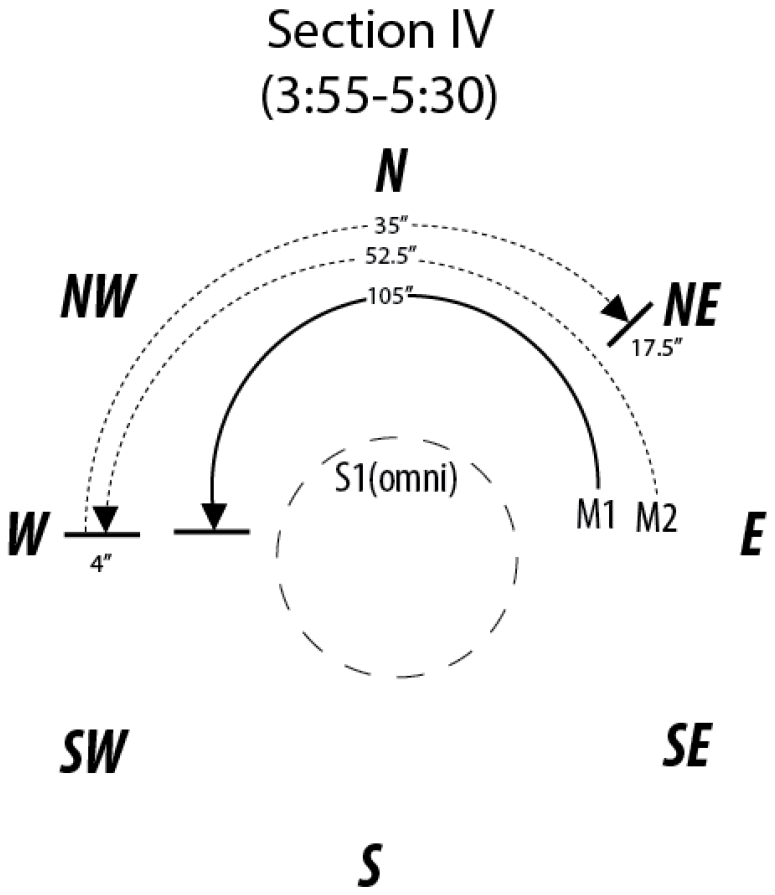


Diagram 5-5

I used this sound diffusion setting to perform this piece on 19.1.2017 in DUP36, Charvátova, Prague. The result was very remarkable and I did satisfy of the sound diffusion in the concert; also, the feedbacks from some audiences were very positive, they told me the spatial effect was very effective as well as the performance made them dream because they could really feel different distances of the sounds while the sounds were moving lively and lyrically around them. In my opinion, this method works effectively and it can be a very powerful musical tool to achieve the desired spatial effect and poetic mood.

Final Note

The system I have introduced in this research by using *Yin Yang, Wu Xing* sequence and *Bagua* for music composition allowed us to employ algorithmic approach to build the pitch classes and chords efficiently. One of the most remarkable features of this system is from the same result of *Bagua,* composers can generate several very different materials, for example from a result, it can build several pitch classes with different intervals and numbers of note; likewise, it can also generate several chords with different qualities and numbers of notes. In other words, thanks to the flexibility of the system, composers can have the freedom to choose the most appropriate materials for the composition. It can make the compositional process much more perceptual.

This system also can apply to the electroacoustic music composition by constructing parameters for controlling timbres and formal structures. It can make the compositional process go more quickly and "surprisingly" since some aspects of the composition are left open to chance. Furthermore, as I said in the last chapter about the feedback of the audiences and my feeling about the sound diffusion in the concert, it proves that the system can contribute to create the sound diffusion around the space smoothly and naturally. It makes different tracks (audio channels) cooperate together in the same aesthetic/musical space fluently.

In my point of view, this system is the best compositional tool for me, as I am attracted to this ability and it helps me to prepare the compositional materials efficiently as well as to organize the overall structures. Also, I can choose very different materials, which are generated by the system. Afterward, I can use it freely in my composition. My system might also be able to find the balance between rationality and sentiment. On one hand, it helps the compositional process not to be overly algorithmic, which may make the composition too systematic and mechanic; on the other hand, it will not only rely on "inspiration" to compose. Those numerical systems methods I mentioned in this thesis are very promising and full of potential to contribute the compositional process.

Recently I have found *The Earthly Branches* very close related the system we have discussed in this thesis: *Wu Xing, Yin Yang* and *Bagua*; additionally, it was constructed by a very detail *Cardinal Directions*[34] (see diagram 6-1) in order to

[34] Raymond Lo. 1992. *Fengshui and Destiny.* Tynron Press, England

follow the orbit of Jupiter, those characteristics are very favorable for building sound diffusion system to create the special spatial environment for electroacoustic performance. Hopefully, I would have a chance to make use of this system to design some strategies of sound diffusion for multichannel performance in the future.

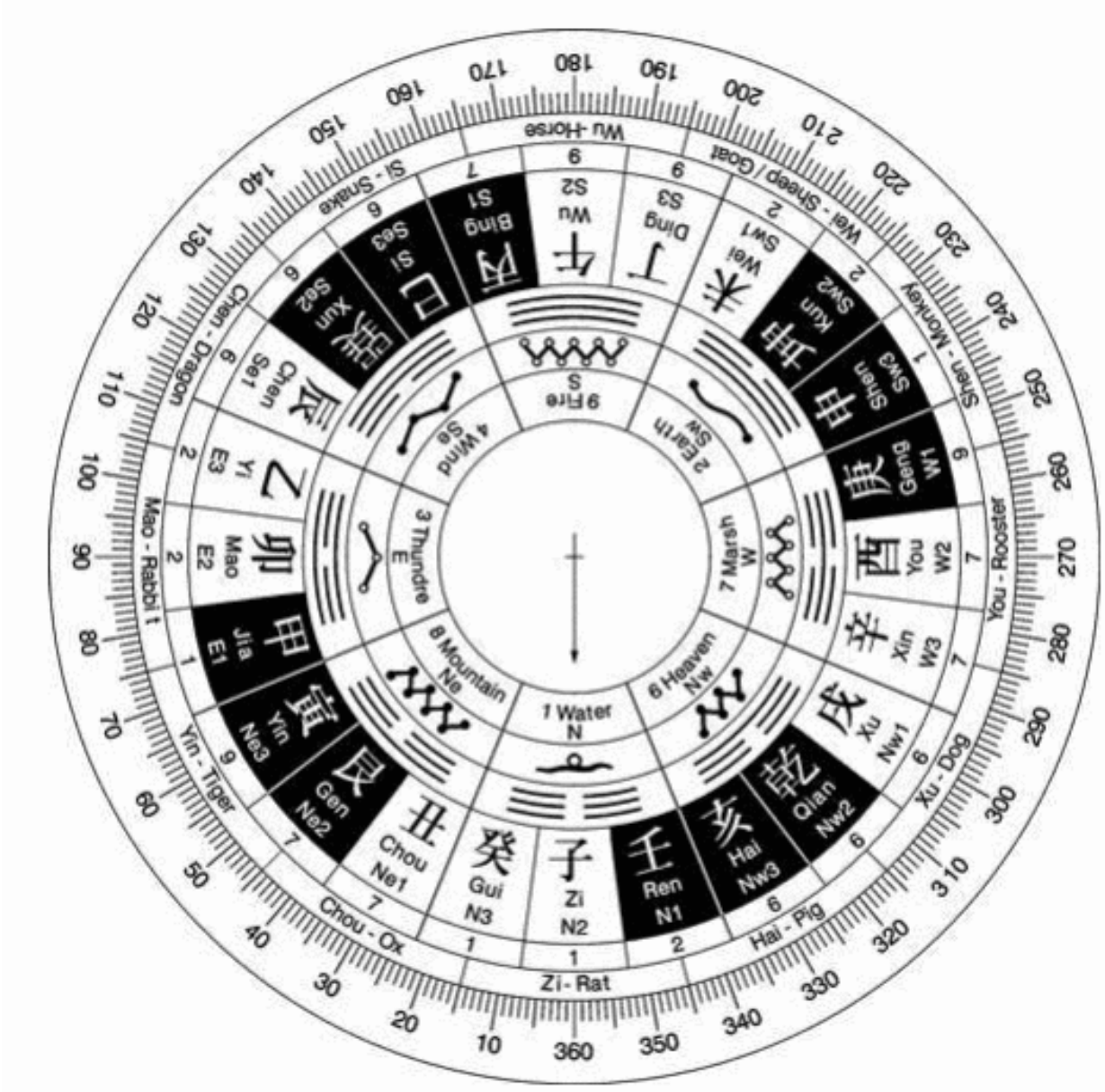


Diagram 6-1

Literature and other sources

King *Wen* of *Zhou*, *Ji Chang* (周文王，姬昌). The 3rd and 2nd millennia BCE. *Yi Jing* (易經\ *Yi Jing's* (Book of Changes) it is one of the oldest of the Chinese classic texts written.

Anonymous. 4 centry BC. *Guoyu(國語)* : Guoyu (The Discourses of the States) is one of the oldest classical Chinese history books that collected the historical records of numerous states from the Western Zhou to 453 BC. Its author is unknown, but it is sometimes attributed to Zuo Qiuming, a contemporary of Confucius. Guoyu was probably compiled beginning in the 5th century BC and continuing to the late 4th century BC. The earliest chapter of the compilation is the Discourses of Zhou.

Zuo Qiuming. Late 4th century BC. Zuo Zhuan (*左傳*/ the Chronicle of Zuo) is among the earliest Chinese works of narrative history, covering the period from 722 to 468 BC. It is one of the most important sources for understanding the history of the Spring and Autumn Period (Chunqiu). Zuo Zhuan is traditionally attributed to Zuo Qiuming, as a commentary to the Spring and Autumn Annals. It was compiled during the Warring States period, with a compilation date not later than *Zuo Zhuan* 389 BC.

Various, compilation traditionally attributed to Confucius. 551–479 BC**.** *Shang Shu* (*尚書*/ The Book of Documents) is one of the Five Classics of ancient Chinese literature. It is a collection of rhetorical prose attributed to figures of ancient China, and served as the foundation of Chinese political philosophy for over 2,000 years.

Lin Yutang (林語堂). 1973. *Chinese-English Dictionary of modern usage*. Chinese-English Dictionary of Modern Usage, Hong Kong Chinese University.

Oliver Messiaen. 1944. *Technique de mon langage musical (The technique of my musical language).* Paris: Leduc. By

Iannis Xenakis. 2001. *Formalized Music: Thought and Mathematics in Composition***.** Hillsdale, NY: Pendragon Press.

Claude V. Palisca and Donald Jay Grout. 2012. *Anthology of Western Music* (ninth edition). NORTON. USA.

Stefan Kostka. 2006. *Materials and Techniques of 20th Century Music" (Third edition).* University of Texas at Austin.

Alpern, Adam. 1995. *Techniques for algorithmic composition of music.* http://alum.hampshire.edu/~adaF92/algocomp/algocomp95.html. Hampshire College.

Grout, Donald Jay and Claude V. Palisca. 1996. *A History of Western Music*. 5th ed. W. W. Norton & Company: New York.

John a. Murer IV. 1999. *A Brief History of Algorithmic Composition*. https://ccrma.stanford.edu/~blackrse/algorithm.html

Richard Kostelanetz. 1973. *John Cage.* Köln: M. DuMont Schauberg.

Richard Kostelanetz. 1988. *Conversing with Cage*. New York: Limelight Editions.

Lendvai, Ernő.1971. *Béla Bartók: An Analysis of His Music.* London: Kahn and Averill. By

Roy Howat. 1983. *Debussy in Proportion: A musical analysis.* Cambridge University Press.

Xiaochun Sun, Jacob Kistemaker. 1997. *The Chinese Sky During the Han*. Koninklijke Brill, Leiden, The Netherland.

James Pritchett. 1993. *The Music of John Cage*, Cambridge University Press.

Roland Barthes.1972. *Mythologies*. (English translation), Hill and Wang, a division of Farrar, Straus and Giroux.

Hannes Hölzl , S&Mt. 2003.*CAN WE CREATE SPACE BY MEANS OF SOUND? – The Quest for the Spatial Dimension in Audio Arts.* Utrecht School of the Arts - Faculty of Art, Media and Technology European Media Master of Arts in Sound and Music Technology

Charles Burkhart. 2005. *The Phrase Rhythm of Chopin's A-flat Major Mazurka, Op. 59, No. 2" in Stein, Deborah*. Engaging Music: Essays in Music Analysis. New York: Oxford University Press.

Maria Anna Harley. 1994. *Space and Specialization in Contemporary Music: History and Analysis, Ideas and Implementations.* Ph.D. Dissertation McGill University, School of Music, Montreal, Quebec, Canada.

Trevor Wishar. 1996. *On sonic art.* Harwood academic publisher.

Richard Rutt. 1996*. The Book of Changes (Zhouyi) A Bronze Age Document*. Richmond: Curzon.

Taylor Latener and Rodney Leon.2005. *The Illustrated Encyclopedia of Confucianism, Vol. 2*. New York: Rosen Publishing Group.

Elizabeth Rochat De La Vallee. 2009. *Wu Xing, Five element.* Redwing Book Co.

Wilhelm, R. & Baynes, C. 1967 *The I Ching or Book of Changes.* Princeton University Press.

Eclectic energies: https://www.eclecticenergies.com/iching/introduction.php

Organic Design. Retrieved 2015-09-03. *I Ching / Divination -. www.organicdesign.co.nz*.

Dr Zai, J. 2015 *Taoism and Science: Cosmology, Evolution, Morality, Health and more.* Ultravisum.

Michal Rataj*. 2010. Electroacosutic music and selected concepts of radio art.* PFAU-Verlag, saarbrücjen.

Frank Ekeberg Henriksen. 2002. *Space in Electroacoustic Music: Composition, Performance and Perception of Musical Spacec.* Ph.D. Dissertation. City University Department of Music

Raymond Lo. 1992. *Fengshui and Destiny.* Tynron Press, England

Arnold Keyserling & R.C.L. 2010. *Yin* and *Yang* http://www.chanceandchoice.com/course-overview/yin-and-yang/

Taylor Latener and Rodney Leon. 2005. *The Illustrated Encyclopedia of Confucianism, Vol. 2*. New York: Rosen Publishing Group.

Gilberto dos Santos Agostinho Filho*.* 2016*. Randomness in music: an overview of the current possibilities.* Master Thesis. Music and Dance Faculty of the Academy of Performing Arts in Prague