THE STUDY OF THE HARMONY PATTERN FOR A THAI AND WESTERN MUSICAL COMPOSITION

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Tóm tắt

Bài tham luận trình bày mô hình hài hòa một cách tương đối giữa các nốt nhạc của âm nhạc truyền thống Thái Lan với âm nhạc phương Tây và kiểm tra sự dịch âm giữa chúng. Nghiên cứu cho thấy âm điệu thấp nhất của Cồng số 6 trong bộ Cồng Khong Wong yai luôn được xác định bởi một tần số không đổi là 440 Hz và quãng tám tương đương với gam 7 nốt, vì vậy, mỗi quãng là 171,4 cent. Với hệ thống tần số của Thái và phương Tây, chúng tôi tập trung vào nhóm 2 tần số, nhóm ba tần số và những bất hợp. Kết quả cho thấy nhóm 3 tần số so thể tạo ra được 67 nhóm phù hợp giữa âm nhạc Thái và phương Tây, sự không hòa hợp có thể được các nhạc sĩ sử dụng trong trường hợp quãng nhạc ít hơn 200 cent.

Abstract

The purposes of this study were to find out the harmonic pattern that approximates the notes of Thai Classical Music and Western Music , and to examine the transposal of Thai Classical Music and Western Music. In this study, a constant frequency was determined using the 6th gong from the lowest tone gong of the khong wong yai that had the frequency of 440 Hz, and the interval of one octave was equal as determined in the seven-note temperament scale, so each interval of the notes was 171.4 cents. For the combination of Thai frequency system and the western, the focus was on the two-frequency group, three-frequency group and the dissonance. The results showed that the three-frequency group could produce 67 groups of the consonance able to harmonize Thai and the Western music, and that the dissonance could be used as the composer needed in case that the interval between the notes should be less than 200 cents.

Introduction

Music is an art of sound spontaneously arising out of the evolution of human wisdom. The music in Europe was so highly and practically developed that it was

world widely accepted as the standard music. Such development has led to the widely accepted determination of the fundamental frequency of the music system.

Thai music is also an art of sound actually occurring within Thai wisdom and culture. The Thai music development has been fostered by Thai life and thought. The high-low tuning has been derived from skillful listening, sound appreciation and value upon unique Thai thought. The Thai music theory on pitch frequency had little statistic references that could be numerically quoted. Consequently, any references, comparisons, or calculations for any study on music are impossible though the enjoyment in performing musical instruments and the genuine music appreciation exist. This problem put major constraints on the study of Thai classical music. The stage of development on Thai music system is ***inhibited***, therefore the prestige of Thai music is being lost, waiting to be as an ***ancient*** object that is likely to be replaced by any contemporary art.

In fact, the study of music is an essential factor on music conservation. Nowadays cultures are freely transferable from one place to another. This occurrence could not be hindered as seen in that Thai people are taking the European, American, Japanese or Korean cultures in their everyday life. One consequence is that the art of music is mixed with the other cultures; Thai, Malaysian, Japanese musicians have mixed their own culture together. This new art of creation is an available alternative to the listeners. But the mixing of Thai music system with the other systems is likely to cause problems on Thai music because the musicians could not exactly set the frequency of the Thai music system and not comparably combine it with the other. To solve such problem, the system was set instinctively; as a result, Thai musical sound was swayed by the others. This may be a root cause for loosing Thai identity. Therefore, it is very interesting to study how to well compose Thai classical music and western music together. The advantages are that: first, the sound of Thai music would be heard internationally; a new art of music led by Thai music is a result; and it is an encouraging start for the use of Thai music data and information for being a reference in the scientific study of music.

To conduct this study, initially, the system of Thai music frequency has been deeply investigated to see whether it is promising to set a fundamental frequency for Thai music. Next, the arrangement of the interval of notes in an octave into a 7-equal

temperament which is the real pattern of Thai classical music is examined. Then, to find out the possibility of creating a harmonic pattern, the experiment on the combination of Thai classical frequency and Western frequency focusing on the two-frequency combination, three-frequency combination was conducted.

The delimitations in this study were as follows.

1. The investigation was on values of the frequency and the intervals of the octave in Thai classical music that might be used as the fundamental frequency.

2. The investigation was on the combination of the Thai classical and Western music focusing on the two-frequency and the three-frequency group combination.

3. Only a frequency from the *khong wong yai* was used to determine the interval of the seven equal temperament within one octave and to be used as the representative of the Thai Classical music.

Definitions of Terms

Interval refers to a pair of notes in the scale that are arranged orderly and continuously in the Thai classical music, the western music or the other systems

Octave refers to the interval between the same notes, or a unison, arranged up or down continuously for example the interval between low *Do* and high *Do*. In Thai, an octave is called *Chuang Tob,* or *Chuang Tob Sieng,* or *Ku Pad*

Literature Review

In his book *On the Sensations of Tone,* Hermann L.F. Helmholtz (1954, in Alexander J. Ellis and Hipkins, 1985) found out that the fundamental frequency of Thai music was 425 Hz.

Seelig (in the diary of His Royal Highness Prince Jayanta Mongkol) said that the fu ndamental frequency of Thai music at A was 870 Hz. – the frequency of pitch was double, so the low A was half, that is, 435 Hz similar to that measured by Hermann Helmholtz (1954).

Phra Chen Duriyang, Jang Wang Tua Patayakosol, Luang Praditphairo and others (in The Fine Arts Department, 1950) collected and made Tam Kuan songs

and Hom Rong Yen song into the western musical notation with the fundamental frequency of 425 Hz.

Morton (1976) used stroboconn in California University to measure the frequency of four major Thai classical instruments: *ranat thum, ranat ek, khong wong yai, and khong wong lek*. Morton found the frequency of those four instruments but no fundamental frequency was shown. However, the frequency value was closed to the previous measurement of the 6th gong from the lowest frequency gong of the *khong wong yai* that had the frequency of 447.5 Hz. This value is very interesting because it is close to the value of 425 Hz measured by Ellis and Phra Chen Duriyang and to the value of 435 measured by Seelig. More importantly, this figure is very close to the western fundamental frequency of A, *i.e.*, 440 Hz.

Chareonsuk and others (1997) collected the frequency data from 30 music communities and 35 manufacturing houses of musical instruments in the Central region of Thailand. The study showed that the fundamental frequency was from 425 – 435 Hz. The most used frequency was 425 Hz.

In her study of *Thai Musical Signal Analysis,* Chinvejkitvanich (2004) measured the frequency of *khlui phiang aw*, called *Do*. It was found out that the *Do* frequency was 465.39 Hz and the fundamental frequency of *Do* above was **892.64** Hz. The results found are rarely reliable due to impractically figures relating to the physic theory, that is, the above value of the fundamental frequency is not double to the lower value. This may be caused by the variation in making the instruments with local wisdom, not with scientific tools. However, the result of this study is very interesting in that the above value of the fundamental frequency, **892.64** Hz divided by 2, was **446.32** Hz. This is very close to the results of the previous studies.

Jarunyanon (1995) said that the long development of the Western frequency ended in 1939 with the fundamental frequency at middle A of 440 Hz.

Her Royal Highness Princess Maha Chakri Sirindhorn, as the President of the Research Project on the fundamental frequency of Thai music said the standard fundamental frequency in Thai music theory was called *odd* which was produced from the 5th tuned gong from the lowest frequency gong of the *khong wong yai*. The frequency was 828 Hz. Moreover, the comparative study collecting data from 28

sources showed that the *odd* at the octave below had the frequency between **397.8 - 482.2** Hz, or **418.69** Hz on average.

The local study

The measurement of the *khong wong yai* was conducted as follows.

1. The measurement was carried out with the *khong wong yai* in the program in Thai Music at Bansomdejchaopraya Rajabhat University. The frequencies of all 16 *gongs* were found (See Table 1). The fundamental frequency was close to the figure gained from the previous studies. The frequency of the 6th *gong* was 450 Hz. Therefore, this study employed the frequency of 450 Hz.

Table 1 The frequencies of the *gongs* in the Thai Music Program at Bansomdejchaopraya Rajabhat University (Hertz)

Gongs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Frequencies	280	315	344	377	416	450	518	565	630	689

11	**12**	**13**	**14**	**15**	**16**
760	832	938	1025	1160	1200

2. At Somchai Dontri Thai, the manufacturer of Thai musical instrument in Muang District, Kanchanaburi Provicne, it was found that the frequencies of 16 *gongs* in *khong wong yai* were close to the previous study (See. Table 2). The frequency of the 6th *gong* was 454 Hz.

Table 2 The frequencies of the gongs from Somchai Thai Musical Instrument manufacturing in Kanchanaburi Province (Hertz)

Gongs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Frequencies	**277**	**313**	**334**	**373**	**420**	**454**	**501**	**565**	**621**	**676**	**747**	**816**	**918**	**1025**	**1130**	**1260**

The determination of the fundamental frequency and the distance of the interval

As previously mentioned, the value gained by Ellis and Hipgins was 425 Hz and that by Phra Chen Duriyang as measured from Tam Kuan and Hom Rong Yen songs was 425 Hz, and that by David Morton was 447.5 Hz. The value measured at Bansomdejchaopraya Rajabhat University was 450 Hz and that at Somchai Thai Musical Instrument manufacturing was 454 Hz. Therefore, this study used four values of 425Hz, 447.5 Hz, **450** Hz and 454 Hz.

It was astonished to discover that Thai music used the fundamental frequencies close to 440 Hz used as a standard value in the Western music, that is, 425 Hz, 447.5 Hz and 450 Hz. That some Thai musicians accepted the values higher and lower than the standard value of 440 Hz was considered very useful. However, it was advantageous to many people if the fundamental and constant frequency of Thai music system does exist. The musicians could adjust their instruments with the same frequency; the evidence for researchers to conduct more scientific study in the same line of interest would be possible; the evidence would be very useful for certain comparative studies or calculations; and when the fundamental frequency similar to standard and world used frequency is available, an experimental study with the other music systems would be very promising.

The interval between the equally tempered notes in Thai music system

Based on the explanation from the specialists of Thai music, information from Montri Tramote and Manop Wisudthipad, and the referenced data from Wasit Jarunyanon, the interval between an octave was a seven equally distance. This was similar to the finding of David Morton indicating that the interval between the notes was 171.43 cents gained by means of the cents calculation, that is, dividing 1200 by 7. Therefore, the assumption in this study was that the interval between the equally tempered notes should be 171.43 cents.

The Calculation for the frequency value of the Thai music

To find out the other values of the frequency, the calculation was carried out by means of The Cents Table of Erich Von Hornbostel with the use of 440 Hz . To start, the first frequency of 446 in the Cents Table was added up with 171.4. Then, the sum of the addition was added up with 171.4 and the addition was repeated until each and every frequency within the interval was added as seen in Table 3.

The Thai music frequency in Cents with the octave division of 7 equal notes

Table 3 The value gained from the calculation using the Cents Table of Hornbostel

446	617	789	960	1132	1303	1474	1646

To get the frequency in Hertz, the calculation was in a reverse with the use of the Cents Table of Hornbostel

The frequency in Hertz with the octave division of 7 equal notes

Table 4 The calculation of the Frequency in Hertz

440	486	536	592	654	722	796	880

The study of the harmonic pattern with two-frequency group

In this experimental study, a pair of one Thai music frequency and one Western music frequency was tried out at a time. The Thai frequency was constantly set at the calculated value and the western frequency was combined to see if they were well matched. The results of the study were as follows.

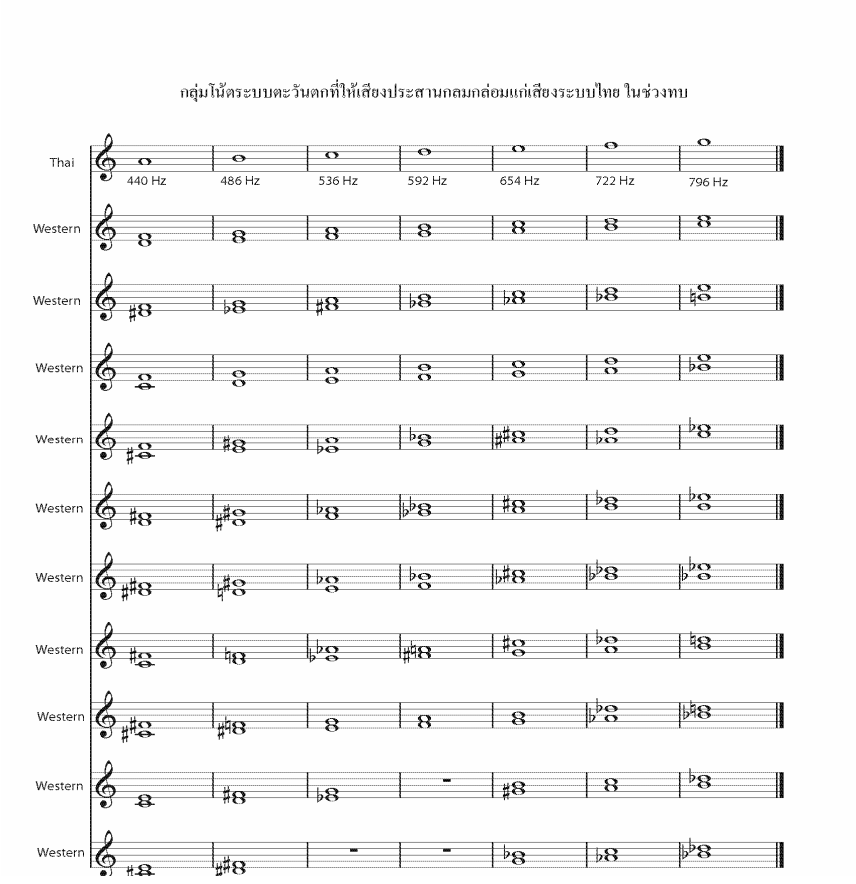
1. The interval of each matched pair was at 0-1090 cents.
2. The interval of each matched pair that produced dissonance was at 13-241 cents. This occurrence was with the interval at 1090 cents
3. The interval of each matched pair that produced consonance was at 257 - 1026 cents
4. The interval of the matched pair that produced consonance were a variety. It can be concluded that when the interval of each pair was wider, the stress was lesser. The pair that produced consonance can be used in the harmony.
5. It can be concluded that every pair with the interval of more than 257 cents was useful; however, the pair with the interval of more than 1090 cents was not because they produced dissonance.

The study of the harmonic pattern with 3-frequency group

In this study, one Thai frequency was tried out with 2 Western frequencies at a time. Seven Thai frequencies were constantly set. The results of the study were as follows.

1. The Thai frequency at 6-440 Hz combined with 2 Western frequencies produced 10 groups of consonance.
2. The Thai frequency at 7-486 Hz combined with 2 Western frequencies produced 10 groups of consonance.
3. The Thai frequency at 8-536 Hz combined with 2 Western frequencies produced 9 groups of consonance.
4. The Thai frequency at 9-592 Hz combined with 2 Western frequencies produced 8 groups of consonance.
5. The Thai frequency at 10-654Hz combined with 2 Western frequencies produced 10 groups of consonance.
6. The Thai frequency at 11-722 Hz combined with 2 Western frequencies produced 10 groups of consonance.
7. The Thai frequency at 12-796 Hz combined with 2 Western frequencies produced 10 groups of consonance.

To conclude, the combination of Thai and Western frequencies resulted in 67 groups of consonance.



The illustration of Western notes that produce harmony to Thai frequency system**.**

Summary of the Study

The results of study can be summarized as follows:

1. The fundamental frequency for Thai music was at the frequency at 440 Hz

2. The interval between the frequencies arising from the evidences from the previous studies was 171.43 cents.

3. The frequencies between each note within the octave were:

The first note was at the frequency of 440 Hz.

The second note was at the frequency of 486 Hz.

The third note was at the frequency of 536 Hz.

The fourth note was at the frequency of 592 Hz.

The fifth note was at the frequency of 654 Hz.

The sixth note was at the frequency of 722 Hz.

The seventh note was at the frequency of 796 Hz.

4. The calculation of the frequency in the other octave can be doubled, for example, the first note was with the frequency of 440 Hz, so the eighth note was with 880 Hz.

5. The interval for one Thai frequency combined with one Western frequency showed that

5.1 The pairs that produced disconsonance had interval from 13-241 cents and more than 1090 cents,

5.2 The pairs that produce consonance had interval from 257-1026 cents, and

5.3 The pairs with wider interval had less stress.

6. The results of the combination of the three-frequency groups of Thai and Western were as follows:

6.1 When one Thai note combined with 2 Western notes at a time was tried out, the results indicated that 7 Thai notes could produce 67 groups of consonance and they can be used in harmony.

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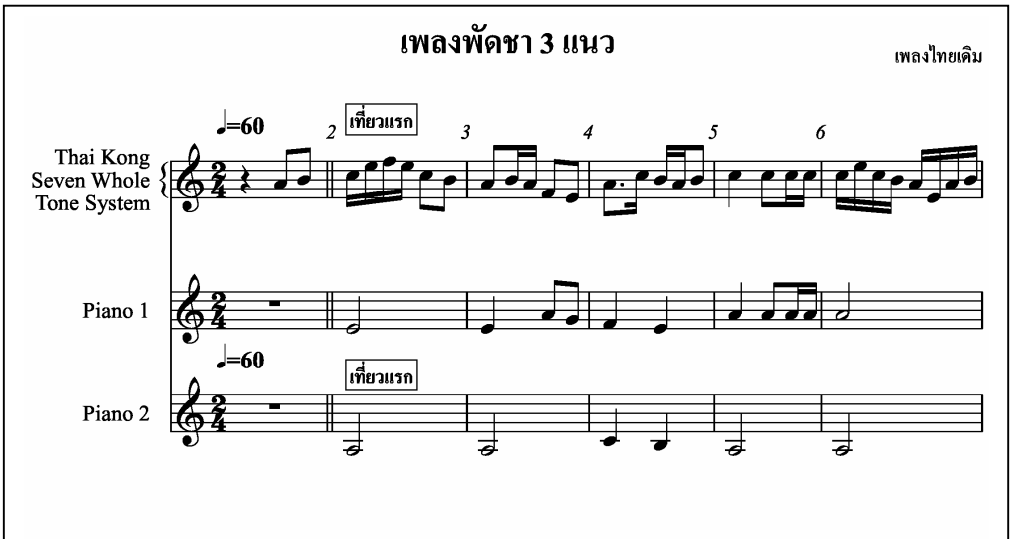
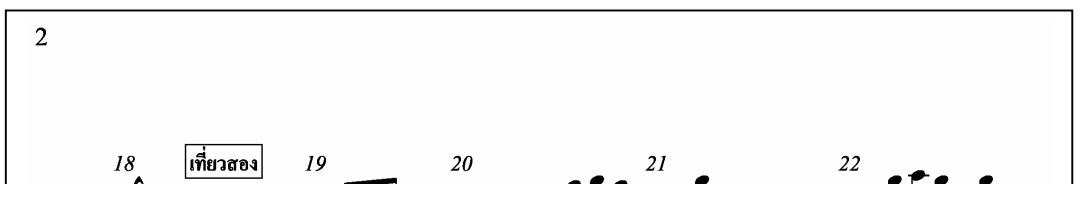
Appendices

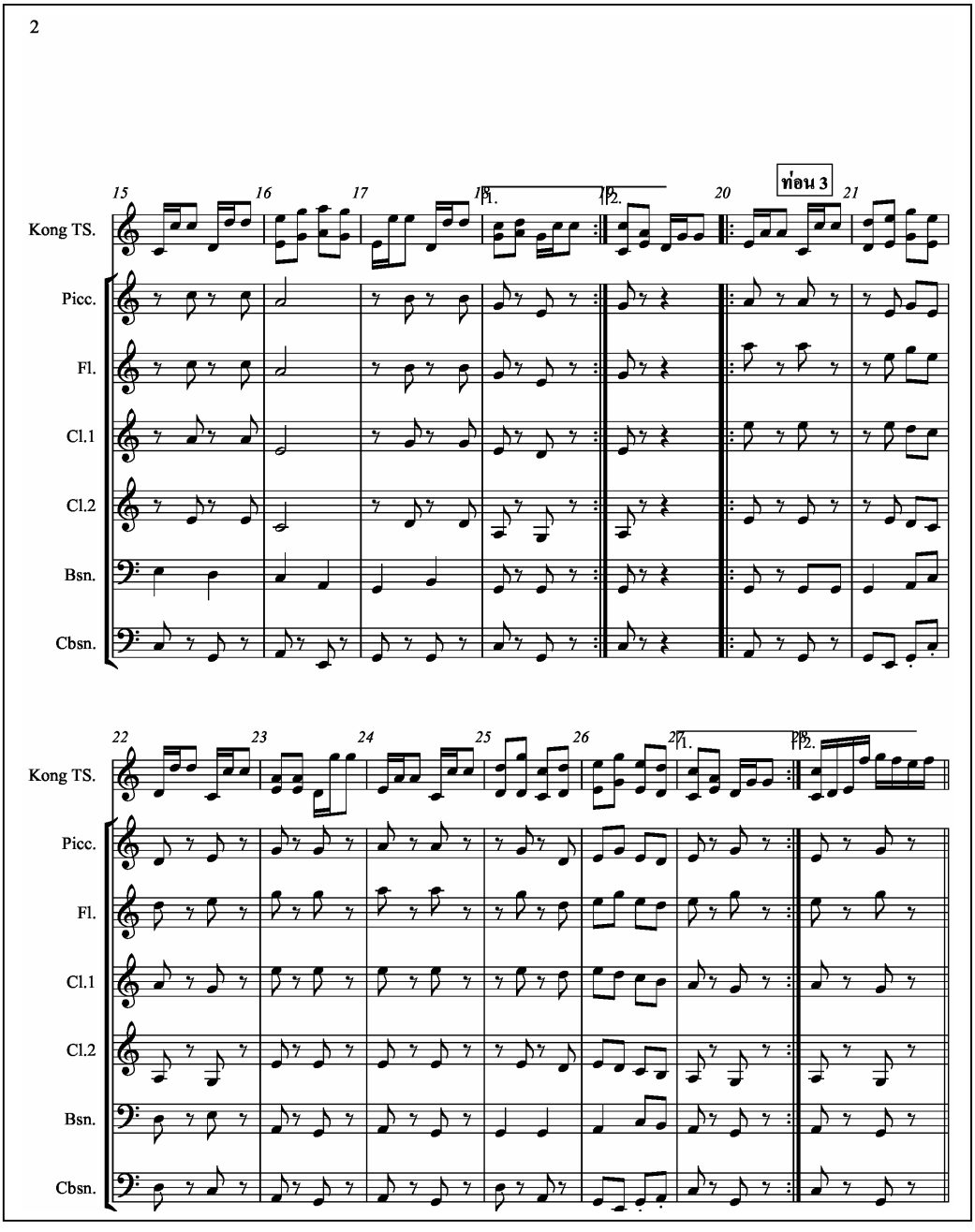
Appendix 1: Examples of the harmony of Patcha, music instruments: *khong wong yai* and piano.

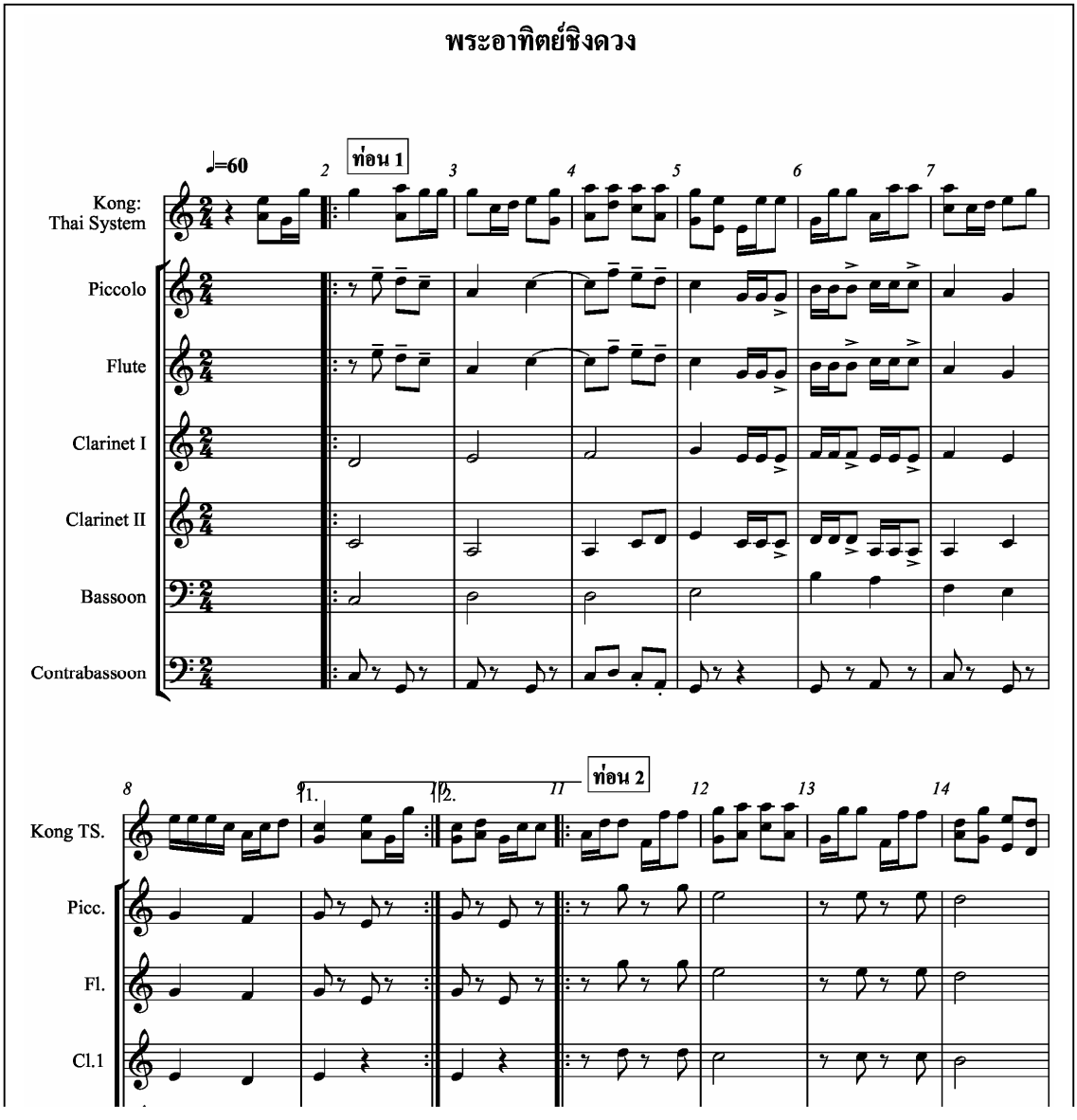
Example of notation

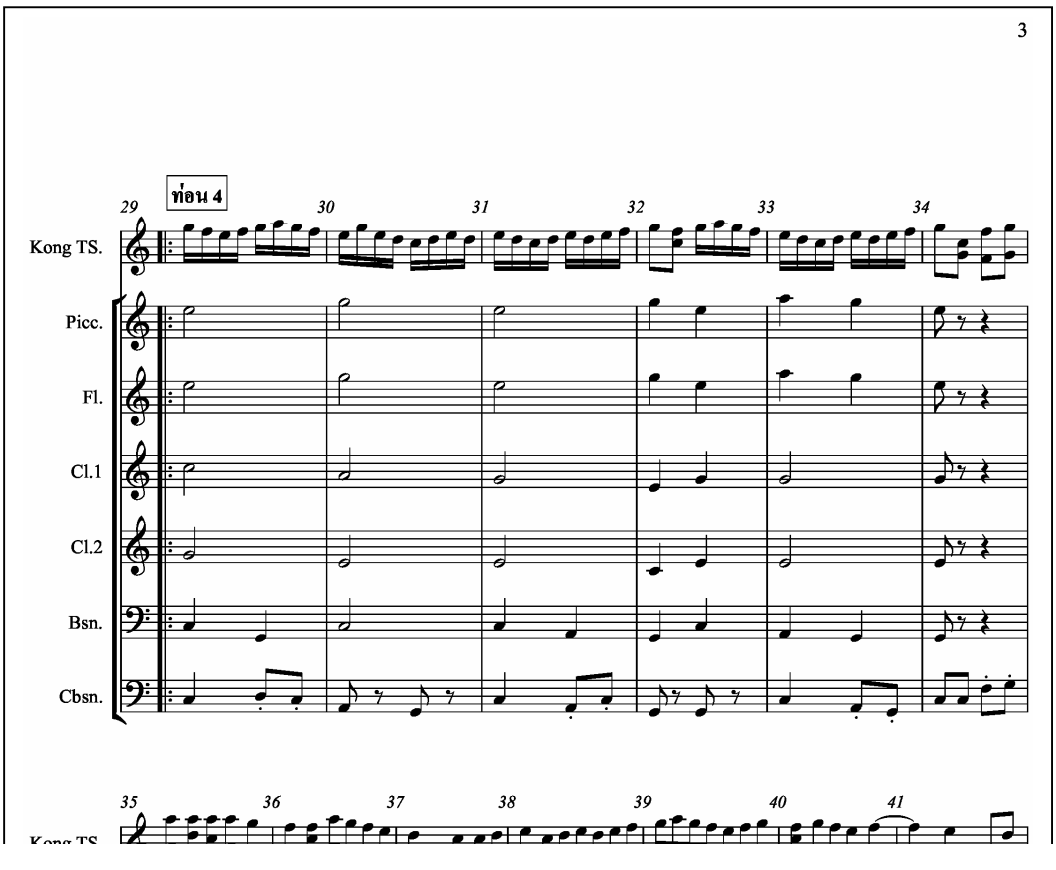


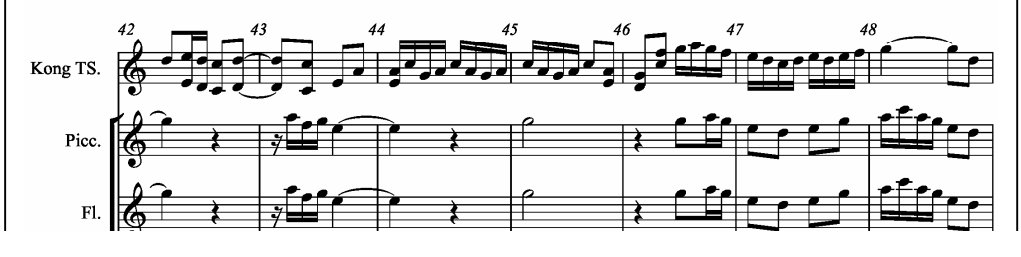

18
เที่ยวสอง
19
20
21
22

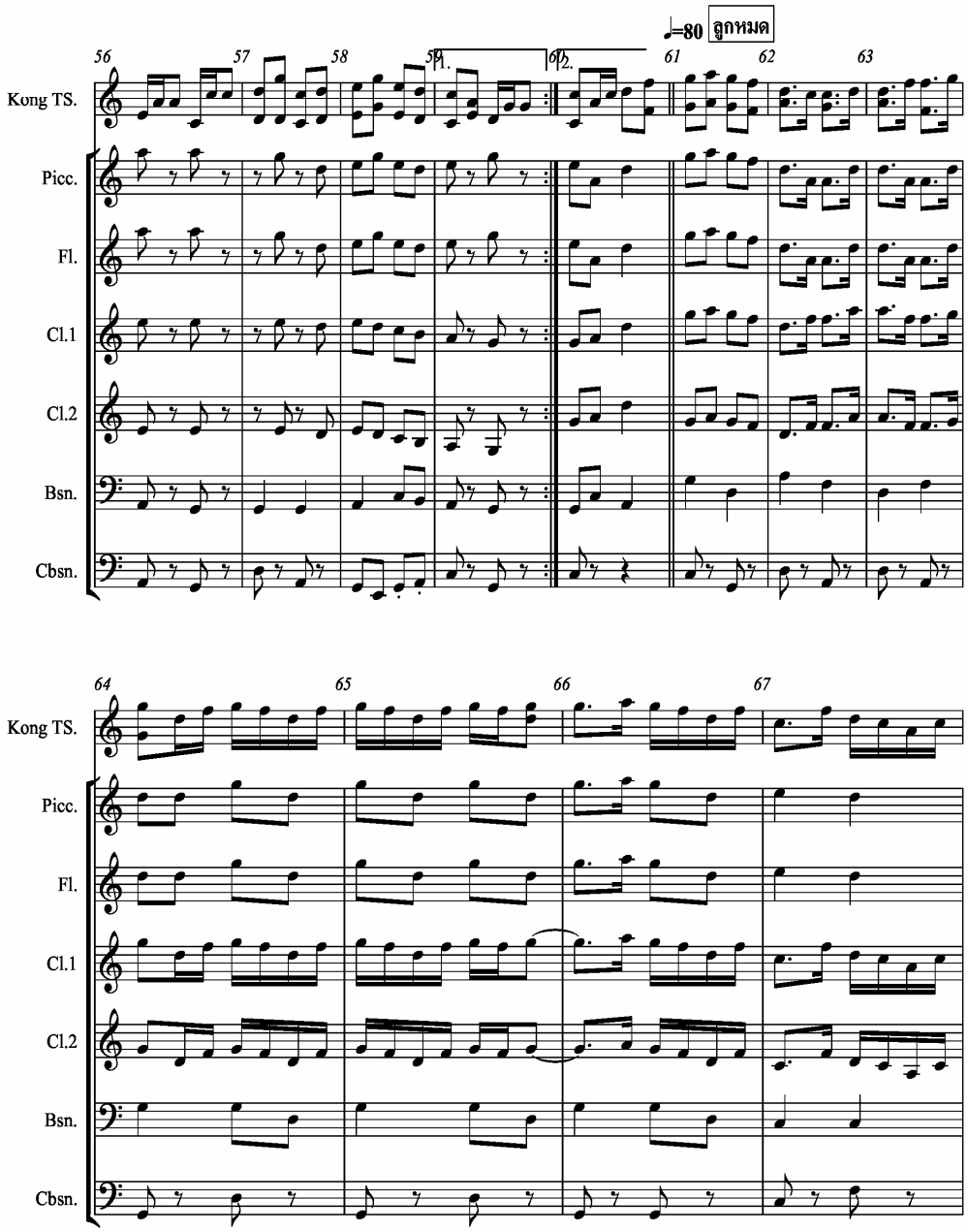
Appendix 2: Example of the harmony of Pra-A-Tit Ching Duang, musical instruments: *khong wong yai*+ flute, piccolo, basson, bass bassoon. Example of notation

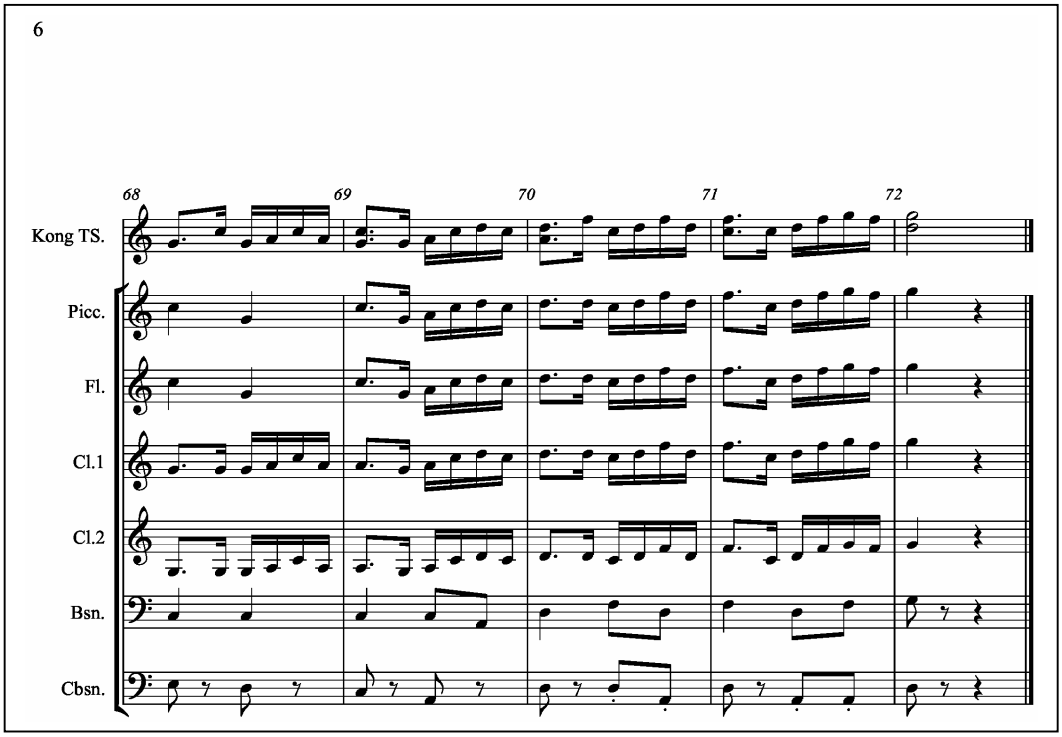



พระอาทิตย์ชิงดวง
♩=60
ท่อน 1
ท่อน 2
Kong: Thai System
Piccolo
Flute
Clarinet I
Clarinet II
Bassoon
Contrabassoon
Kong TS.
Picc.
Fl.
Cl.1


ท่อน 4
29
30
31
32
33
34
Kong TS.
Picc.
Fl.
Cl.1
Cl.2
Bsn.
Cbsn.
35
36
37
38
39
40
41
Kong TS.


42
43
44
45
46
47
48
Kong TS.
Picc.
Fl.


♩=80 ลูกหมด
56
57
58
59
1.
60
2.
61
62
63
Kong TS.
Picc.
Fl.
Cl.1
Cl.2
Bsn.
Cbsn.
64
65
66
67
Kong TS.
Picc.
Fl.
Cl.1
Cl.2
Bsn.
Cbsn.


68
69
70
71
72
Kong TS.
Picc.
Fl.
Cl.1
Cl.2
Bsn.
Cbsn.