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Examination for teaching the create and acoustic characteristics of Guhu of the Zhuang ethnic group in Guangxi, China

Hao Wu [a], Nataporn Rattanachaiwong [b] *

[a] *Performing Arts of Doctor of Philosophy program, Faculty of Fine and Applied Arts, Suan Sunandha Rajabhat University*

[b] *Asst. Prof. Dr. Faculty of Fine and Applied Arts, Suan Sunandha Rajabhat University, E-mail: nataporn.ra@ssru.ac.th*

Abstract

This study uses a qualitative methodology. The objective was to examine a musical instrument for teaching the creation and acoustic characteristics of Guhu of the Zhuang ethnic group in Guangxi, China, about shape and structure to summarize raw materials, craftsmanship, and process of Guhu, then measure by acoustic instruments, conclude the acoustic characteristics of Guhu, and discuss the use and functional significance of the instrument more accurately and logically. The raw materials, tools, production points, and specific steps of Guhu are systematically recorded by interviews, observation, and personal experience. Several acoustic measurements are made to explore the acoustic characteristics of Guhu. Guhu's culture and characteristics are fully demonstrated in the core of technical practice and the theory of technical knowledge. The study results show that: the traditional production method. Overall, it has the potential to be universal and representative of acoustic characteristics. Guhu's wood, leather, and aggregate materials are all standard. Guhu's creation has an influence on its shape, structure, and acoustics. Guhu is being improved as time passes, and research into characteristics is also helping guide the development of a more standard production process and a new improvement scheme. This will result in the integration of knowledge to study techniques and methods for creating Guhu that will last indefinitely.

Keywords: Guhu musical instruments, Creating music instruments, Zhuang ethnic group, China

1. Introduction

When archaeologists excavated a bone flute in Jiahu Village in 1987, they discovered the world's first real instrument and wind instrument (Juzhong et al., 2000). In November of the same year, Huang Xiangpeng, a former PhD supervisor at the Chinese Academy of Arts, led a team to bring a flash spectrum sound meter. Stroboconn went to the Institute

* Corresponding author Nataporn Rattanachaiwong
E-mail address: nataporn.ra@ssru.ac.th

of Cultural Objects of Henan Province to measure one of the seven sounds, the hole bone flute number M282:20. The scale structure of the flute bone must be at least six tones in size, and it may be a summary of the ancient lower emblem scale with seven tones, as Dai Nianzu said in the article "History of Chinese Acoustics" (Zhang et al., 2004; McGovern, 2009; Juzhong & Qilong, 2013; Liu, 2020). They fought each other in the spring and autumn, as well as during the state era. A complete theory of calculation and tools for examining musical instruments have emerged in China. It is the birth of early Chinese acoustic music. Houyi During the Suisian District Hubei interstate war, each bell can hit two tones of the third scale. The entire set of bells displays twelve sounds and can play pentatonic scale music. six tones or seven tones. That was 20 years ago. Mukam in Xinjiang has a Mukam mode. Four modes (including neutral tones) In May 2006, the Chinese Academy of Social Sciences discovered a pipa-shaped musical instrument at two sites of the Tupuluken Buddhist Temple in Damagu, Sele District. Xinjiang during archaeological activities in Xinjiang the oldest harp-like instrument, due to its string of ghosts, disappeared when found. Scholars are talking about how to define lines in a more reasonable way. This is a problem in the field of musical acoustics, as Han Baoqiang said in the article "An Overview of China's Modern Music Acoustic Research," "Musical acoustics are disciplines that use the theories and methods of physical acoustics to explore the laws of music production and transmission," while at the same time pointing out in "Instrumental and Space Music Sound Systems" that "a combination of instruments requires different sound field spaces to match for optimal sound effects". Music acoustic research consists mainly of the relationship between the physical properties of music and human hearing. Acoustics of musical instruments Acoustics of singing the acoustics of the hallway Pieces of acoustic electrolytes closely related to music and the acoustics of microelectronic music (Tuohy, 2001; De Kloet, 2005; Ho, 2006; Ho & Law, 2012; Hu & Yang, 2017; Tang, 2020).

Guhu is a folk string instrument of Zhuang, which is called "Randu" in Zhuang (Jian & Nicolas, 2021; Yan & Chonpairot, 2021). It is most popular in the Zhuang and Buyi regions of northwest Guangxi, southwest Guizhou, and southeast Yunnan, and has evolved into the main instrument of "Beilubayin," "Beilu Zhuang Opera," "Buyibayin," and "Buyi Opera" of Zhuang.It is a treasure in the world of Zhuang music. There is no clear information about the birth time or inventor of Guhu in the documentary records. Guangxi is home to only a few legends, the most famous of which is the story of Ran and Lie. Later, in order to commemorate Aran and Alie, people called Guhu "Ranlie," and Guhu art was spread in the villages of Zhuang along with their footprints. This devoted and passionate love story casts a romantic mystery over Guhu's origins.

According to the "Guhu Art" of Su Sha'ning, it can be inferred that Guhu was born in the Qing Dynasty (1736–1795) and is an important traditional art with a rich heritage and a history of 200 years. It is also recorded in the annals of Tianlin that in the 20th year of Jiaqing (1815) of the Qing Dynasty, there was an incomplete professional Zhuang Opera

troupe in Nalao, Xilin. Nanlu Zhuang Opera is played in Xinlin. The main instrument of the original Nanlu Zhuang Opera is the qinghu. With the development and prosperity of society and the increasingly frequent cultural exchanges among different ethnic groups, huqin and other stringed instruments are introduced into Lingnan from the Central Plains and enter the lives of the Zhuang people. Later, for their own artistic appreciation, the Zhuang people used bone materials to imitate the shape and structure of Huqin and transform into Guhu. As one of the main musical instruments in Zhuang Opera in Guangxi, the guhu is popular in all counties and towns under the jurisdiction of Baise (Yung, 1989; Zhang, 2018; Widman, 2019; Ban, 2020; Baolong & Chonpairot, 2021; Jian & Nicolas, 2021; Zhao et al., 2022; Zhang, 2022).

Based on the above analysis, Guhu originates from Xiqin for Huyue (Huyue), the music of the Xi people in the Tang Dynasty. During the Sui and Tang dynasties, the Xi people moved south to Shanxi and Hebei, and Xiqin spread to the south. In the Song Dynasty, Xiqin changed in shape and structure and developed into Jiqin, Mawei Huqin, and so on. In the Yuan Dynasty, Qin developed from Xiqin and was called Huqin, with new shapes and structures such as Huobusi. In the Ming Dynasty, Huqin was widely used and spread among the people. Huqin in the Qing Dynasty was close to modern ones due to continuous innovation in shape and structure, and it spread to Lingnan through regional exchanges. In modern times, the Zhuang people transformed Huqin into Guhu in production and life and developed it together with Zhuang Opera. It can be concluded that Maguhu appeared during the reign of Emperor Qianlong of the Qing Dynasty (1736–1795), with a history spanning more than 200 years. The research on Guhu in academic circles mostly focuses on the analysis of Guhu culture and its musical works, while there is less research on the production process and acoustic characteristics of Guhu. Guhu's manufacturing craft is very exquisite in both materials and production technique, with distinct Zhuang culture characteristics in ethnic musical instruments.

2. Method

The measurement of acoustic characteristics is investigated in this paper by studying the production process of Guhu of the Zhuang ethnic group in Guangxi. The author collected data through literature research and book interviews, observed the production process of Guhu, and conducted field research. This paper will focus on the production of Guangxi Zhuang Guhu through an acoustic recognition system to do acoustic measurement research to finally explore the acoustic characteristics of Guhu.

Table 1. A sheet of recordings of Guhu

Date	September 26, 2021	Place	Recording Studio on the eighth floor of Nanhu Campus of Guangxi Arts Institute
Temperature	23°C	Voltage	220V
Test content: open strings			
Recording equipment			
Category	Name	Brand	Quantity
Hardware	Computer	MacBook pro	1
	Speaker	Dynaudio BM12A	2
	Controller	Digidesign Control 24	1
	Test microphone	Earthworks M30	1
	Sound pressure meter	RadioShack Sound Level Meter	1
Software	Digital audio workstation	ProTools10	1
	Audio analysis	Sonic Visualiser	1
Surveyors: Huang Lansi, Li Youmei (measurement), Wu Hao (monitoring)			
Performer: Wu Hao			
Recording guide: Hua Wei			
Recording staff: Li Youmei and Huang Lansi			

3. Result

3.1 The Production of Guhu.

Guhu originates from the infinite love for life of the Zhuang people in Guangxi, and its production and transformation are closely related to local culture and products. Guhu is mainly made of wood, leather, and aggregate. In the early stage of the production process, a luthier studies the main factors that determine the shape and the dominant physical characteristics of Guhu, including the selection of raw materials, conception of shape, and initial idea of sound.

1) Materials for making Guhu.

The head, handle, pegs, cento, and other parts of the guhu are made of wood. At present, there is no uniform standard for the wood used in Guhu. Luthiers specify types of wood according to the buyers' musical needs or preferences or choose different kinds of wood according to the preciousness of the material, the difficulty of buying it, and the degree of corrosion and wear resistance. The wood that is commonly used to make Guhu has annatto (rosewood and Dalbergia cochinchinensis pierre), ovengkol, Toona sinensis, and

Excentrodendron hsienmu. Guhu is very selective in material, using only heartwood rather than sapwood, the center cellless part of a tree.

Figure 1. Annatto
Source: Hao Wu (2021)

The leather needed for Guhu is also very particular. The membrane of Guhu is used to cover the ends of the drum resonator. Guhu evolves from Huqin. The ends of the drum resonator of Huqin-like stringed instruments are usually closed with a wooden sound window or skin to achieve a more significant sound transmission effect. So far, Guhu has used a variety of types of skin, such as frog skin, fish skin, and snakeskin. According to the experience of luthiers, wild python skin with a unique structure of warp and weft is more elastic and flexible than other skins and can produce a wider range of tones. Therefore, python skin becomes the first choice for Huqin. At present, Guhu luthiers mainly use python skin from artificial breeding farms in Vietnam and Yunnan. The length and width of the membrane of Guhu are about 13 cm. A complete snakeskin can only be used for 5–7 pieces. There are sometimes irregular scales on the snake's skin. In order to make the finished sound better and more beautiful in appearance, it is necessary to avoid the places with strange scales for cutting.

Figure 2. Python skin
Source: Hao Wu (2021)

In China, most Huqin-like stringed instruments mainly have a bamboo or wooden drum resonator, and Guhu is the only one that uses horse bone as the drum resonator. Luthiers generally use the femur of a dead horse aged 6–10 years from a nearby or familiar foreign horse farm as the raw material for the special drum resonator of Guhu because the horse bone at this growth stage is fine, strong, and suitable, and the produced Guhu has a bright tone and strong penetration. Only bones that are suitable in size, straight, and clean, with no obvious bumps or scratches on the surface, can qualify for the Guhu drum resonator.

Figure 2. Horse bone
Source: Hao Wu (2021)

2) Manufacturing process of Guhu.

The realization of production means depends on technology, and technology depends on the initiative of human beings to use production tools, process production raw materials, and produce technical achievements. There are four types of tools used to make guhu, namely cutting tools, grinding tools, punching tools, and skinning tools. The four types of tools are further classified in more detail, with different functions and features. Cutting tools are generally used for cutting wood and aggregate, grinding tools for shaping, punching tools for drilling, and skinning tools for making and adjusting cortical sound windows. In the limited space available, luthiers demonstrate their infinite knowledge and ability to complete the important process of making a guhu -- making and assembling each part. Only by upgrading production tools can we improve production efficiency and quality and keep pace with the times. The cutting and grinding tools of Guhu have changed from manual to mechanical instruments. The comprehensive use of manual and mechanical instruments greatly improves the production efficiency of Guhu and, to a certain extent, solves the limitations of manual production.

The production process of Guhu is roughly the same as that of other Huqin-like instruments: from zero to whole, first made in separate parts and then assembled as a

whole. In the first process, "cutting," the wood is sent to a local woodworking shop and cut into square panels according to the dimensions of the different parts. After the panels are brought back to the studio, different parts are made. Usually, the head, handle, and pegs of the guhu are made first, then the drum resonator, membrane, cento, and bridge, and finally they are assembled and integrated.

At present, the craftsmen of Guhu basically carve the head by hand. The horse's head is first drawn with a pencil on a cut square of wood with a side length of 20 cm. Second, the excess wood is cut along the outer outline of the horse's head with a hand saw to form a coarse embryo. Third, the horse's head is fixed to a machine so that the mane and facial details can be trimmed with a file. Finally, it can be polished with fine sandpaper. The handle is a part connecting the drum resonator and pegs. It has the function of structural support and reflection of sound waves in performance and is one of the important components of Guhu. When making the handle, it is necessary not only to ensure its functionality but also to have good hardness and moderate elasticity to ensure its comfortable feel. It takes a fairly sophisticated level of craftsmanship to make the handle by hand. Luthiers need to have rich experience in handle making and good mastery of guhu playing skills to achieve the best level of craftsmanship for the handle. As the main part of tuning, the material of the pegs is very important. The quality of the instrument depends largely on the raw materials and the production process. Therefore, when selecting the material of the pegs, we should first consider whether its texture and characteristics meet the requirements of the instrument.

The drum resonator is the soul of Guhu. It is particularly important to select a high-quality material for the drum resonator of Guhu. Guhu is made of different sizes of bones and has different tones. Only by making a drum resonator with the appropriate size, shape, and thickness of the resonant cavity can the horse bone make the most pleasant sound. When making the membrane, it mainly deals with snakeskin, including cutting, cleaning, extending, and covering. The processing technology for the membrane plays a decisive role in the tone of Guhu, and it is the process link that tests the skill of luthiers the most. There was no cento in the early days. In the 1960s, Guangxi Song and Dance Troupe and Beijing Musical Instrument Factory found in the process of playing Guhu that the drum resonator was small, the handle was short, the center of gravity was easy to be unstable, and it was difficult to carry the bow. Therefore, they specially organized personnel to reform Guhu and added a cent for Guhu. It is relatively easy to build the bridge. We only need to cut a small piece of hardwood with a length of 1.5 cm, a width of 0.7 cm–0.8 cm, and a height of 0.5 cm–0.6 cm, take the length as the edge, polish it to a three-dimensional trapezoidal shape, and finally carve the groove for the clamping string.

To sum up, the craftsmanship of Guhu is not only the practice process of Guhu but also a cultural phenomenon in which the production technology for Guhu is constantly adapted

to the development of human beings and modern society. After generations of luthiers' research and exploration, the production of Guhu has been gradually developed and matured. In the framework of the interconnectedness of technology for Guhu with people and society, luthiers use the family as the basic material facility for the development of technology for Guhu, so that it can be realized, inherited, and developed. In this sense, the production process of Guhu is a kind of manual technical practice. As the main body of technical practice, Guhu luthiers fully display their initiative and dominance in the control of technical means (the use of tools) and technical objects (materials). With the continuous development of social consciousness, people's aesthetic appreciation of art is also changing. The craftsmanship of Guhu is constantly improved; its shape and structure tend to be perfect, and the form and content of the works are also more and more abundant.

3.2 The Acoustic characteristics of Guhu.

Guhu is a musical instrument that makes sound by using a lot of physical processes and related subject knowledge. Structural vibration and acoustics are two of the most basic and directly related processes. When the guhu strings are pulled, the strings begin to vibrate, causing the bones and structure to vibrate in turn, causing the air around the structure to vibrate and eventually spreading to the human ear in the form of sound pressure – creating sound. Therefore, understanding the acoustic theory is an essential basis for studying the sound of Guhu.

1) Basic characters of Guhu.

Guhu is a Huqin instrument with a barrel of about 100 mm in length and 50 mm in diameter. It is sawed with the natural leg bones of cattle, mules, horses, and other large animals of similar size to the required length. The face is covered with snake or frog skin. It is about 600 mm long and 20 mm in diameter and is made of natural bamboo sticks, golden bamboo sticks, or rosewood. Natural Huang Qiong Angle is used for the chord axis, and silk is used for the string. Piano code is made of wood and 500 kg of thread. The horse tail of a fine bamboo tie is a bow, about 40 cm long. There are two kinds of strings: one is the sinusoidal "15," whose height is roughly between "g1-d2" and "bb1-f2," and the other is the antistring, a three-degree low fixed "6-3" string, whose height is roughly between "e1-b1" and "g1-d2," which can be adjusted according to the sound condition of the singer on the scene. The range is about 10 degrees. The bass register sounds strong and rough; the middle register is clear and bright; and the high register is sharp and sharp. The volume of all registers is relatively thin, and the sound quality is hard and slightly sandy. Its performance is a sitting posture; the barrel is sandwiched between the knees. The rod is vertical, the left hand holds the rod according to the string, and the right hand holds the bow to make the string sound. The unique playing techniques include front bow, back bow, and special glissando.

2) Key points of measurement preparation.

In the acoustic measurement of Guhu, the selection of the interviewer is particularly important. If an unqualified performer is selected, real and effective data cannot be measured in the experiment, and the experiment of measuring pitch and dynamic range cannot be completed. It is very likely that errors such as being out of tune and having no change in intensity may occur. Therefore, the level of the recorder's performance directly affects the quality of the sound required by the experiment. Therefore, all the Guhu recordings are completed by professional performers. The voice recorder and record-keeping personnel are all teachers or students of this major, and they all have certain professional knowledge of Guhu to ensure the authenticity and professionalism of the recording process. In the whole process of instrument sounding, the sound wave will be transmitted around, and the floor and wall will reflect the sound, and these reflected sounds will be recorded in the recording tool. When the two kinds of sounds are mixed, the sound spectrum and ADRS will be interfered with, and the acoustic characteristics of the instrument cannot be truly reflected. In Shi Zhongwei's paper, "Analysis of the Acoustic Measurement System of Chinese National Musical Instruments" (Shi Zhongwei 2016), two types of sound field environments are described: the sound field standards of recording studios and field recordings. The recommended length, width, and height of a recording studio room are 1.9:1.4:1.0, the area is not less than 25 m2, the volume is 100 (30) m3, and the reverberation time is controlled within 0.3-0.65s (250 Hz-4 kHz). Background noise is controlled below 30 dB (A). The temperature is between 20 and 25 degrees Celsius, and the humidity is between 50% and 75%. The sound field standard of field recording: the recording environment shall not have subjective variable sound defects, shall not appear to have echo, multiple echoes, vibration echo, sound focusing and resonance, and other recognizable sound defects, and shall not appear due to the noise of field equipment and external environment noise interference. In the frequency range 500–1000 Hz, the reverberation times of different sizes of spaces in the open field condition shall not be higher than the lower limit, as shown in Figure 3–3. The recommended reverberation times for other frequencies are: 1.0 to 1.2 s at 125 Hz, 1.0 to 1.1 s at 250 Hz, 0.9 to 1.0 s at 2000 Hz, and 0.8 to 1.0 s at 4000 Hz. The early reflected sound field should be evenly distributed in the space, and the delay time of the natural sound source at the microphone location is less than 35 ms. The ambient background noise is controlled below 35 dB(A); the temperature is between 20 and 25 °C, and the humidity is between 50% and 75%. The author conducted audio measurements and acoustic analyses on two different types of Guhu, 30 cm and 60 cm. The Guhu, made in an unknown year, was a traditional Guhu from the 1950s that was left by Li Xike's teacher. It was replaced by Li Xike after its shaft broke with the strings. It has preserved the original bone sound cylinder and instrument stick. The canister is made of the leg bones of a pony in the Baise area, and the neck of a stringed instrument is made of a local, characteristic teak trunk. Later, the Guhu was restored after replacing the string spindle, installing the base under it, and extending the headstock, which was decorated with a horse's head when it could not be played. The total length is 670 mm, and the bottom support is 633 mm. The neck of Guhu is uneven from top to bottom, while the whole of Guhu is very slim. The canister is irregularly round, with a length between 120mm and 123mm. The diameter of the canister is 50mm and 44mm, respectively. The inner chord length is 470 mm, and the outer chord length is 383 mm.

3) Acoustic measurement of Guhu.

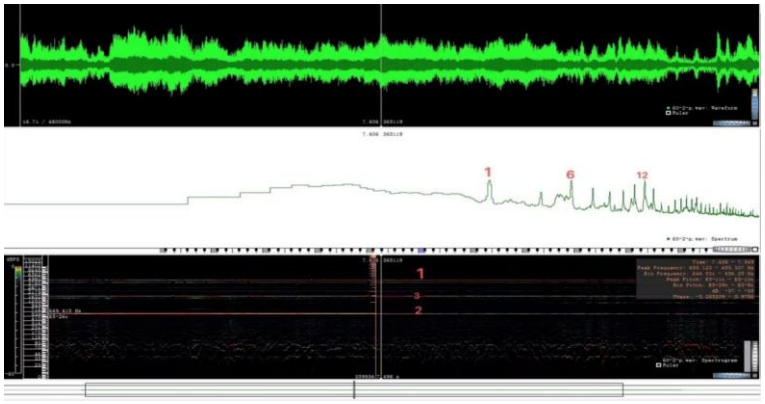

Figure 3. Audio analysis of Guhu sample 1

Source: Hao Wu (2021)

From Figure 3, (60-2-p) is played with a weak force, with a base frequency of 651.389 Hz and a pitch of E5-21c. As can be seen from the spectrum diagram, audio number one begins to vibrate, producing several distinct partials in the middle and high frequencies, the most powerful of which is harmonic No. 12 (E8-25c, 5198.29Hz), the base second, and the sixth harmonic (B6-14c, 1939.24Hz) third. The pitch and the most energetic 12th harmonic form the pure octave, which is the perfect consonant interval. The pure fifth forms between the pitch and the sixth harmonic, which is a complete consonant interval relationship. In addition, there are many overtones in audio No. 1, and most of the overtones are harmonic intervals. For example, the two most powerful overtones, the 12th harmonic and the sixth harmonic, are pure fourths and belong to complete harmonic intervals. Therefore, combined with the subjective hearing evaluation, it can be known that the tone of audio No. 1 is soft and thin, with a clear pitch and no medium or low frequency sense of thickness.

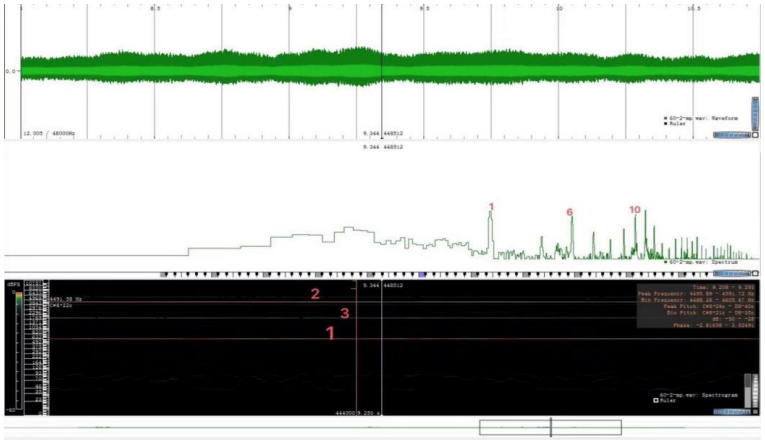

Figure 4. Audio analysis of Guhu sample 2

Source: Hao Wu (2021)

From Figure 4, (60-2 mp) is carried out at mp (medium and weak) strength. The frequencies are only 13 parts apart, but the harmonic intensity is quite different from that of the first audio. In the spectrum diagram, we can clearly see the three most energetic harmonics, among which the base is the most energetic, followed by the 10th harmonic (C#8+22c, 4491.58 Hz). The third highest energy intensity is the sixth homonym (B6-46c, 1923.89 Hz), but these stronger harmonics still maintain the consonant interval relationship with the pitch. The pitch and the 10th harmonic form the major sixth interval, belonging to the consonant interval relationship. And the sixth harmonic is the complete consonant interval relationship of the pure fifth. The sequence of harmonic intensity changes as the intensity changes. In addition, with reference to the subjective auditory evaluation of the No. 2 audio, it can be known that although the listening sense of the No. 2 audio is still thin, the sound head is clear and crisp, and the timbre is bright.

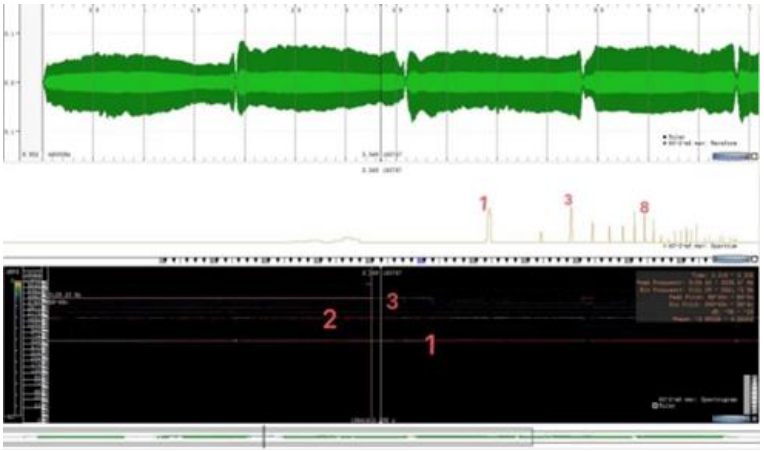

Figure 5. Audio analysis of Guhu sample 3

Source: Hao Wu (2021)

From Figure 5, is played with mf (medium-strong) intensity, with a base frequency of 651.389 Hz and a pitch of E5-21 c.Audio No. 3 has the same pitch as audio No. 1, but you can see from the spectrum that the harmonic intensity energy order is different from audio No. 1. In the third audio, the most powerful note is the base, the second most powerful is the third harmonic (B6+30c, 2009.89Hz), and the third most powerful is the eighth harmonic (E8-48c, 5129.25Hz). The pitch and the third harmonic form the perfect consonant interval relationship of the pure fifth, and the eighth harmonic is the perfect consonant interval relationship of the pure octave. Furthermore, there is a strong sixth and seventh homophonic compound in audio No. 3. Thus, the sound color of audio 3 is prominent, and the sound is brighter and fuller, which is more powerful than audios 1 and 2. This conclusion is also consistent with the conclusion of the subjective and hearing evaluations.

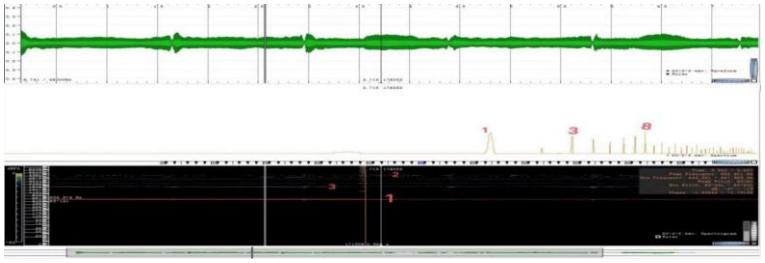

Figure 6. Audio analysis of Guhu sample 4
Source: Hao Wu (2021)

From Figure 6, (60-2-f), the dynamics are f (forte), the fundamental frequency is 665.61 Hz, and the pitch is E5+17c. From the spectrum, the fundamental tone has the strongest energy, followed by the 8th harmonic (E8-9c, 5246.54 Hz), and then the 3rd harmonic (B6-45c, 1924.63 Hz). Although the harmonic content of audio 4 is clearly distributed in the middle and high frequency bands, the energy intensity is maintained in the middle frequency band for a long time, namely the frequency band where the fundamental tone is. Moreover, the energy intensity of the 8th harmonic in the high-frequency band is second only to the fundamental frequency. As a result, the sound in the audio file 4 is very solid, with a distinct sense of power and a bright tone. Combined with the subjective hearing evaluation, there is a brief harsh tone in the playing process of audio 4.

4. Conclusion

Audio (in general, it refers to all sounds in nature that humans can hear, and the frequency spectrum range of sounds that humans can hear is typically 20-20,000 Hz) and speech (speech refers to the sound of human speech, and the frequency spectrum and energy range of human speech sound are mostly distributed between 300 and 3400 HZ) are different. One can see that one can hear a wider range of sounds than one can speak. And that's why people can hear sounds like musical instruments, nature, and shrill sounds, but they can't make them. The author carries over the fractional type statistics to the listening sense of the Guhu from the strength, and the statistical results are as follows:

Table 2. Subjective hearing score of audios of Guhu

Distance	Times	Dynamics	Sense of hearing			
			Dim thin	Bright crisp	Loud full	Sharp glitchy
60cm	1	p	10	0	0	0
		mp	8	4	0	0
		mf	0	6	7	0
		f	0	7	8	0
60cm	2	p	10	0	0	0
		mp	9	2	0	0
		mf	0	6	7	0

Distance	Times	Dynamics	Sense of hearing			
			Dim thin	Bright crisp	Loud full	Sharp glitchy
60cm	1	p	10	0	0	0
		mp	8	4	0	0
		mf	0	6	7	0
		f	0	7	8	0
		f	0	7	8	2
60cm	2	p	10	0	0	0
		mp	9	3	0	0
		mf	0	7	7	0
		f	0	8	8	2

At this distance, when the dynamics of the string are low, the tone is dim and thin, and the sound is gentle according to the subjective sense of hearing. Although the sound is still relatively dim and thin, the tone is brighter, and the sound head is crisper compared with the performance of p-force. According to the subjective sense of hearing, when the dynamics of the string are mf, the tone is brighter, stronger, and fuller than that with the dynamics of p or mp. When the dynamics of the string are good, the tone is loud, solid, and sometimes harsh in the process of pulling the string.

Guhu, mentioned by the author, is a kind of guhu used in folk songs, which is a relatively traditional production method. Overall, it can be universal and representative in the embodiment of acoustic characteristics. Guhu's choices of wood, leather, and aggregate are all of the conventional variety.The making of Guhu plays an important role in its shape, structure, and acoustics. With the development of the times, the improvement of Guhu is also in progress, and the exploration of acoustic characteristics is also helpful to produce a more standard production process and new improvement scheme.

After more than two hundred years of development, the guhu has become a popular regional representative of national art as a street musical instrument. Firstly, this paper analyzes the historical origins of Guhu by sorting out historical documents. Secondly, the raw materials, tools, production points, and specific steps of Guhu are systematically recorded through interviews, observation, and personal experience. Finally, several acoustic measurements are made to explore the acoustic characteristics of Guhu. The paper deeply researched and analyzed the production process of Guhu and its acoustic characteristics in Guangxi, which makes up for the regret of a single research perspective and the insufficient depth of research on Guhu. The paper focuses on the core of technical practice and the theory of technical knowledge and fully demonstrates the culture and characteristics of Guhu.

5. Discussion

During making the Guhu, the material changes from natural materials to musical instruments that produce sounds of nature, which is the interaction between the luthier and the material, the interaction between the produced Guhu and the performer, and the interaction between the performer and the audience, all of which are the interactive display of the Guhu rooted in the culture of the Zhuang nationality area. In the old days, the productivity of the Zhuang people was relatively low, and they were affected by the natural environment, so they placed many good wishes on "God." This direct connection between man and nature reflects the existence of human autonomy and value. As a musical instrument for the Zhuang people to express their feelings and emotions, the Guhu also shows reverence for nature and the vision of communicating with the gods during play, which is flowing in the blood of Guhu culture. Returning to the production of Guhu, the luthier makes a horse bone, a piece of python skin, and a bunch of horsetails into people's favorite Guhu, which is not only a respect for the precious wealth presented by the natural environment to the Zhuang people but also a positive interaction for the needs of the performers. A good Guhu culture cannot be separated from the production process of Guhu, and the interaction between the luthier and the performers is the beginning of a wonderful rhythm (Jing & Changefei, 2021). There is also an interaction between the performer and Guhu. When performing the Guhu works, the performer understands the Zhuang culture on a deep level, the music connotation, the emotions that the composer wants to express, and his own performance skills. For example, Tan Dachuan from Guangxi Opera and Dance Theatre studied the Guhu performance through analyzing the music structure, melody style, and other aspects of Guhu's representative music, "Early Spring in Zhuang Village," and summarized the playing skills that should be paid attention to in the actual performance of the song so that the player can better control Guhu and music.

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