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A Study on the Sound Characteristics Analysis of Drum-Sound Rock

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Abstract: Palgong mountin near Daegu Metropolitan City has drum-sound rock which is known to play drum sound as if by magic. The drum-sound rock is about 3 m in size with a wide, flat surface and is reminiscent of a large drum. The drum has a structure in which diaphragms face each other with empty space in between. When strike one side both diaphragms and voids sound and the sound is sustained. The drum-sound rock also has two large plates facing each other and it is empty so that when the rock is hit, it resonates and sounds like a drum sound by continuing the sound through the empty space. In this study, sound from drums-sound rock of Palgong mountin is analyzed by sound engineering through comparison of spectrum and reverberation time it is scientifically investigate how similar it is to actual drum sound. Results of comparative analysis of each sound for drum sound, wooden gong sound, drum-sound rock. While the usual rock resonates at 1,700 Hz, the resonance frequency of about 250 Hz in the drum, about 600 Hz in the wooden gong about 400 Hz in the drum-sound rock appear, so that, the drum-sound rock has a sound component close to the drum sound. However, drum-sound rock has a reverberation time that is significantly shorter than drum sound which sometimes sounds like a wooden gong sound. The longer the reverberation time of the drum-sound rock sound, the more it sounds like a drum sound.

Key words: Palgong mountin, drum-sound rock, drum sound, resonance frequency, reverberation time, wooden gong sound

INTRODUCTION

A drum is a typical percussion instrument. It refers to a musical instrument that makes the animal's leather wrapped tightly at the butt end of the drum. It often means collecting several pieces of pine to form a drum frame and putting cowhide on both sides. The drum has a long history because of its simple structure it can easily find traces used in all parts of the world. We can see that the ancient sculptures of the ancient Orient of 3,000 BC have already been used in the drum in our music we can see that, it has already been used in the period of the three states. Drums have been used primarily for threatening animals or enemies for repulse for priests and magicians, for alarms and signaling instruments, for rhythmic instruments and melodic instruments for musical expression.

Located in "Daegu Metropolitan" and "Bugye-myeon, Gunwi-gun, Gyeongsangbuk-do", Palgong mountin has drum-sound rock which is popularly known for drum sound. The drum-sound rock is about 3 m in size with a wide, flat surface and is reminiscent of a large drum. When the first King of the Goryeo Dynasty was besieged by Hubaekje's army, 8 commanders including Sung-gyeom Sin, jumped on the enemy to save the first king of the Goryeo Dynasty. Palgong mountin was named in honor of 8 commanders. The drum sound from the rocks seems to inform us of the loyalty and spirit of the historical greats.

Generally, when you hit or hit a rock, most of the time you hear a blunt sound like "Puck Puck". However, some of the stones sound like drum sounds or wooden gong sounds. Most stones have a lot of impurities, no vibration the "Puck Puck" or crackling sound is very different from the drum sound. However, the Palgong mountin's drum-sound rock sounds like a drum sound or a clear wooden gong sound, depending on the position of the hit. This is because the inside of the drum-sound rock is empty the rock surface on both sides serves as a diaphragm the sound continues through the empty space (Kim *et al*., 2017a, b; Shon and Bae, 2004a, b; Na and Bae, 2000).

In this study, we analyze the sound of Palgong mountin's drum-sound rock by sound engineering and scientifically investigate how it resembles actual drum sound through comparison of spectrum and sound reverberation (Fig. 1 and 2).

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Fig. 1: Usual rock measurement/recording

Fig. 2: Drum-sound rock

MATERIALS AND METHODS

Basic theory of sound analysis

Three elements of sound: The sound is that the sound waves generated by the vibration of the object can be heard in the eardrum. These sounds can be classified into three characteristics for analysis and their characteristics are called the three elements of sound. The three elements of sound are classified into frequency, amplitude and duration of sound. Frequency is the number of times the sound vibrates for one second when moving in space. Amplitude refers to the degree of vibration of a sound and refers to the amount of energy that travels from the center to the maximum when moving in a periodic vibration or during a displacement unit time. The duration is the same size and height but the duration of the sound is different and the sound is different (Parsons, 1987; Bae and Lee, 1998).

Resonance frequency: Resonance refers to the phenomenon that an object vibrates at a large amplitude at a specific frequency. An object vibrates at its own frequency which is called the resonance frequency. At this time when the external force equal to the resonance frequency is periodically transmitted to the object, the amplitude of the vibration is greatly increased. This resonance frequency is the main sound component of the object when it is tapped (Bae and Lee, 1998).

Reverberation time: The reverberation time is the most basic measure to show room acoustic characteristics. When a sound source is generated in a room, a large number of reflected sounds are generated. When a reflected sound is viewed on a time axis, first and second reflected sounds arrive after a direct sound arrives to a listener when a sound source occurs. The reverberation time is the time until the sound pressure level falls-60 dB after the sound source is stopped. Equation 1 shows the reverberation time as a formula which is proportional to the volume and inversely proportional to the sound absorption rate (Bae and Lee, 1998):

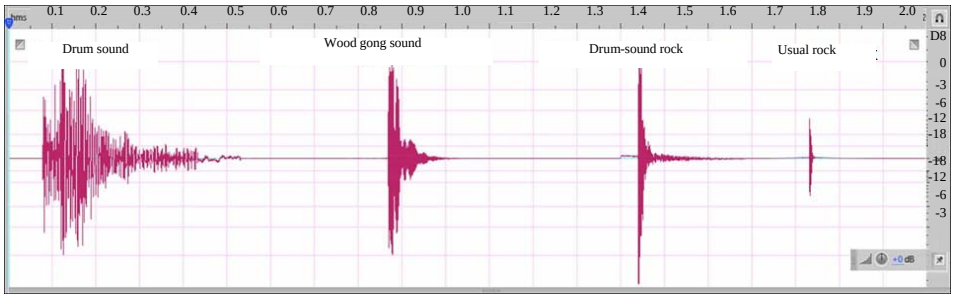
$$RT = \frac{0.161 \cdot V}{S\bar{a}} \quad (1)$$

The principle of sound generation of drum-sound rock: The drum and the wooden gong face each other with diaphragm the space between them has an empty space. When one of the diaphragms is struck, the diaphragm vibrates the other diaphragm vibrates due to the resonance. Then, the vibration is reflected again through the empty space the vibration continues to vibrate. Depending on the type of drum, it resonates at 150~500 Hz and the reverberation time lasts more than 0.1 sec. In the case of wooden gong, resonance occurs at 600~700 Hz depending on the type the reverberation time lasts less than about 0.1 sec. If the resonance frequency is low and the duration is long, it sounds like a drum sound. If the resonance frequency is high and the duration is short, it sounds like a wooden gong sound.

Palgong mountin's drum-sound rock sounds like a wooden gong sound and a drum sound depending on where you hit it. The drum-sound rock has two structurally large plates facing each other and the gap between them is empty, so that, the rock acts as a diaphragm, resonating through the space between them sounding like a wooden gong sound or drum sound do. You can not hear a wooden gong or a drum sound when you hit anywhere on the drum-sound rock. If you strike a surface that can act as a partially thin diaphragm, you will hear a sound if there is an accidentally created space in the course of rock formation, it will continue to sound like a wooden gong or drum (Kim *et al*., 2017a, b).

RESULTS AND DISCUSSION

Palgong mountin's drum-sound rock sounds very similar to drum sound or wooden gong sound when hitting. Therefore, we want to identify the sound components that make similar sounds by comparing the sound characteristics of Palgong mountin's drum -sound rock, drum wooden gong sound. The objects to be compared are "drum sound", "wooden gong sound", "drum-sound rock's sound" "usual rock sound". For each



(a)

Fig. 3: Comparing wave form of each sound source

Fig. 4: Frequency spectrum of each sound source

sound source, characteristics such as resonance frequency and reverberation time were compared and analyzed through sound waveform and spectrum.

The MOS test was performed to confirm that the drum-sound rock's sound of the Palgong mountin is actually similar to the drum sound and the wooden gong sound. When we adjusted the reverberation time of the drum-sound rock's sound, we asked how much it sounds like a drum sound or a wooden gong sound. MOS test was performed on 20 subjects without distinction between men and women the degree of the sound of each sound source as a drum sound or a wooden gong sound was shown as an average value. The sound source file was sampled at 11025 Hz and 16 bit quantized. The software used was audition CC and Cool edit pro 2.1.

Figure 3 shows the sound waveform for each source. In Fig. 3, the drum sound has a reverberation time of more than 0.1 sec, a wooden gong sound of about 0.07 sec and a drum-sound rock of about 0.05 sec. The usual rock has almost no reverberation time. The order of "drum sound <wooden gong sound> <drum-sound rock's sound> usual rock sound" continued to resonate.

Figure 4 shows the frequency spectrum for each source. Figure 4 shows the resonance frequency which is the main sound component of each object. The resonance frequency is about 250 Hz for a drum, about 600 Hz for a wooden gong about 400 Hz for a drum-sound rock. It is hard to say that the usual rock is resonance frequency but it reacted most at about 1,700 Hz. The resonance frequency measurement shows that the drum-sound rock resonates between the drum sound resonance frequency and the wooden gong sound resonance frequency which can sound like a drum sound and sound like a wooden gong sound.

Figure 5 is a spectrogram showing the frequency energy distribution over time of drum sound, wooden gong, drum-sound rock usual rock. The drum sound has a reverberation time of at least 0.1 sec while the

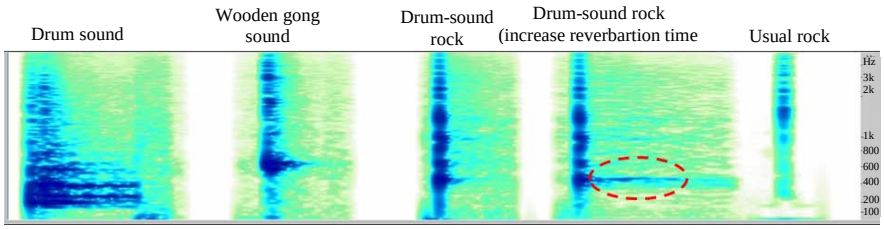


Fig. 5: Spectrogram of each sound source

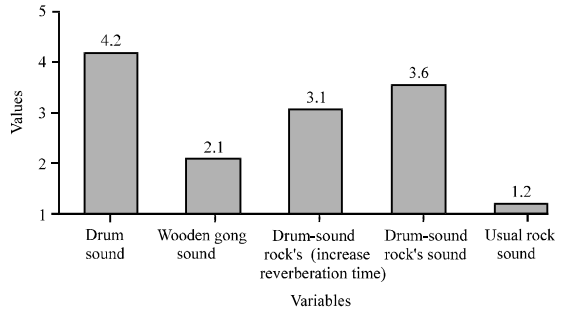


Fig. 6: MOS test result of similarity with drum sound and each sound

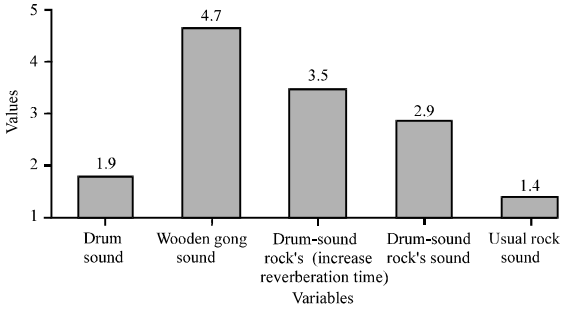


Fig. 7: MOS test result of similarity with wooden gong sound and each sound

drum-sound rock has a reverberation time of >0.05 sec. In addition, we compared the sound by increasing the reverberation time of the drum-sound rock to about 0.15 sec. By increasing the reverberation time of the drum-sound rock, we were able to feel a lingering imagery similar to the drum sound.

Figure 6 shows the results of the MOS TEST which shows the comparison average for the degree of sounding as a drum sound when listening to five sources ("drum sound", "wooden gong sound", "drum-sound rock's sound", "drum-sound rock's sound(Increase reverberation time)", "usual rock sound") without revealing the source of the source. The answer of the questionnaire is as follows (Very well, yes, I do not know, not drum sound, not very drum sound). The sound source that responded to the most drum sound except the drum sound was "drum-sound rock's sound (Increase reverberation time)" then the "drum-sound rock's sound" sounded like a drum sound. "Wooden gong sound" and "usual rock sound" did not sound like drum sounds.

Figure 7 shows the results of the MOS test which shows the comparison average for the degree of sounding as a wooden gong sound when listening to five sources ("drum sound", "wooden gong sound", "drum-sound rock's sound", "drum-sound rock's sound (Increase reverberation time)", "usual rock sound") without revealing the source of the source. The answer of the questionnaire is as follows (Very well, yes, I do not know, not wooden gong sound, not very wooden gong sound). In a question asking whether it is the same as a wooden gong sound, "drum-sound rock's sound" responded with a result (MOS 3.5) similar to the question of whether it sounds like a drum sound. On the other hand, the result of "drum-sound rock's sound (Increase reverberation time)" in the question of whether it sounds like a drum sound was 3.6 but in the question of whether it sounds like a wooden gong sound, the result was lowered to 2.9.

As a result of the above MOS test, drum-sound rock's sound has a result of 3.1 as to whether it sounds as a drum sound and 3.6 as to whether it sounds as a wooden gong sound. This means that drum-sound rock's sound can be heard as a drum sound and can also be heard as a wooden gong sound. This is a very high rate compared to the fact that the usual rock sound is not heard as drum sound or wooden gong sound. In response to the drum-sound rock's sound which increased the reverberation time to 0.15 sec, the response to sound like a drum sound increased and the response to sound like a wooden gong sound decreased. Because the drum sound is deep bass and sustained for a long time, we can see that the longer the duration of the bass component drum-sound rock's sound, the more it sounds like a drum sound.

CONCLUSION

The Palgong mountin has a drum-sound rock which is known for its magical drum sound. Drum-sound rock is

a drum-like structure with two wide plates facing each other. The gap between them is empty, so that, the rock that acts as a diaphragm is resonated the sound continues through the space between the drum sound and the wooden gong sound.

In this study, we analyzed the drum sound, the wooden gong sound, the drum-sound rock sound the usual rock sound through sound analysis. In addition, the MOS test including the case of increasing the reverberation time of drum-sound rock's sound was conducted and compared. As a result, the sound of drum-sound rock has a sound component similar to the resonance frequency of drum sound and wooden gong sound, so it can be heard as a drum sound and a wooden gong sound depending on the listener. Also, the longer the duration of the drum-sound rock's sound is, the lingering imagery is felt like a drum sound, so that, it sounds more like a drum sound. In order to regain a reputation for the name drum-sound rock, it should sound more like a drum sound by striking a rock hard with a large, heavy drumstick and making the sound last longer with enough vibration to make it sound like a drum sound.

Drum-sound rock is a specialty of Palgong mountin, a mystery created by nature. There are sounds around us that make the nature of our country meaningful, like Palgong mountin's drum-sound rock. By identifying these sounds, we can think about the mystery and beauty of our country again.

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