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Original Article

A Study on Foley Sound for Producing Thunder Sound

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Abstract *- This paper studies the Foley Sound of Thunder, one of the Foley Sound tools used to produce radio dramas in the early days of broadcasting. This study introduces the Foley Sound tool and its sound for producing Thunder Sounds and analyzes and verifies its principles and ideas. The thunder Foley Sound tool and the sound obtained through this process will be developed into various sound contents. This paper will examine the creative production principles and interesting usage methods of the Thunder Foley Sound tool and compare/analyze and verify the Thunder Foley Sound with Actual Sounds to determine and establish whether Thunder Foley Sound has value as sound content. Based on the research results, this study will preserve materials in the field of sound effects that deal with broadcast-related sounds while also exhibiting and allowing people to experience the unique methods and sounds. Sound contents are tangible and intangible products with various expected material values such as education, exhibition/experience, performance, space utilization, and practical use created with contents related to sound, and their development potential and potential value are high. Thunder sound polysound can be used as new content utilizing sound.*

Keywords *- Radio drama, Foley Sound tool, Thunder Sound, Sound Content, Sound Effects*.

1. Introduction

In radio or TV dramas, sound effects are divided into background sounds that explain the scene and purpose sounds that express the movement of characters or objects. Background sounds are used as the background, purpose sounds are used appropriately, and the actors' performances are expressed more realistically. The Thunder Sound that we will discuss in this paper can be used as both background sounds and target sounds in radio dramas or TV dramas. When it only expresses the scene's environment, the background sound has a greater meaning, and when it is involved in the event motif and gives it an important meaning, the target sound has a greater meaning. In other words, there are cases where the sound of thunder expresses bad weather and where its meaning is deepened and is used for a clear purpose, such as a hint of an event that will occur in the future or a device to induce fear. In radio dramas, a genre that expresses only through sound, sound effects are an essential sound element to create a sense of three-dimensionality and realism in the play. Among them, the tool that creates the sound of thunder is interesting and original in terms of creativity and originality and can be utilized as various sound content. Such sound contents have the potential to be developed as performances, exhibitions, experiences, or creative sound education content. The research method is to compare and analyze the Thunder Sound Foley Sound created using the tool with the Actual Thunder Sound to prove the similarity and to study the production principle and usage method. The research purpose is to apply the creativity and originality of the Thunder Foley Sound tool and its usage method to sound content and study it as various contents. The actual thunder sound for the study is a high-quality sound material verified and used as a sound effect in broadcasting stations. The thunder Foley sound was recorded in the studio with a digital recorder (ZOOM, H2) by generating sound using a tool. The program for analysis was Adobe's Audition program, which was used to score originality and similarity. The MOS test was used. [1, 2]

2. Study of Thunder Sound Foley Sound

Thunder Sound is a sound caused by shock waves generated by the lightning phenomenon caused by friction between cloud layers in the Earth's atmosphere and the difference in charge between cloud layers and the ground surface, causing the surrounding air to expand and explode, generating a tremendous amount of current and high temperatures. In other words, thunder is a phenomenon that appears in addition to lightning. Lightning is light, and thunder is sound, and there is a big difference between light and sound until humans perceive them. The speed of light is 300,000 km/sec and the speed of sound is 340 m/sec, so after lightning appears as light, the sound of thunder is transmitted to human ears with a difference of several seconds depending on the distance. In other words, the sound of thunder is perceived at different times depending on the distance from the lightning's epicenter to the listener's location. However, when expressing lightning and thunder in plays, movies, and broadcasts,

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especially dramas, they use expressions that are somewhat out of common sense. In other words, in plays, dramas, broadcasts, and TV dramas, lightning scenes are expressed with both the light of lightning and the sound of thunder, and in radio dramas, lightning is described with the sound of thunder. The reason is that it is a broadcasting technique that is implicitly accepted and forced upon the audience or viewers due to the flexibility of directing in the development of the play. In the early days of broadcasting, when portable recorders did not exist, it was impossible to record actual thunder, so tools were used to record thunder. After portable recorders became popular, it became possible to record not only thunder but all sounds using recorders. So gradually, that interesting Foley sound disappeared, and only a few traces remained. Such regret the idea was to discover the disappearing polysound and use it as various sound contents. As part of this, the polysound of thunder used in the early days of broadcasting was reproduced and verified through this thesis. Sound contents are performances using sound or various materials, such as exhibition experience content and educational sound teaching materials, which can be used.

2.1. Creating a Thunder Foley Sound Tool

In order to create any Foley Sound, you must closely analyze the characteristics of the Actual Sound you want to describe. It is important to understand the principles of lightning and the resulting thunder phenomenon for the Thunder Foley Sound tool. Thunder Sound comprises a strong impact expansion sound and a rumbling sound. The strong Impact Sound is a momentary expansion sound caused by the high heat of lightning, and the rumbling sound is a reverberation sound caused by the waves of the expansion sound. In order to create a sound Foley Sound tool, it is also important to listen to the Actual Sound repeatedly and decide which tool to use to generate the corresponding sound.

In order to create a Foley Sound, you must analyze the actual sound based on the three sound elements. In other words, you must analyze the timbre, scale, and volume of the actual sound you want to imitate. The timbre of the thunder sound is a strong plosive sound, and the scale occurs with changes in high and low tones. The volume of the thunder sound must be expressed very strongly and loudly. [3, 4] The sound of thunder must be made by distinguishing between an impact sound and a rumbling sound because it must be a strong, instantaneous sound and the resulting resonance must be in a low- to mid-range for a long time. The tools that make this momentary frictional sound and rumbling sound are paper or drums, but paper or drums do not make sounds that explode or expand and burst; rather, they make sounds by clumping together and then gradually resonating. The sound of thunder is a strong, single, piercing sound that seems to break, close to an explosion. In the process, a tin plate was prepared as a tool suitable for imitating the sound of thunder.

Figure 1 (a) is a Thunder Sound Foley sound tool. A thin tin plate is hung on a wooden frame, and the sound is made by striking it with a stick or shaking it to create a Thunder Sound that matches the shape of lightning in Figure 1 (b). To imitate the Foley sound of thunder, a large piece of tin is struck with a stick to create a loud impact sound, and then the tin is shaken to create a low-pitched rumbling sound.

2.2. How to Use Foley Sound Tool for Thunder Sound

The method of generating Thunder Sound using the Thunder Sound Foley Sound tool can be expressed in a variety of ways depending on how the Thunder Sound Foley Sound tool is used. The Thunder Sound Foley Sound tool was created by studying the principle of Thunder Sound generation, and the sound generated by the tool can be appropriately expressed according to the thunder situation.

(a) Thunder Foley Sound Tool

(b) Lightning

Fig. 1 Thunder foley sound tool

In other words, the Actual Thunder Sound comes from lightning, and the lightning is the sound that comes from the interaction between clouds and clouds, and clouds and the ground surface, causing a 30,000-volt instantaneous current to rapidly generate high heat and expand and explode the surrounding air. In order to imitate the Thunder Sound, which is an instantaneous explosive sound caused by lightning, first strongly impact the Thunder Sound Foley Sound tool to make a sound and shake it lightly to imitate the rumbling phenomenon. It is also a good method to practice while listening to Actual Thunder Sounds. Impact and rumbling are important when using the Thunder Sound Foley Sound tool. In the above Figure 1, a is a plate-shaped thunder Foley Sound tool. It can be hung up and struck hard to create impact, and it can be struck lightly to create rumbling. Alternatively, it can be held in both hands, strongly crumpled, and then spread out to create impact.

It can also be gently shaken to create rumbling sounds. The tool for making thunder sounds is a sturdy wooden frame, as shown in Figure 1a, that is neither too thin nor too thick, about 0.5 mm thick, and is about 1.5 m wide and 2 m long. A flat square sheet of tin must be prepared by hanging it. The hung sheet must have enough clearance to make a sound when struck with a bat and must be installed so that the sound reverberates when shaken. When using the thunder Foley sound in a radio drama, it is necessary to use an autonomous sound. When used in a TV drama, the sound must be generated in accordance with the lightning shape in b of Figure 1. The most important thing to keep in mind when creating a thunder sound Foley sound is that the first sound must be very strong and appealing. This is because the sound of thunder is mainly used in scenes that provide shock in extreme situations. When used as sound content, it will be an effective tool as content if the sound is created strongly. [5, 6]

3. Comparison and Analysis of Foley Sound and Actual Thunder Sound

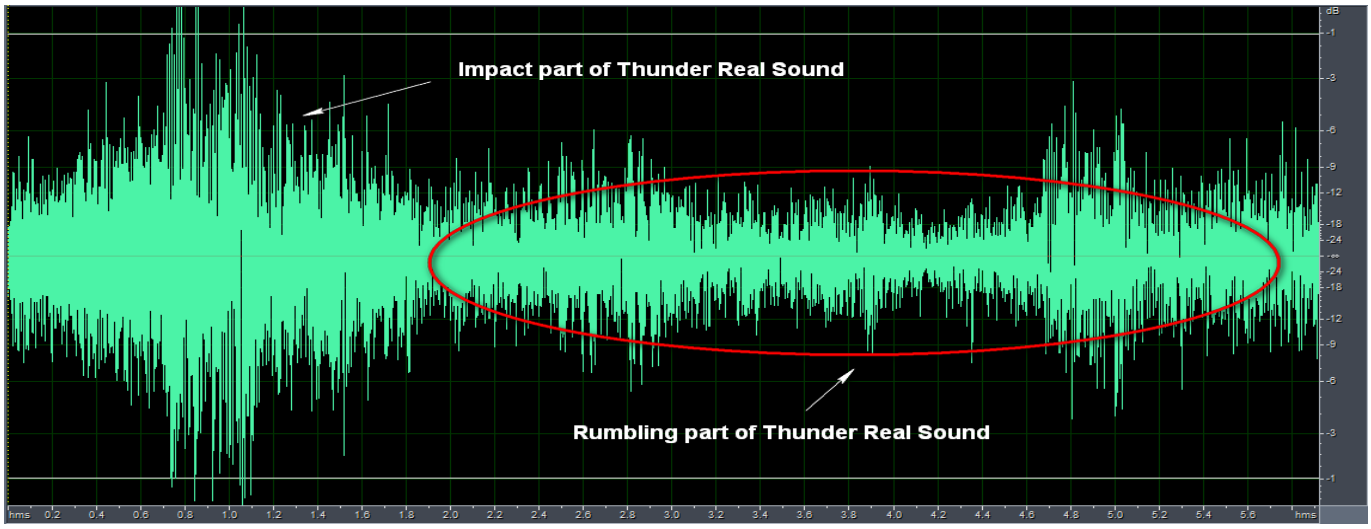
In radio dramas, thunder has both background and target sound elements. When used as background sound to express bad weather during the rainy season, it is used with rain sounds, the impact sound is expressed small, and the rumbling sound is used a lot. When used as a target sound to express fear or to suggest an event, the impact sound is expressed more emphasized. In order to find out the similarities and differences between the Thunder Sound Foley Sound and the Actual Sound, the strong impact sound, which is a characteristic of thunder, and the low mid-low sound, the rumbling sound, must be compared. Actual Thunder Sound was recorded for the study, and the Foley sound of Thunder Sound was compared and analyzed. In the comparison and analysis of Thunder Sound, the parts that should be particularly focused on are the explosive burst sound and the frequency characteristics and resonance characteristics of the subsequent rumbling. Through Time domain analysis, the intensity of the impact and the frequency of the rumbling were analyzed; through Spectrum analysis, the distribution of the sound band was analyzed; and through Spectrogram analysis, the tone, sound quality, and volume were analyzed. [7]

3.1. Time Domain Analysis for Thunder Sound

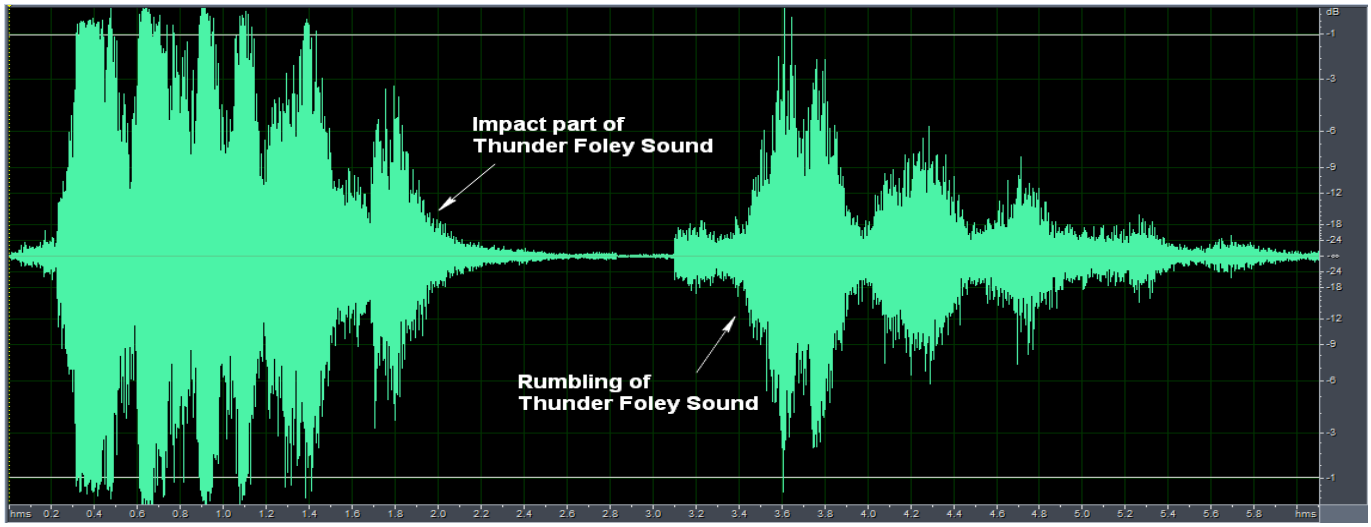
The Thunder Sound has the main sound of Impact Sound and the sub-sound of Rumbling Sound. That is, the beginning sound is a strong, explosive sound that surprises the surroundings, focuses them, and energizes them. The sound that follows is a soft and heavy low sound that comforts and reassures the surprised heart. The Thunder Sound has no regularity or musicality, but it strongly overwhelms the atmosphere, dominates the surroundings, and creates momentary immersion and tension. Figure 2 shows the characteristics of Thunder Sound through the Time Domain analysis of the Actual Thunder Sound and Foley Sound. First, looking at the Actual Thunder Sound of a, you can see that the sound expression is thick and natural, and the Thunder Sound Foley Sound of b shows a similar pattern. This is a trace of the effort to make the Foley sound similar to the Actual Sound, and you can see that it is quite artificial and exaggerated. However, the similarity of the sound is high, and it has the potential to be fully utilized as a symbolic effect as the Thunder Sound.

3.2. Spectrum Analysis for Thunder Sound

In order to compare the characteristics of the Actual Thunder Sound and the frequency band of the Foley Sound, the spectra were compared and analyzed. Since the Thunder Sound is divided into the impact part and the rumbling part, the spectrum analysis was also divided into a comparison of the Actual Sound of the impact part and the Foley Sound and a comparison of the Actual Sound of the rumbling part and the Foley Sound. Looking at the comparative analysis of the impact part, the graph shows that the Actual Thunder Sound produces a strong low tone of -20dB in the low frequency below 200Hz and drops steeply to -74dB above 10,000Hz. The spectrum of the Foley Sound of thunder shows a low tone lower than the Actual Sound at -32dB in the low-frequency part of 200Hz but rather shows a curve that rises to -28dB from 600Hz to 2,000Hz and then gradually decreases above 10,000Hz to reach -52dB. The graph shows that both the impact sound and the rumbling sound have more Foley sound emphasis than the actual sound. [8] As shown in Figure 3, the fact that the Actual Sound of thunder produces strong low-frequency sound in the low-frequency range is a phenomenon in which the energy of the strong expansion sound unique to thunder is added to the common low-frequency characteristics of natural phenomena. The Thunder Foley Sound also tried to express the low-frequency band with strong energy, but since it is a tool used in a studio, the scale is small, and the scale of the recording environment is limited, so there is a limit to obtaining more low-frequency effects. However, if we continue to research and improve the Thunder Sound tool, it is expected that we will be able to imitate even more similar Thunder Sounds. [9, 10]

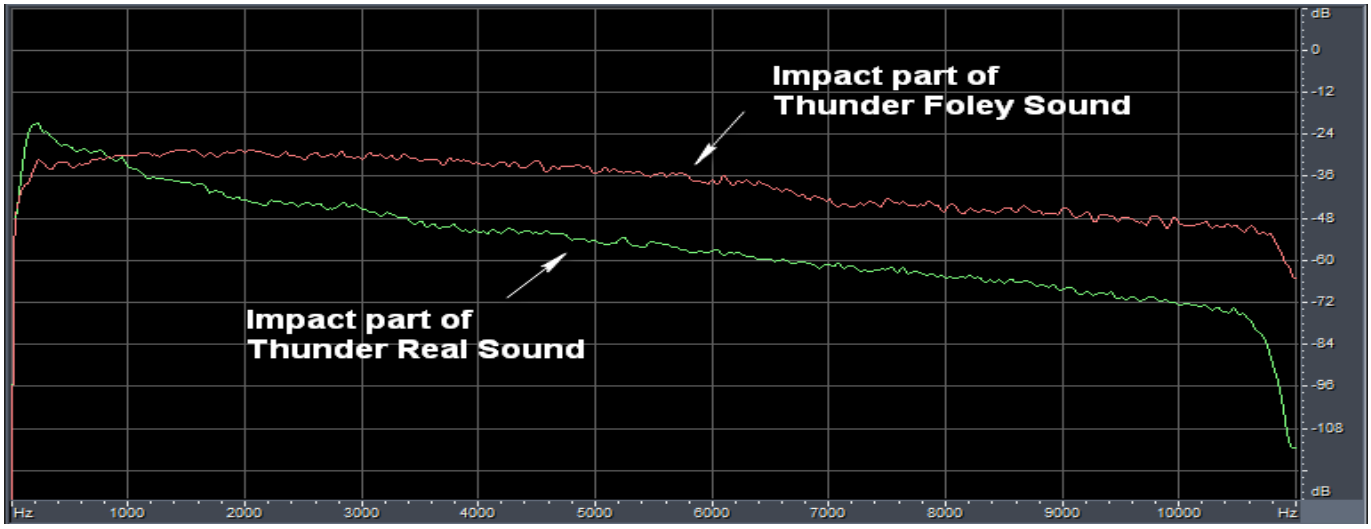


(a)Thunder actual sound time domain

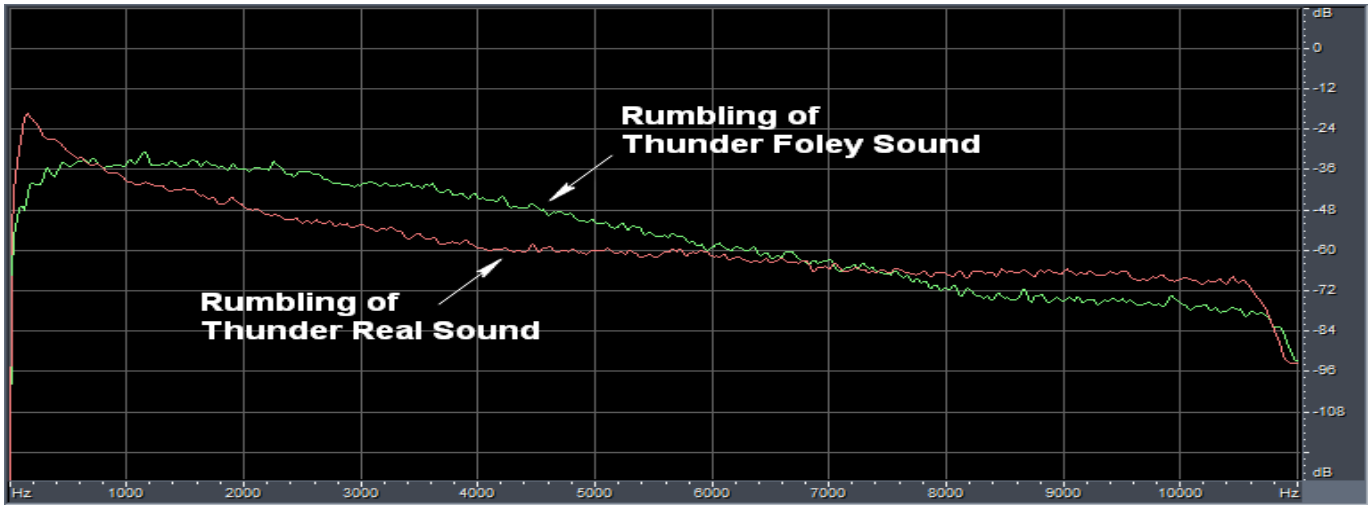


(b) Thunder foley sound time domain

Fig. 2 Time domain analysis of actual thunder sound and foley sound

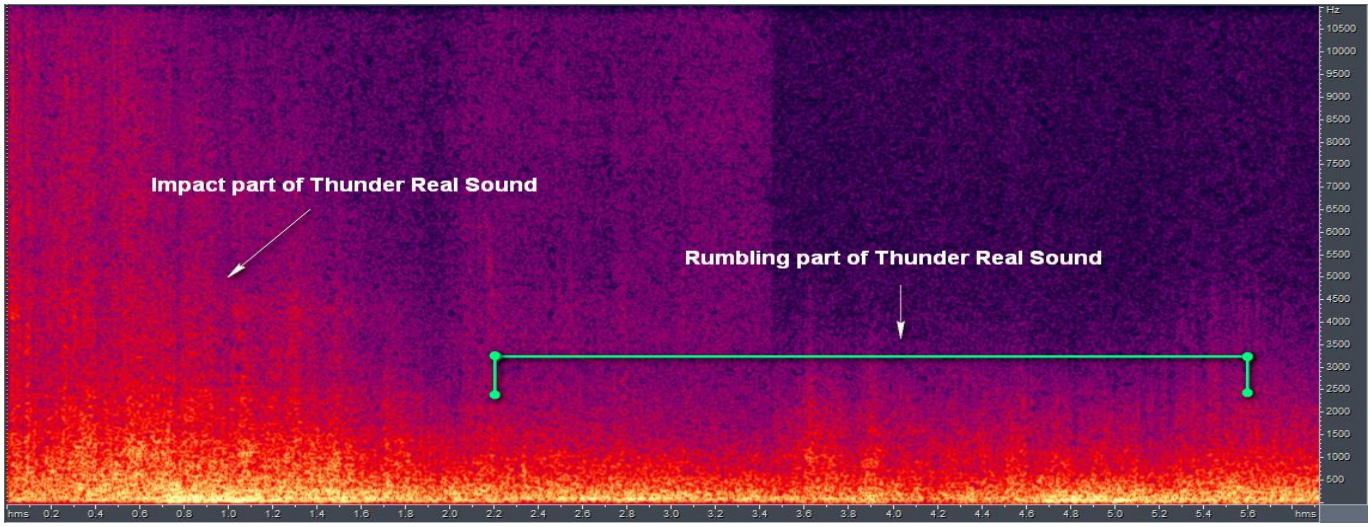


(a) Compare actual sound and foley sound for an impact

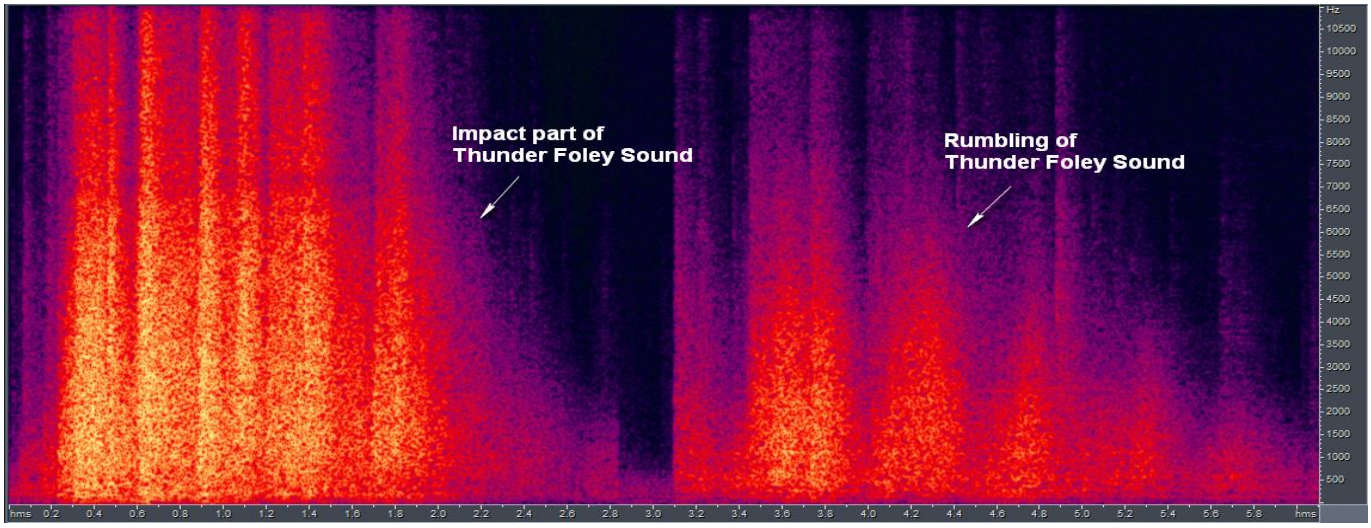


(b) Compare Actual Sound and Foley sound for rumbling

Fig. 3 Analysis of an average spectrum for actual and foley thunder sound



(a) Spectrogram of Actual Thunder Sound



(b) Spectrogram of foley thunder sound

Fig. 4 Spectrum analysis of actual thunder sound and foley sound

3.3. Spectrogram Analysis for Thunder Sound

By comparing and analyzing the spectrogram of the Actual Sound of thunder and the Foley Sound, we aim to prove the similarity by more clearly confirming the distribution and component elements of the sound, as well as identifying the differences and suggesting areas for improvement. The Thunder Sound is composed of an Impact Sound and Rumbling Sound.

In the spectrogram of the Actual Thunder Sound in Figure 4(a), the overall low-frequency sound is expressed with strong energy, and the impact part shows even energy across the entire band. After that, it weakens from 4000 Hz and disappears further from 4,500 Hz, and no energy is expressed from 5,000 Hz. This well represents the characteristics of the rumbling phenomenon, which is a phenomenon in which electric charges are generated between clouds and clouds and between clouds and the ground, causing an expansion explosion, and the amplitude reaches 15 km and disappears.

In addition, the unique characteristic of the Actual Sound, white noise, is more clearly expressed in the impact part, and is also expressed weakly in the rumbling part, but across the entire band. Figure 4 (b) is the spectrogram of the Foley Sound of Thunder, and it is expressed by dividing it into the impact part and the rumbling part like the Actual Thunder Sound, but there are many differences. The impact part shows considerably stronger power in all bands, including low, mid, and high frequencies, than the Actual Sound and the rumbling part also shows strong power up to a considerably high-frequency range. Also, it is difficult to find white noise seen in the Actual Sound. This is a common difference between the Actual Sound and Foley Sound and is an area that requires additional research [11, 12].

4. Result

The results of the Time Domain analysis clearly distinguished the characteristics of thunder, namely, impact and rumbling phenomena. The Actual Sound could analyze the rough impact phenomenon and the diverse and natural rumbling phenomenon, and the Foley Sound could observe the Impact Sound, which seemed more organized but stronger than the Actual Sound and the Rumbling Sound, which was shorter and clearer than the Actual Sound.

In the spectrum analysis, the Actual Thunder Sound and the Foley Sound were not compared as a whole, but were compared and analyzed by dividing them into a comparison of impact parts and a comparison of rumbling parts. As a result, the Actual Thunder Sound could be seen to have strong energy concentrated in the low-frequency band in the impact and rumbling parts and gradually weakening from the mid-frequency part to the high-frequency part. The Foley Sound had weaker energy in the low-frequency part than the Actual Thunder Sound, but it could maintain higher energy than the Actual Sound evenly in both the impact and rumbling parts up to the mid-frequency and high-frequency parts. The spectrogram analysis results show that the Actual Thunder Sound clearly distinguishes between the impact and rumbling parts and that strong low tones are continuously expressed. The Foley Sound has a clear distinction between the impact and rumbling parts compared to the Actual Thunder Sound, and it is expressed clearly and artificially without surrounding reverberation because it was created in a studio. The various research results above show that the Actual Thunder Sound is composed of the impact and rumbling parts and that it occurs irregularly but dynamically. Although the Thunder Foley Sound reflects and describes such characteristics, it is insufficient to imitate the energy of the low tones, and the mid- and high-frequency parts are too exaggerated. However, it was found that they are expressed similarly in terms of the overall sound composition.

5. Conclusion

The Thunder Sound does not have a beat, rhythm, and uniformity. However, it is composed of rough and strong impact and irregular rumbling, so the analysis was focused on describing the characteristics. The analysis results showed that the Foley Sound sound showed higher high notes overall in the impact and rumbling parts than the Actual Thunder Sound. The Thunder Sound Foley Sound is similar to the Actual Thunder Sound, where a loud bursting sound is combined with resonance, created using a tool.

The Foley Sound tool for the Thunder Sound was selected as a tin plate based on empirical thinking and common-sense judgment while listening to countless Actual Thunder Sounds. The method of use is to create the impact of the strong bursting sound of the Actual Thunder Sound momentarily and then express some rumbling, so the Thunder Sound Foley Sound tool is strongly struck and then struck more gently for a while, or it is expressed by shaking instead of striking. In the future, continued research is needed to supplement the energy of the low-frequency part and the resonance characteristics of the mid and high-frequency parts. In particular, Foley artists should strive to produce more effective sounds by handling the Foley Sound tool with larger movements and more powerfully.

In this way, the shape of the tool and the appearance of the Foley artist handling it can be sufficiently sublimated into a performance on stage, and it is expected that it will be able to serve as performance content with sufficient value as a nonverbal performance. In addition, if the Foley Sound tool is displayed and the audience is allowed to directly observe and handle it, it can be recognized as an exhibition experience sound content. Furthermore, it was concluded that the Foley Sound tool and its unique usage method are valuable as creative educational content. The novel tool and interesting usage method of the thunder sound Foley Sound are together with the sound generated by it. It will be an excellent resource for sound content such as performances, exhibition experiences, and educational programs.

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