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Study on the Sound Transmission Characteristics of Rescue Signal 'Ya-Ho'

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Abstract:

When we climb the high mountain, we yell 'Ya-ho'. However, it is a noise pollution that gives damage to the creatures living in the mountain to shout loudly 'Ya-ho' on the mountain. The actual meaning of 'Ya-ho' is a global common rescue signal that requests rescue in voices at close range. There are so many words to ask for a rescue. However, 'Ya-ho' sounds very loud and can be heard relatively well. In this paper, we tried to find out how far 'Ya-ho' could be heard by comparing and analyzing several words that request rescue. As a result of the sound analysis, 'Ya-ho' has a very simple phoneme configuration, which makes the mouth wide open and loud. As the voice is opened wide, the pronunciation becomes clear, the tone frequency of the voice becomes high, and the harmonics become clear to the high frequency. In addition, 'Ya-ho' sound composition is very simple, and the frequency component is clear up to the 4KHz band, so it is easy to understand it as 'Ya-ho' even if it sounds small from far away. This 'Ya-ho' is very suitable as a rescue signal because of its ability to recognize 'Ya-ho' from far away.

Keyword: '*Ya-ho', Rescue Signal, Sound Analysis, Phoneme, Harmonics, Frequency Component*

1. INTRODUCTION

We want to cry out loud to the panoramic view after a long time in the mountains. When I climb the top of the mountain and look out over the mountain and yell 'Ya-Ho' in a loud voice, the sound echoes to me and says 'Ya-Ho'. In Korea, 'Ya-Ho' is being used as a way to reduce stress by spreading my spirit to the high mountains and voicing vigorously. People often come to the mountains and cheerfully shout in foreign countries, not Korea. However, for those living in the mountains, the sound of 'Ya-Ho' in the mountains is a very serious noise pollution. Screaming near the animals in the mountains gives a very high level of tension and stress. In particular, it is known to cause great damage to birds. Birds are said to give up their spawning or to break eggs that are hatching due to the sound from the mountains. It is even said that they leave their young ones. In recent years, awareness of nature protection has increased, and shouting 'Ya-Ho' is shameless. So much shouting 'Ya-Ho' in the mountains is much less. In fact, 'Ya-Ho' is a global common rescue signal that requests rescue with voice when it is close. 'Ya-Ho' was originally derived from German's 'johoo', and the Alpine Highlands shepherd shouted to announce its location. It was then spread by the rescue request signal by professional mountain climbers and mountain rescue workers in the Alps, and the pronunciation became 'Ya-Ho' (ya-hoo). 'Ya-Ho' written in Europe came to Korea through Japan, and it was mainly used as a cry for the great spirit in addition to its original rescue signal. In fact, 'Ya-Ho' is a rescue signal of the global common, so it is not appropriate to shout 'Ya-Ho' on the mountain comfortably. The global common rescue signals such as 'Ya-Ho' include 'SOS', which is mainly used as a Morse code, and 'Mayday', which is used in transmission telecommunication. Also, in each country there are 'Help me' (English), 'Dowajuseyo' (Korean), 'Helfe' (German), and 'Au Secoure' (French) such as 'Ya-Ho' [1-3].

'Ya-Ho' has a very simple phoneme structure compared to other rescue signals and is very convenient to pronounce. It is also advantageous for the speaker to speak very loudly because he can pronounce his mouth wide open. For a variety of reasons, if you request rescue using voice, it is very advantageous to say 'Ya-Ho'. For this reason, the ancient shepherds of the Alps would have shouted 'Ya-Ho' to tell their location [4-6].

In this paper, we tried to find out how far the 'Ya-Ho', the global common rescue signal, is heard through sound analysis. In Chapter 2, the basic theory of speech signal processing for 'Ya-Ho' is analyzed. In Chapter 3, experiments and results are discussed. Chapter 4 concludes.

2. BASIC THEORY OF SPEECH SIGNAL PROCESSING

2.1 Phoneme

The phoneme is the smallest unit of sound that distinguishes the meaning of words and is divided into vowels and consonants. When articulating, the phoneme coming out without disturbance of the articulator is separated into vowels, and the consonant is distinguished from the phoneme which does not sound alone without the vowel, while being obstructed by the articulator. Korean phonemes are 19 consonants and 21 vowels [7-9].

2.1.1 Vowel

The vowel can make a sound without the consonant by the sound of the air from the lung coming out of the neck or mouth without clogging. Korean vowel has single vowel and diphthong. The single vowels are ‘ㅏ(a), ㅐ(ae), ㅓ(eo), ㅔ(e), ㅗ(o), ㅚ(oe), ㅜ(u), ㅟ(wi), ㅡ(eu), ㅣ(i)’. And the diphthongs are ‘ㅑ(ya), ㅒ(yae), ㅕ(yeo), ㅖ(ye), ㅘ(wa), ㅙ(wae), ㅛ(yo),

ㅝ(wo), ㅞ(we), ㅠ(yu), ㅢ(ui)' that make a sound by moving their lips or tongue. Figure 1 is a vowel quadrangle showing the position of the tongue when pronouncing the vowel [7-9].

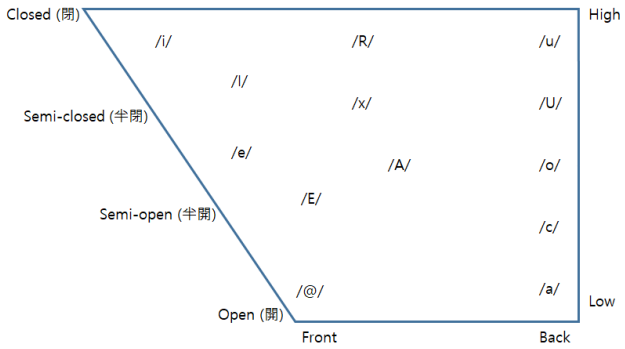

Fig 1. Vowel quadrangle [8]

2.1.2 Consonant

The consonant is the sound of the flow of air coming out of the lung as it is interrupted in the neck or mouth. And the consonant can only make a sound if it has a vowel. Consonant is divided into 'labial sound, coronal consonant, palatal, velar, guttural sound' according to the sound position, and 'plosive, affricate, fricative, nasal, liquid sound' according to the sounding method. It is divided into 'usual sound, tense sound, strong sound' depending on the strength of 'plosive, affricate, fricative'. The distinction of Korean consonants is shown in Table 1 [7-9].

Table 1. Distinction of consonant of Korean

Classification		Labial sound	Coronal consonant	Palatal	Velar	Guttural sound
Plosive	Usual sound	ㅂ(b)	ㄷ(d)		ㄱ(g)	
	Tense sound	ㅃ(pp)	ㄸ(tt)		ㄲ(kk)	
	Strong sound	ㅍ(p)	ㅌ(t)		ㅋ(k)	
Affricate	Usual sound			ㅈ(j)		
	Tense sound			ㅉ(jj)		
	Strong sound			ㅊ(ch)		
Fricative	Usual sound		ㅅ(s)			ㅎ(h)
	Tense sound		ㅆ(ss)			
Nasal		ㅁ(m)	ㄴ(n)		ㅇ(ng)	
Liquid sound			ㄹ(r)			

2.2 Frequency spectrum & spectrogram

The sound changes with the passage of time, and sounds different depending on the type of change. This change can be attributed to the variation of the frequency component combination that the sound has over time. Therefore, the sound signal can be analyzed as a frequency domain signal. The frequency domain represents the relationship between the magnitude of the signal and the frequency as an independent variable. The sound signal in the time domain can be represented by frequency domain information through Fast Fourier Transform (FFT). This information in the frequency domain can be used to analyze how the sound is made up of a combination of frequency components and how the combination changes over time. The combination of these frequency components and their changes may indicate what the sound is meant to be, and may also represent the unique characteristics of an individual or an object. In the frequency domain, the frequency spectrum is the representation of the magnitude of the signal on the vertical axis with the horizontal axis as the frequency, and the frequency spectrogram represents the degree to which the magnitude of each frequency component varies with the passage of time [10-14].

2.3 Loudness characteristic

Individuals may have individual differences, but it is said that they can usually hear sounds of 20 to 20 kHz. Among these, the section where the person can hear the sound best can hear the smallest sound at about 4 KHz. However, the sound of the low frequency region is less sensitive to the ear, and the low frequency sound becomes very difficult to perceive by the auditory sense. Also, the larger the sound, the less the sensitivity of the ear to the frequency change. This is the equal loudness contour that represents the sensitivity of the ear to the sound. The equal loudness contour is a curve of lines connecting the sound pressure levels of different frequency ranges with the same sensitivity as the dB value at 1 KHz. A line representing the same sensitivity based on the dB value of 1 KHz is expressed in the unit of Phone. In the equal loudness contour, the sound level that can not be heard by humans is 4.2 dB at 1 kHz, which is called the minimum audible pressure level. Figure 2 shows the equal loudness contour calculated

using the equal loudness coefficient [14-15].

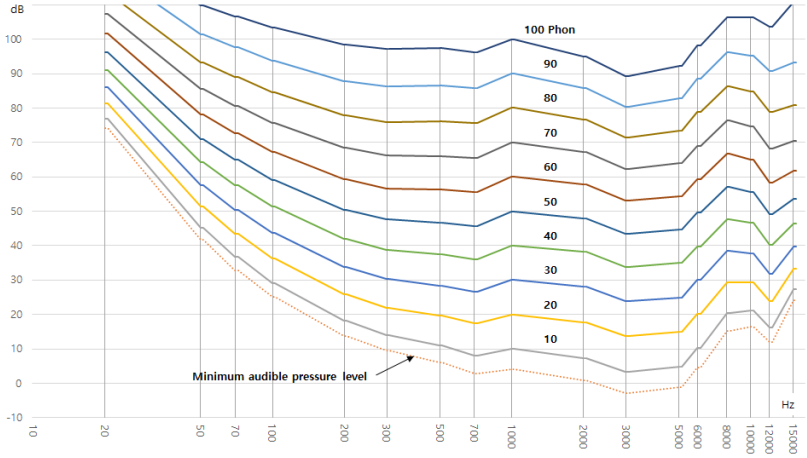

Fig 2. Equal loudness contour [14]

3. EXPERIMENTS AND RESULTS

In this study, the sound component was compared and analyzed with various rescue request signals in order to confirm the transmission characteristics of the rescue signal 'Ya-Ho'. In this study, the sound component was compared and analyzed with various rescue request signals in order to confirm the transmission characteristics of the rescue signal 'Ya-Ho'. First, even if I said the same thing as 'Ya-Ho', I did see how the results of speaking with large sound differ from those with speaking with small sound. Second, rescue request signals such as 'Help me' (English), 'Dowajuseyo'(Korean), 'Hilfe' (German), 'Au Secoure' (French) and 'SOS' were compared with 'Ya-Ho' , To see which signal hearing better in the ear. Figure 3 shows the frequency spectrum of a sound source with 'Ya-Ho' as a small sound, medium sound, and large sound.

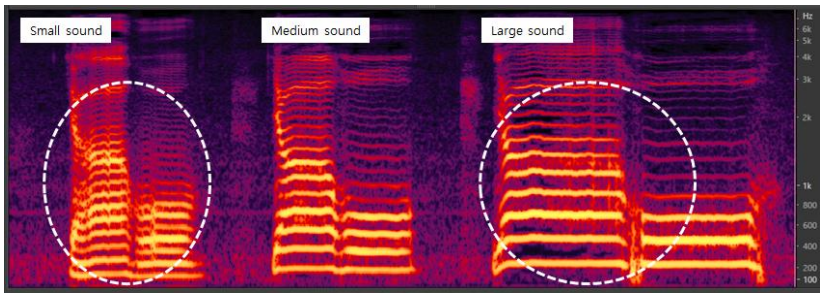

Fig 3. Frequency spectrum for 'Ya-Ho'

Figure 3 shows that even with the same 'Ya-Ho', loud shouting increases the fundamental frequency and the harmonic structure becomes clearer up to 4 KHz than small shouting. In addition, the difference between the sound frequency band and the non-sound frequency band becomes clear, and the sound becomes clearer. In order to make the sound louder, you have to open your mouth wide. If you shout "Ya-Ho", the movement of the tongue in your mouth becomes smooth and the pronunciation becomes clear. Also, if you make a loud voice with your mouth wide open, the air from the lung flows well without clogging and the vocal organ is less disturbed and the tone of the voice becomes higher and hearing better.

Figure 4 is a frequency spectrogram showing the sound components of various rescue request signals. Figure 5 is a frequency spectrogram of the sound that is predicted to be heard about 400m away from the sound component of Figure 4. The sources used in the analysis were collected to screaming loudly for each rescue request signal in the anechoic room. The sound at a distance of 400m is predicted by applying a distance attenuation which decreases the sound size by 6dB when the sound is twice as far away.

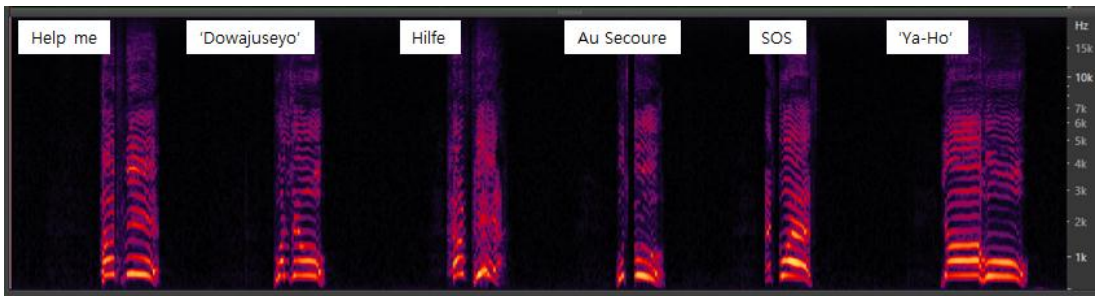

Fig 4. Frequency spectrograms per rescue signals

Figure 4 shows that most rescue request signals except for Ya-Ho have a rather complicated sound component structure. In the case of 'Ya-Ho', the phoneme information is very simple as 'ㅑ(ya)', 'ㅎ(h)', and 'ㅗ(o)'. Especially, 'ㅑ(ya)', 'ㅎ(h)' and 'ㅗ(o)' have no phoneme that interfere with air emission such as affricate, plosive, and can make loud sounds without changing sound. On the other hand, 'Help me'(English), 'Dowajuseyo'(Korean), 'Hilfe'(German), 'Au Secoure'(French) and 'SOS' have a very complicated phoneme structure compared to 'Ya-Ho', and it can be seen that it is difficult to shout confidently by making sounds that block or interfere with the radiating air like 'ㅍ(p)', 'ㅊ(ch)', 'ㅋ(k)' and 'ㅅ(s)'.

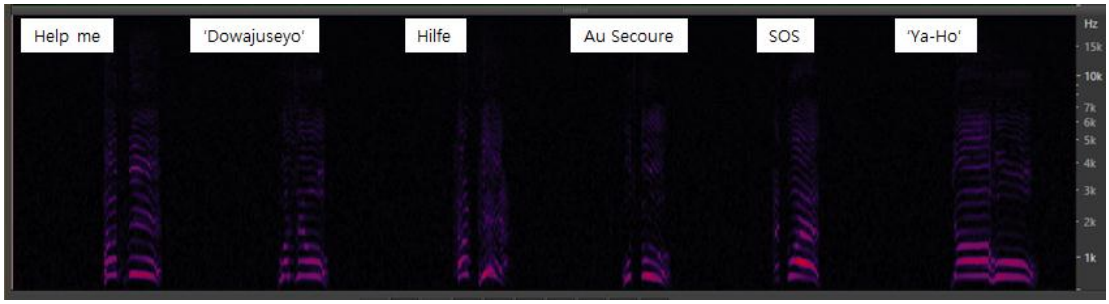

Fig 5. Sound component predicted at 400m far away

Figure 5, which predicts the sound heard at a distance of 400m, shows that the shape of the sound component is not much different from that of Figure 4, even though the sound intensity is somewhat smaller in the case of 'Ya-Ho'. However, in the case of other rescue request signals, it is difficult to distinguish the sound components as shown in Figure 4 in Figure 5. In addition, 'Ya-Ho' sounds are somewhat higher in frequency than other rescue request signals, and can distinguish harmonics in the 4KHz band, where people can hear the sound best.

Table 2. Hearing distance measurement result per rescue signals

Rescue request signal	200m	220m	240m	260m	280m	300m	.....	400m
Help me (English)	O							
'Dowajuseyo' (Korean)	O	O	O					
Hilfe (German)	O							
Au Secoure (French)	O	O	O	O				
SOS	O	O	O					
'Ya-Ho'	O	O	O	O	O	O	.....	O

Table 2 shows the result of measuring the hearing of the sound 200 ~ 400m away from the shouting person for several rescue request signals. As a result of the measurement, even if the same person shouted a rescue request signal, the distance to hear the sound was different. In the case of 'Ya-Ho', it was understood to 400m away. On the other hand, 'Dowajuseyo' could only understood to 240m away, 'Help me' could only understood to 200m away. 'Ya-Ho' was able to hear easily with a high frequency sound even though the sound was a little small, and easily understood as 'Ya-Ho' by simple pronunciation. However, other rescue request signals are not only difficult to hear. Even if i hear the sound, it is difficult to understand easily what it is.

4. CONCLUSION

When we climb the mountain, we shout 'Ya-Ho' to radiate great spirit. However, 'Ya-Ho' is a global common rescue signal with 'SOS' and 'Mayday'. 'Ya-Ho' is used by the ancient Alpine shepherd to tell his location far away. It is also widely used as a rescue signal by professional mountaineers and mountain rescue workers. The rescue signal is the signal that survivors send requests with faint hope. Therefore, the rescue signal should be well hearing or well visible. Since 'Ya-Ho' is a very well hearing sound, it is a very suitable signal as a rescue signal.

In this paper, we attempted to confirm how the global common rescue signal, 'Ya-Ho', served as a rescue signal through sound analysis. As a result of the experiment in Chapter 3, 'Ya-Ho' could be understood even farther than other rescue request signals. Since 'Ya-Ho' can shout very loudly on the phoneme structure, the fundamental frequency of the sound increases and the harmonics become clear to the high frequency band of 4KHz, which people can hear best, so it will be able to hearing well far away. Moreover, due to the simple phoneme structure, it is very easy to recognize what is called 'Ya-Ho', even if it hearing from a very long distance to a small sound. On the other hand, since 'Help me'(English), 'Dowajuseyo'(Korean), 'Hilfe'(German), 'Au Secoure'(French) and 'SOS' are phoneme structures such as plosive and affricate, they are disturbed by greatly shouting. In addition, when hearing from far to small sound, the phoneme structure is complex and it is inappropriate to transmit the meaning to voice. These results show that 'Ya-Ho' is a suitable signal for rescue request signal.

The wisdom of old people who used 'Ya-Ho' as a rescue signal considering the phoneme structure, vocal principle and loudness characteristic is amazing. However, shouting 'Ya-Ho' on the mountain as a means of divergence of great spirit is irresponsible behavior that harms nature. We all love nature, we shout 'Ya-Ho' only when it is absolutely necessary as when we were in distress.

REFERENCE

[1] *Mountaineering*, Korea Alpine Federation, 2003
[2] Y. D. Lee, *Mountaineering Common Sense Dictionary*, Hainaim, Korea, 2010
[3] Y. D. Lee, *Mountaineering School*, Hainaim, Korea, 2006
[4] You, K.-B., Bae, M.-J., "A study of the variations of energy of the speech signal when english speakers speak Korean", *Information (Japan)*, Vol.20, No.7, 2017, pp. 5035-5040.
[5] Bae, S.-G., Lim, B.-M., Bae, M.-J., "A comparative analysis on allophone of Korean for English natives", *Information (Japan)*, Vol.20, No.5, 2017, pp. 3291-3298.
[6] Lee, W.-H., You, K.-B., Bae, M.-J., "On a study on drinking judgement using phonation characteristics in speech", *Journal of Engineering and Applied Sciences*, Vol.13, No.5, 2018, pp. 1093-1097.
[7] [http://terms.naver.com] Phoneme (Encyclopedia of Korean Culture, The Academy of Korean Studies)
[8] M. J. Bae and S. H. Lee., *Digital Speech Analysis*, DongYoung, Korea (1998).
[9] *Korean Linguistic Rules*, National Institute of Korea, Republic of Korea, 2017
[10] Kim, B.-Y., Bae, M.-J., "A study on identification rate difference of sound color marker according to bandwidth-limited of voice signal", *International Journal of Engineering Research and Technology*, Vol.11, No.9, 2018, pp. 1463-1470.
[11] Bae, S.-G., Lee, W.-F., Bae, M.-J., "A Judgment of Intoxication using Pitch Contour Compare Signal(PCCS)", *Information (Japan)*, Vol.20, No.4, 2017, pp. 2417-2424.
[12] Kim, B.-Y., Bae, M.-J., "A study on the sound characteristics analysis of drum-sound rock", *Journal of Engineering and Applied Sciences*, Vol.13, No.12, 2018, pp. 4414-4418.
[13] Bae, S.-G., Bae, M.-J., "Using high frequency emphasis as a personal speech bandwidth in speech signal", *Information (Japan)*, Vol.17, No12B, 2014, pp. 6537-6542.
[14] S. T. Lee, *Principles and Application of Sound*, Cheong Moon Gak, Korea (2004).
[15] J. S. Kim, *Noise and Vibration Engineering*, Sejinbook, Korea (2013)
[16] Park, S.-B., Kim, M.-S., Bae, M.-J. "A study on the high-pitched vocal voice of Lee, Nan-Young", *Information (Japan)*, Vol.20, No.6, 2017, pp. 4063-4070.