Measuring progressions in the play technologies of French Horn by the professional musician lessons
Ichiro TOKUHIRO1,2, Aya MORISHITA1, Isoharu NISHIGUCHI1, Kiyohiko YAMAYA3
1 Department of Information Media, Kanagawa Institute of Technology, Kanagawa, Japan
2Showa University of Music, Kanagawa, Japan
3Sonaresearch Co., Ltd., Kanagawa, Japan
tokuhiro@ic.kanagawa-it.ac.jp

Abstract
For musicians, it is the famous sentence that "Horn is the most difficult brass instrument to play in the world" described in the Guinness Book of Records. After 30 minutes lesson by the professional musician teacher of French Horn, progressions in the play technologies of the amateur student, who had only 1 year experience in Brass Band club, were measured using ①the amplitude of time waveform, ②the rising time, ③the sonagram, ④the power spectrum, ⑤the time variation of the harmonics of the Horn sound. Even a short time, in order to improve the horn playing technology, professional lesson was found to be effective.

Keywords: French Horn, Lesson, Spectrum, Rising Time, Harmonics

1. Introduction
It is said that about 100 million people from the junior high school to the society enjoy very popular brass band in Japan. However, different from the trumpet in wind instruments, Horn has been avoided. This reason can be understand by this sentence, "Horn is the most difficult brass instrument to play in the world", published in the Guinness Book of Records. So the number of research reports about French Horn is small compared to the other brass instruments such as the trumpet. In Japan, Hirano and others reported about the orofacial muscular activity and related skin movement for the tone production on the French horn.

In view of the difficulty of horn performance, after the 30-minutes lesson by the professional musician teacher of French Horn, progressions in the play technologies of the amateur student, who had only 1 year experience in Brass Band club at University, were measured using ①the amplitude of time waveform, ②the rising time, ③the sonagram, ④the power spectrum, ⑤the time variation of the harmonics of the Horn sound.

2. Lessons of Professional Horn Player
The name of the male professional musician teacher of French horn was Daich Tanaka who has been the members of the Senzoku New Philharmonic Orchestra, Blitz Philharmonic Winds and so forth. The female 22-year-old amateur student, who had only 1 year French horn experience in the Brass Band joint club at Kanagawa Institute of Technology and Sagami Women's University.

For the recording of French horn sound to the PC, six M-1235 microphones (Ono Sokki Co., Ltd.) attached to the preamplifier MI-3111 and one IMS130P10SN5670 microphone (PCB Co., Ltd.) were used. The microphone information of French horn sound was put into DS3200 multi-channel data station (Ono Sokki Co., Ltd.). The time waveforms were recorded and spectrums were calculated by FFT processors in real time. The result of the measurement and calculation such as spectrums were displayed on the monitor of PC. Let's note CF-B10 manufactured by Panasonic Corporation.

Both the teacher and the student performance of three types of sound level, such as ①low ②normal ③high were recorded. And three types of the attack time were ①slow, ②normal, ③fast, two types of the pitch were ①F and ②B. So each sound was recorded twice. As the sampling conditions, frequency range: 5kHz, sampled points: 16384, measurement time: 1.28 seconds, window function: Hanning window were used.

3. Advice of performances from Teacher
Advice of performances from Teacher were the following five items, such as ①Suck the breath to inflate the abdomen, ②Image the sound in your brain when you play, ③Do not make noise at the onset of sound by tonguing, ④Put out sucked breath straight, ⑤Open interior of throat widely for low frequency sounds.

4. Progression of Student by Lesson
Graphical Comparisons between before lesson and after lesson to the student are shown as ①Time waveform in Fig.1, ②Power spectrum in Fig.2 and ③Power waveform of Harmonics from 1st to 11th in Fig.3.

From Fig.1, It can be seen that the time waveform amplitude of the student is larger and more stable by the lesson. As the value of spectrum at fundamental, 2nd and 3rd harmonics frequency became larger after lessons from Figure 2, so it can be said that the student became to play with the pitch sense. And since the value of spectrum at the harmonics frequency over 8th harmonic frequency, the student became to play with bright tone.
From Fig.3, it can be found that the rising overshoot and the fluctuations of the 3rd harmonics in the power waveform of harmonics after lessons is smaller than before lessons, so the student got the stable sound to play.

4. Comparison between Teacher and Student

Graphical Comparisons between teacher and student are shown as ① Power spectrum in Fig.4 and ② Power waveform of Harmonics from 1st to 8th in Fig.5. The teacher’s value of spectrum at the fundamental, 2nd and 3rd harmonics frequency were enough larger 10~15[dB] than student’s value from Figure 4. And teacher’s value of spectrum at the harmonics frequency over 11th harmonic frequency were enough larger 10~25[dB]. So it can be said that the teacher can play French horn with good sound than the student.

5. Conclusion

By lessons of professional horn musicians, student’s performance technology was improved in the large amplitude, the fast rising, the reduce of fluctuations in pitch and harmonics, overtones of the high frequency range.

These facts are verified by time waveform analysis, spectral analysis, time variation of the power harmonics.

Acknowledgment

Authors would like to thank to Mr. Daichi Tanaka for the French Horn Lesson. And for providing many ideas, we thank to Tomoya Akahori who is a student of Tokuhiro laboratory. This work was supported by JSPS KAKENHI Grant Number 25330245.

References

[1] Andy Thompson, “A Study of French Horn Harmonics”, http://www.adrianjamesacoustics.co.uk/technicalstuff/A%20Study%20of%20French%20Horn%20Harmonics.pdf
[2] Takeshi Hirano, Kazutoshi Kudo, Tatsuyuki Ohtsuki, and Hiroshi Kinoshita, “Orofacial muscular activity and related skin movement during the preparatory and sustained phases of tone production on the French horn”, Motor Control, 2013, Vol.17, No.3, pp.256-272.
[3] https://cyta.jp/horn/s/daichihorn/lesson.html