An evaluation method of concert hall acoustics
- With real musical instruments in low frequency range -

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Abstract: Many physical parameters to evaluate a concert hall acoustics have been proposed. However, no one can believe they provide a perfect one. Here, a new test method with using some musical instruments for concert hall acoustics in low frequency range is proposed.

INTRODUCTION

Evaluation method of concert hall acoustics has complicated problems. Even as the music (or sound) source, there are many problems, such as types of music, directivity of the source, kinds of musical instrument, execution of the instruments, size of ensemble etc. Furthermore, no one can express his true opinion of his judgment as he afraid to be impolite for the owner and many people who related to built the concert hall. There are halls, however, some have good acoustics and some have not. This problem will be solved only by developing an appropriate objective measurement not to conflict with subjective judgment.

HEARING

When we attend a concert, sometimes we feel disappointment with lack of basic fundamental tone, which is very important message of the composer. For example, Saint Saens: Symphony No.3(Fig. 1, a), Beethoven: Symphony No.9(Fig. 1, b), Respighi: The pine of Rome, J.S. Bach: Matthews-Passion and Passacaglia c-moll etc. etc.. We can also have the same feeling with comparing the recorded music played by different musicians of the same one, though there are some other factors, every one can recognize the big difference in low frequency range, e.g. comparing CD records of Fig.1,a by Ernest Ansermet, and by Seiji Ozawa, and such & such.

Now, as a main target is concentrated to the problem of sound generation and transmission limited in low frequency range, since it is common and very important for classical music.

Fig.1, a From C. Saint Saens

Fig.1, b From L. van Beethoven

EXPERIMENTS

1. With an Organ-pipe: The results of an experiment with an organ-pipe have reported as a chart for “Layout Design of Organ-Pipes”[1], and also shown this chart can be useful for select the position of musical instruments on a stage in low frequency range[2]. The chart shows very simple fact that where the distance from the organ-pipe to the
nearest reflecting wall equal to $\lambda/4$ the fundamental of radiated sound is decreased.

Here, an additional experiment with an organ-pipe is shown (by VTR) that the sound field radiated from the organ-pipe follows the curve shown in the chart, even if a microphone close to the pipe, except very near field of the mouth.

2. With a Gran.Tambro(Bass dram): The wave form and spectrum of a dram sound are shown in Fig. 2. The sound from a dram in a room also follows the chart mentioned above [1],[2]. This fact can be recognized by VTR, and the measured sound pressure distributions in the room show the sound levels are different throughout the room depending on the driving point (DP) as shown in Fig. 3.

3. With a Violoncello: When the Drams; Clarinet-trio was recording a small hall, the tone of the violoncello changed depending on its position. At one position it generates a strange tone in some note (or pitch) similar to the wolf-tone, while at another position only a few tens cm distant from the former position the tone become clear and proper. This fact is considered as a kind of coloration caused by reflected sound or interference in the hall.

DISCUSSION

Room acoustics naturally consists of many reflected sound. The time sequence of the reflections obviously compose the tone quality of the room and both good and bad acoustics are borne. The acoustic design of a concert hall, therefore, is a technology to control the reflected sound wave. Unfortunately, any general standard for judging the tone quality does not exist, so we must listen frankly the opinion of the experts of the musical sound. The phenomena described above show needs of research how to control the reflection in low frequency range, i.e. how to diffuse the reflected sound, with a target for getting uniform sound field without influence of interference especially on the stage of concert halls.

REFERENCES