Technical Note: Comparison of Simulation and Actual Measurements

1. Basic concept of Y-S3

Aural impressions such as spaciousness, clarity, intelligibility, etc. are mainly affected by the direct sound and early reflections. For the sound system design, the consideration of direct sound is more important than early reflection for designers usually prioritize of the coverage of the audience area with direct sound in order to achieve high intelligibility. Early reflections from walls around speakers also influence the aural impressions, but those reflections are hard to predict without considering wave phenomena such as diffraction, etc

The Y-S3 simulates only direct sounds using measured directional impulse responses based on a geometrical method so that Y-S3 can simulate the responses rapidly and precisely.

Using Y-S3, you can tune the system during the design stage while checking the coverage of each speaker and influences of interference between speakers for direct sound and generate ".ddf" data of the simulation result and export it to the DME. You can put the simulation result to use in your actual system setup, then check other acoustic effects such as early reflections and optimize the system on site quickly and with minimum effort.

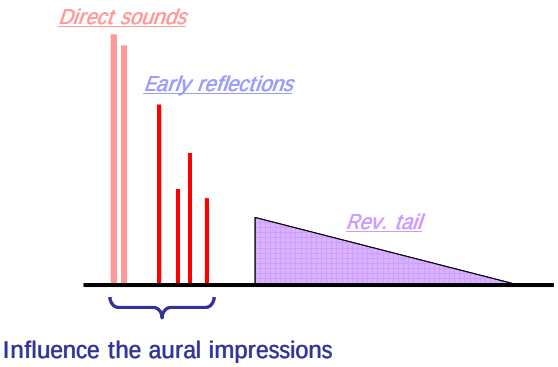

Fig. 1. Direct sound & Early reflections

2. Accuracy of the simulation

To check the validity of estimation for the sound system responses, we took measurements in an actual hall (Fig.2) and compared them with simulation results of Y-S3.

Fig. 2. Hall for measurement

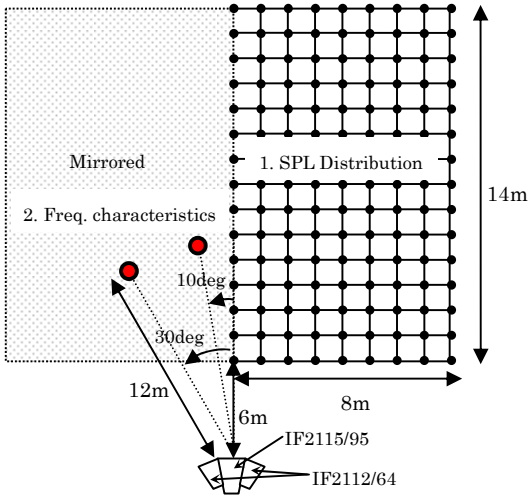

Fig. 3. Measurement conditions

2.1. Measurement Condition

Fig.3 & 4 shows the measurement conditions. Three speakers (IF2112/95 & 2xIF2115/64) were used together as an array speaker. In order to remove the effect of reflections from the floor, we used omni directional microphones and set them just above the floor to make their characteristics the same as

boundary microphones. After measuring the impulse responses, other reflections were also removed and only the direct sounds from the array were picked up. SPL distribution and frequency characteristics, were calculated from the impulse responses. Then we set the same conditions in Y-S^3 and calculated the indexes to compare the results.

Fig. 4. Array speaker & microphones

2.2. Comparison of Calculation results

2.2.1. Sound Pressure Level Distribution

Fig.5 shows the SPL distribution results at 1kHz for both the Y-S^3 simulation and actual measurement. The simulated result corresponds well with the pattern actually measured. You can observe the same interference between the speakers from both results.

2.2.1. Frequency characteristics

Fig.6 shows the comparison of FFT results at the receiving points indicated in red of Fig.3. The frequency and level of peak and dip of SPL which are also caused by interference patterns between speakers corresponds well with each other.

These results indicate that you can estimate the cover age area of the speakers and interference during the design stage and optimize the system according to the Y-S^3 results. Y-S3 also provides auralization, which lets you hear and evaluate the direct sound heard at any point in the space, using any dry (anechoic) recorded sound source, for even better subjective monitoring.

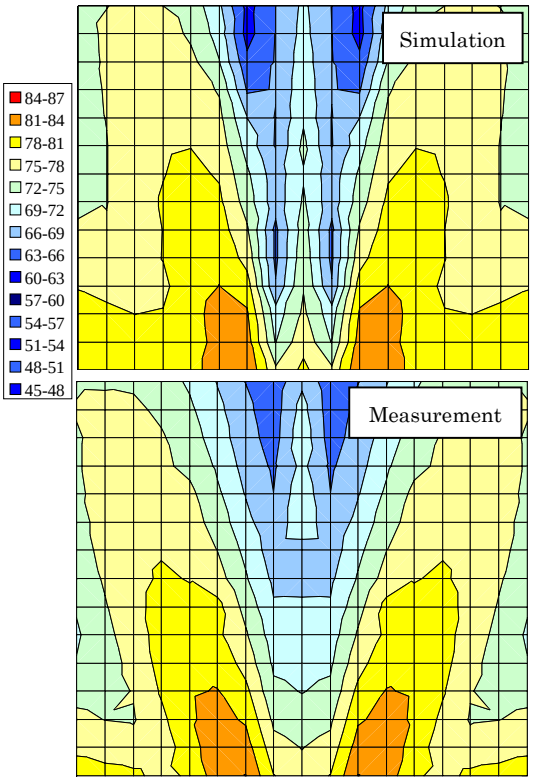

Fig. 5. Comparison of SPL Distribution

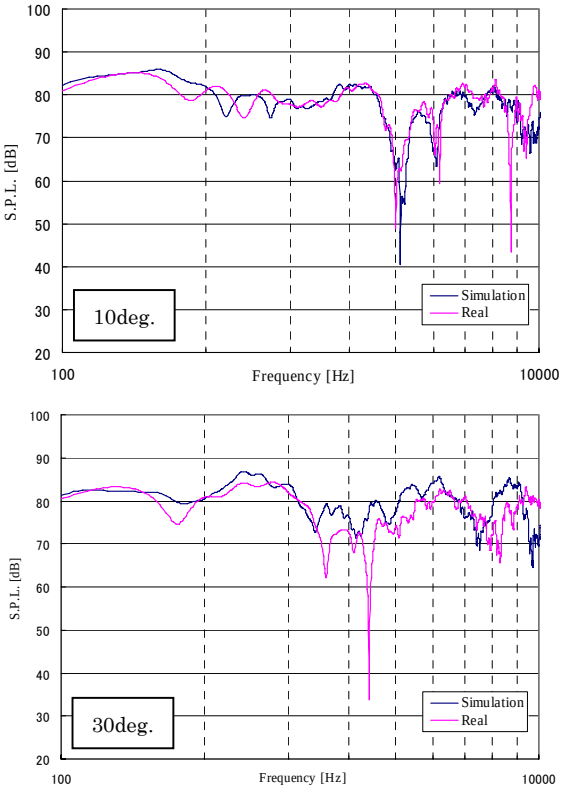

Fig. 6. Comparison of Freq. characteristics