Measurement Examples of a New Wireless Measuring System

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ABSTRACT

There are various demands of multi-point measurements in measurements of noise and vibration. We have developed a new wireless measuring system. The system has functions such as one-third octave band analysis, Fast Fourier transform analysis, waveform recording in one single instrument, which provide an intuitive operation with a touch panel for users. Wireless multi-point measurement doesn't need any cable connection which significantly reduce time and cost required for real situations. We report some measurement examples in a field such as road traffic noise measurement and architectural acoustic measurement with the new measuring system and effects of wireless measurement compared with conventional measurement methods.

Keywords: Measurement, Multi-point, Wireless I-INCE Classification of Subjects Number: 71.3

1. INTRODUCTION

There are various demands of multi-point measurements in measurements of noise and vibration. In the case of wired multi-point measurements, it is necessary to lay down cables and adverse effects of cables laid between instruments. It is difficult to lay down cables depending on measurement condition. In such cases, a wireless system capable of various system configurations is a great help to measurers.

We reported a new measuring system which can conduct multi-point wireless measurements with compact system configurations. Moreover we discussed wireless data transfer and throughput in each analysis method such as fast Fourier transform analysis and octave band analysis under an ideal environment[1].

We report measurement examples in actual environments with the wireless measuring system and the effects of wireless measurement.

2. SYSTEM CONFIGURATION

The wireless measuring system consist of a main measuring unit (main unit) and a wireless measuring unit (wireless unit) as shown in Figure 1.

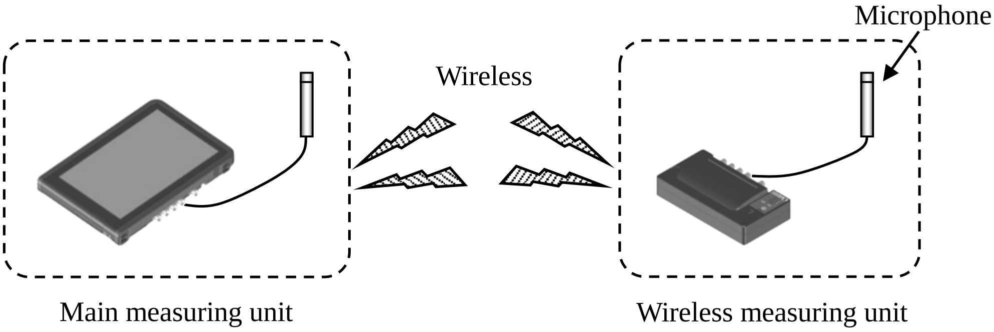

Figure 1 – System configuration

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The main unit has four signal input connectors, and performs various analyses, such as fast Fourier transform analysis and octave band analysis and displays analysis results graphically. The wireless unit also has four signal input connectors, and performs analysis. Furthermore the wireless unit is able to transfer analyzed data to the main unit with wireless LAN. The system is able to select frequency band either 2.4 GHz or 5 GHz to avoid radio wave interference. In this report, we used 2.4 GHz band. The main unit is able to simultaneously communicate with wireless units of up to four. Therefore, users can build a flexible system configuration.

Required transmission speed for each analysis is shown in Table 1. Mbps denotes mega bit per second or data size which is transferred per second.

Table 1 – Required transmission speed for each analysis

Analysis Method	Transmission Speed
Octave Analysis	0.3 Mbps
One-third Octave Analysis	1.0 Mbps
Waveform	4.6 Mbps

3. MEASUREMENT EXAMPLES

In order to confirm the effectiveness of wireless measurements in actual environments, we carried out measurements of airborne sound insulation which used road traffic noise as sound source and airborne sound insulation between meeting rooms.

3.1 Trial Measurement of Airborne Sound Insulation by Window Sash

We conducted a trial measurement of airborne sound insulation by the window sash of a building. Sound sources in the measurement are road traffic noise.

3.1.1 Measurement Environment and Condition

We used a wooden laboratory building as a measurement location (Figure 2).

There is a road with double lane across the sidewalk of about 3 meter width in front of the building. Traffic volume of the road is about 12.5 cars per minute.

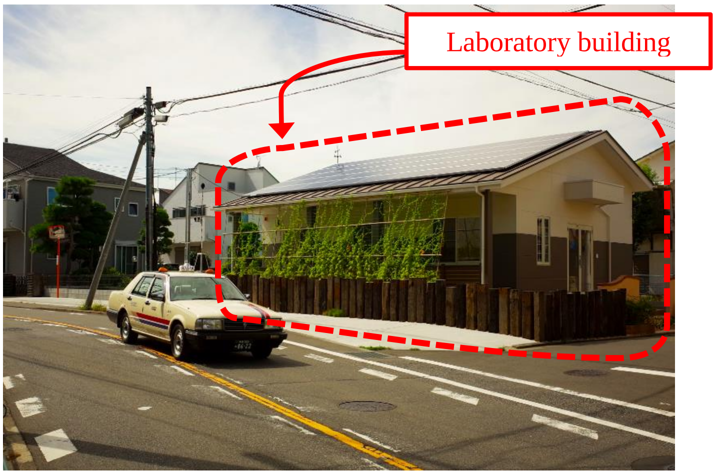

Figure 2 – Laboratory building of RION

We set the main unit as a measuring point (point A) in the building which is within 2 meters away from the window sash. We set the wireless unit as a measurement point (point B) on the porch of the building which is 0.5 meter away from the window sash. The window between the point A and the point B is closed. The plan view of the building and the configuration of measurement are shown in Figure 3.

We measured $L_{\mathrm{Aeq,1\ min}}$ of one-third octave band analysis at both measurement point of A and B.

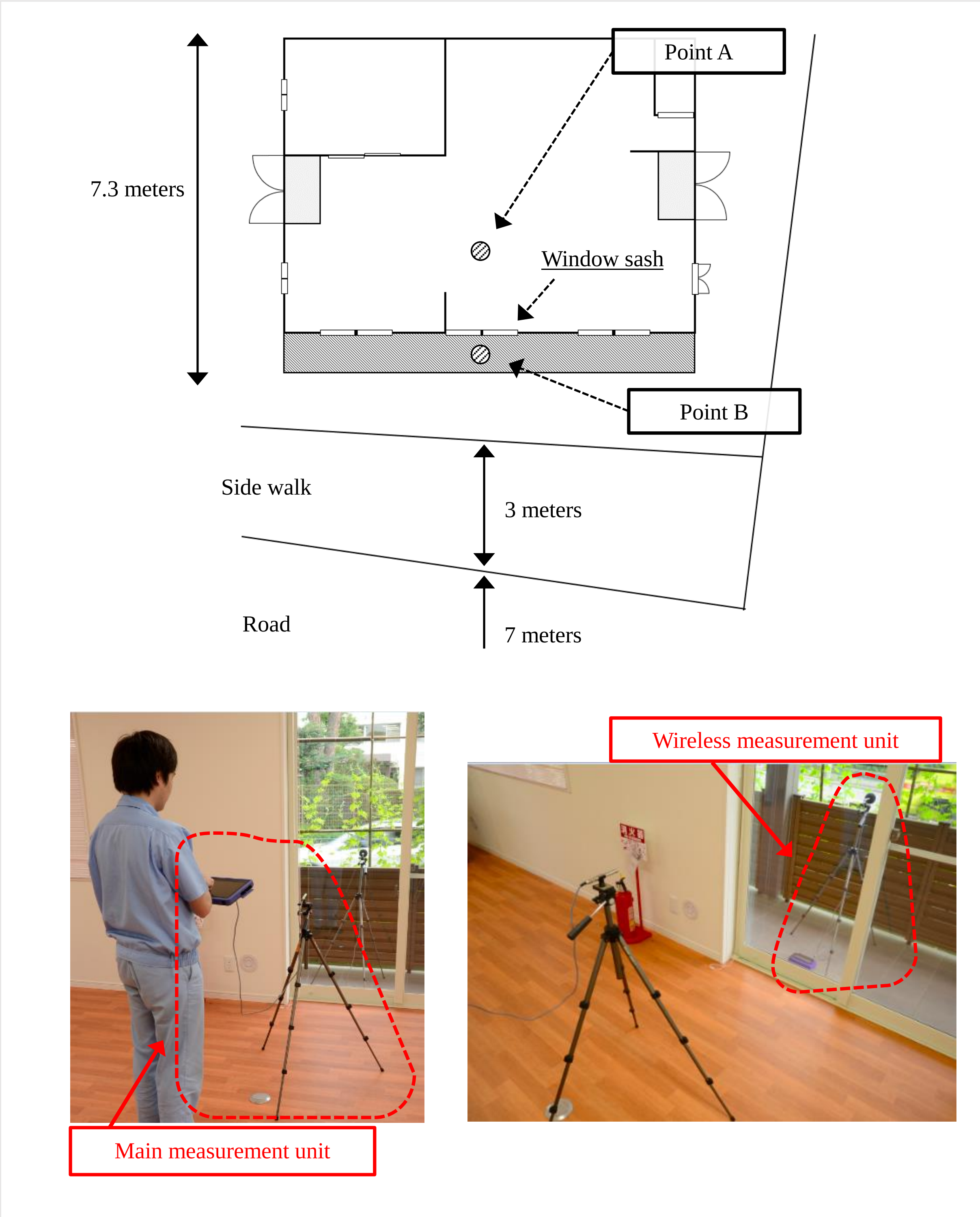

Figure 3 – Plan view of the building and configuration of measurement

3.1.2 Measurement Results and Consideration

The measurement results of the point A and the point B; and the level differences between the inside and outside are shown Figure 4.

Transfer speed is 14.5 Mbps on average between the point A and the point B. The communication speed which is required in one-third octave band analysis is 1 Mbps or more as shown in Table 1. 14.5 Mbps which was measured is enough communication speed to transfer one-third octave band analysis data.

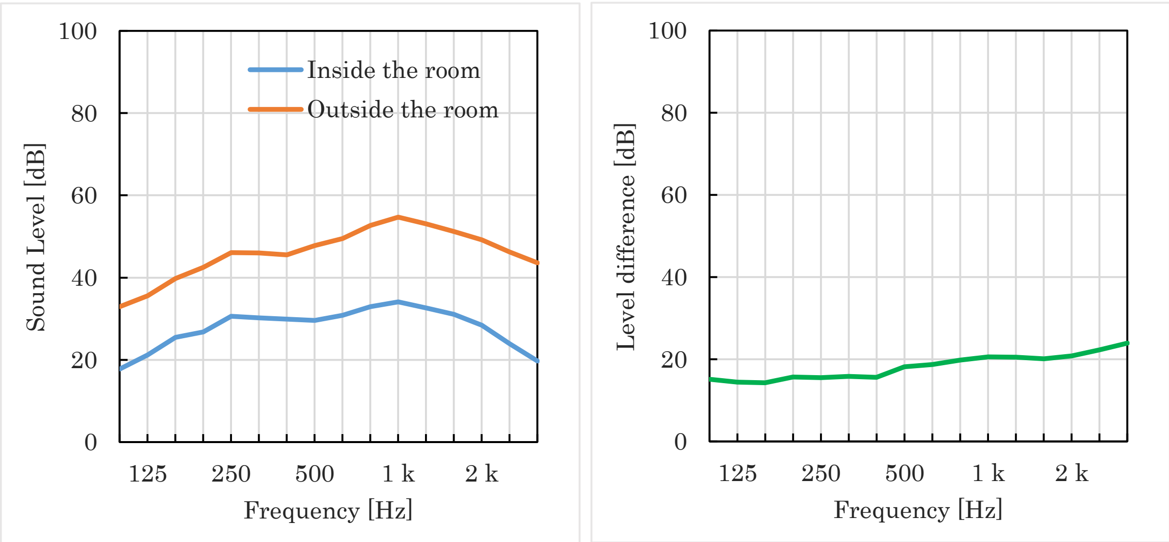

Figure 4 – Measurement result of the point A and the point B (left)

and level difference between the inside and outside (right)

Laying down of cables was unnecessary because the connection between the point A and the point B was wireless. When laying cables through the back side of the building not to affect on the front side window sash measurements, it is necessary to lay down cables of about 20 meters. In the measurement setup, we have just put the wireless unit at the point B and the main unit at the point A.

It is possible to check the results which were measured by the wireless unit on the display of the main unit. we were able to compare the real-time data measured inside and outside building during the measurement simultaneously.

The main unit can communicate with up to four wireless units. If the wireless units are added, users can easily measure at multi points inside or outside of building depending on requirements.

3.2 Trial Measurement of Airborne Sound Insulation between Rooms

We conducted a trial measurement of airborne sound insulation between rooms.

3.2.1 Measurement Environment and Condition

We used conference rooms as measurement location. The building is made of reinforced concrete and the partition between the conference rooms is made of wood based materials.

We used the conference room A, which is about 14 square meters, as a sound source room and the room B, which is about 11 square meters, as a receiving room. In this measurement, we carried out the simplified measurement of airborne sound insulation. The measurement diagram and scene are shown in Figure 5.

We measured $L_{\mathrm{Zeq,10\ sec}}$ of one-third octave band analysis at points of both the sound source room and the receiving room.

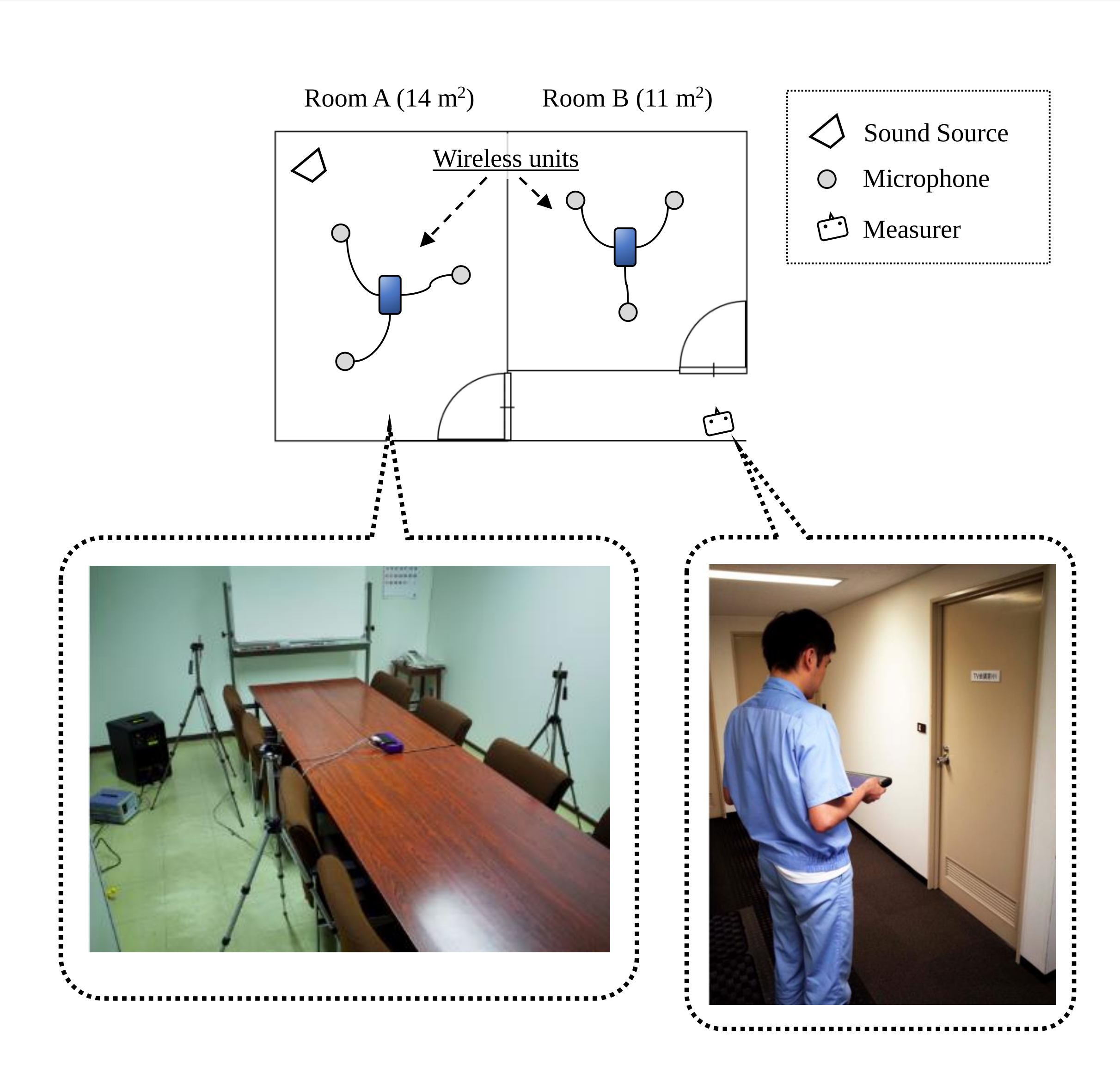

Figure 5 – Measurement diagram and measurement scene

3.2.2 Measurement Results and Consideration

The measurement result of the sound source room and the receiving room and the level difference between rooms are shown in Figure 6.

The communication speed was 7.0 Mbps on average between the main unit and the wireless unit in the sound source room. On the other hand, 8.0 Mbps on average between the main unit and the wireless unit in the receiving room. In this measurement, since the main unit communicated with two wireless units, the communication rate was slower than communication rate when communicating one-to-one.

As mentioned above, the communication speed required in one-third octave band analysis is 1 Mbps or more. The communication speed of 7.0 Mbps or 8.0 Mbps which was obtained in this measurement was enough to transfer one-third octave band analysis data. Generally, nominal communication speed of Wireless LAN is announced in unobstructed view conditions. We confirmed that there is enough communication speed for measurements even if one unit cannot see through the other.

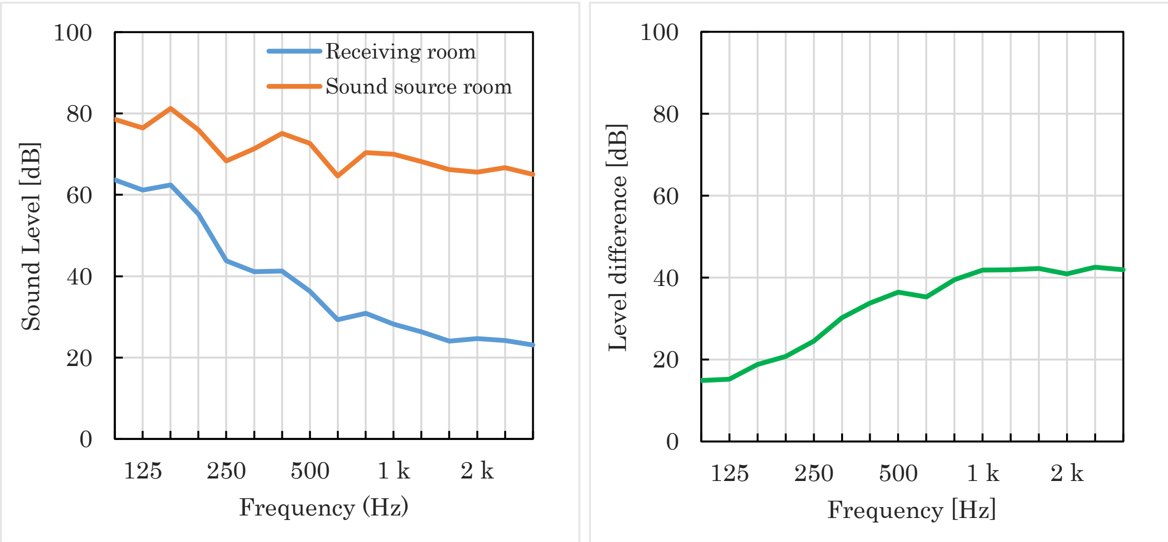

Figure 6 – Measurement result of the sound source room and the receiving room (left) and level difference between rooms (right)

Not only a lot of measuring instruments but also time and effort to lay down cables are necessary to measure airborne sound insulation. However, in this system, we have just set up the sound source in the sound source room, and the wireless unit and microphone in the sound source room and the receiving room. The wireless system can reduce time for preparations and measurements.

4. CONCLUSIONS

We carried out measurements of the airborne sound insulation by the window sash of the building and rooms with the wireless measurement system and confirmed the effectiveness of wireless measurements

It was possible to obtain the sufficient communication speed for transferring one-third octave band analysis data in both measurements.

In the future, we will confirm the usefulness of the this system by adapting the system to measurement scenes where wired measurement has been performed. Moreover we continue to confirm usefulness and limitations of the system in a variety of environments by adapting the system to situations where wired measurement is difficult.

REFERENCE

1. Yasutaka Nakajima et. al., "A case study of the new multi-function, multi-point measurement instruments," Proc. INTER-NOISE 2013, (2013) p.448