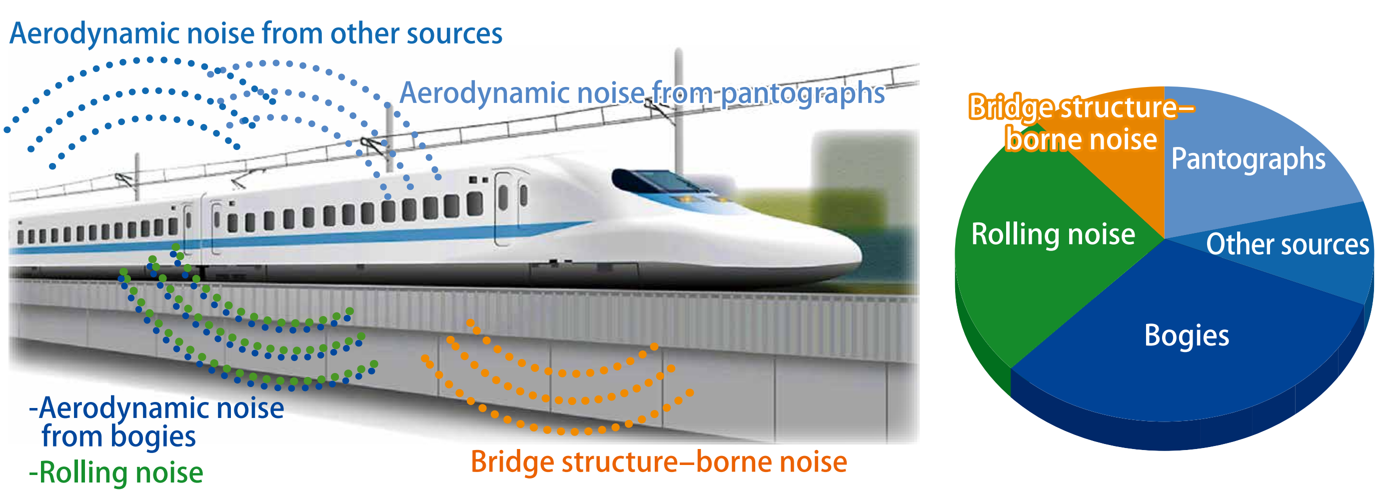
Ms. Yukie Ogata
Laboratory Head
Noise Analysis

Noise Analysis Laboratory

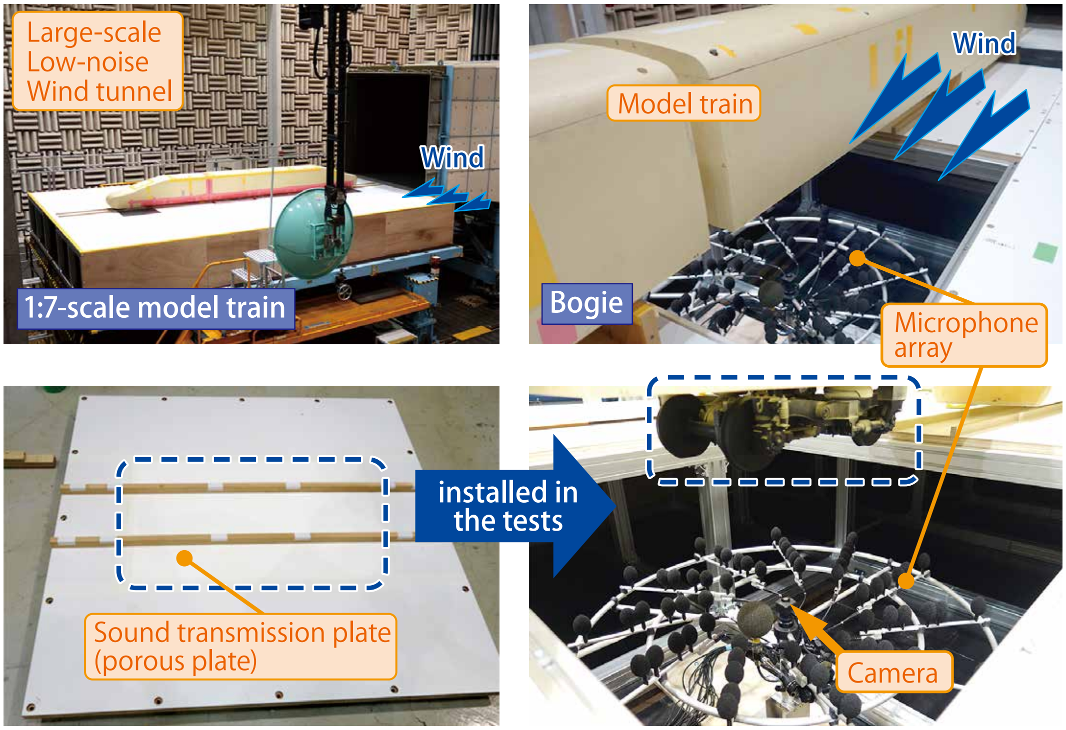
Targeting the conventional lines, Shinkansen lines and maglev, the Noise Analysis Laboratory is researching noise source analysis and reduction measures for railway noises. Examples of noise sources are aerodynamic noises generated by the vehicle running at high speed, and structure-borne noises caused by the vibration of wheels, rails, and railway structures. The Noise Analysis Laboratory is also expanding the capabilities of the noise prediction model, focusing on the effects of wayside structures on noise propagation. The following gives more details with a focus on the Shinkansen.

Source analysis of Shinkansen noises

Railway noise is complex and composed of various noise sources with different generation principles. To reduce such complex noise effectively, we need to examine the contributions of respective noise sources in the wayside and take measures against noise sources with large contributions, with priority given to these. Wayside noises of the Shinkansen lines are classified into pantograph noises, upper part aerodynamic noises, lower part noises (rolling and aerodynamic noises), and bridge noises according to the location of noise generation (Noise sources of Shinkansen and contribution of each noise source at a point 25 m away from the track). The results of noise source analysis using data from our field test showed that when the latest-model Shinkansen vehicles run at a speed over 300 km/h, the contribution of noises from the vehicle's lower part is



Noise sources of Shinkansen and contribution of each noise source at a point 25 m away from the track (Concrete viaduct, slab track, noise barrier with a height of 2 m and train speed at 320 km/h)



Evaluation of aerodynamic noise from the carbody

Microphone array was located beneath the bogie, and sound source detection was conducted by using sound transmission plate.

the largest, followed by that of pantograph noise. The aerodynamic noise from the lower part of the vehicle was found to increase with running speed (Noise sources of Shinkansen and contribution of each noise source at a point 25 m away from the track).

Aerodynamic noise

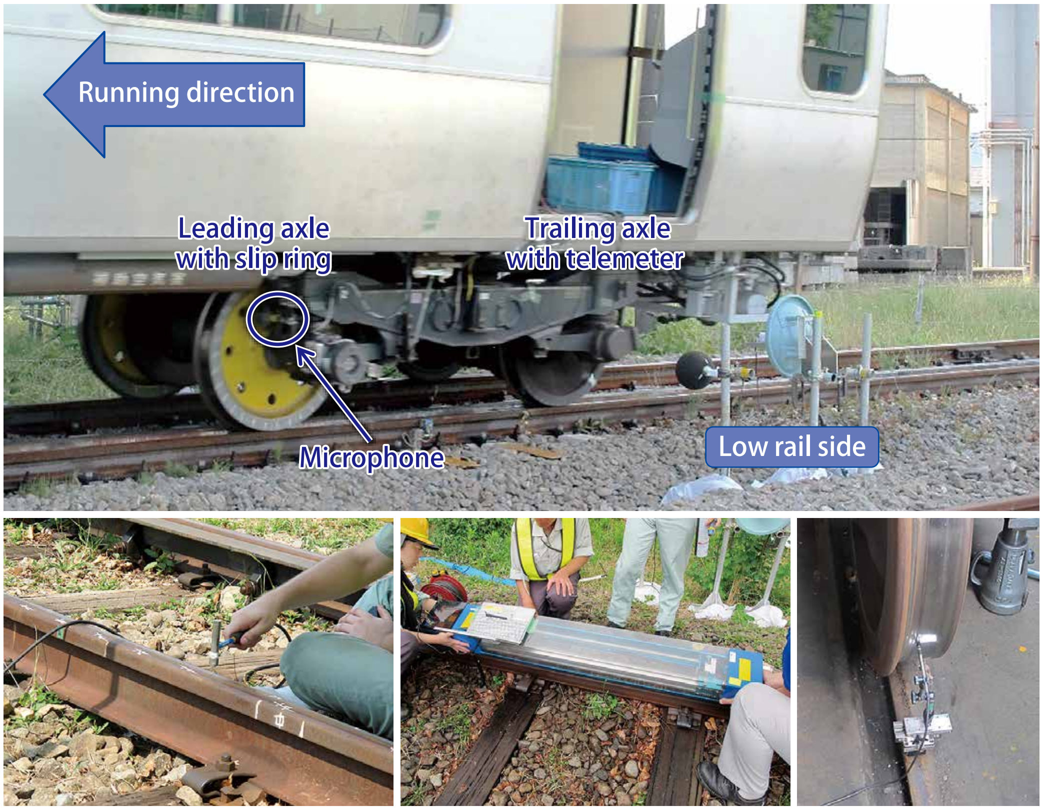
To suppress the increase in wayside noises of the Shinkansen due to its running speed increase, we need to elucidate the generating mechanisms of aerodynamic noises from the bogie section and the current collection system and develop measures to reduce them. Thus, regarding aerodynamic noises in the bogie section, we used wind tunnel testing to study the benefits of using a noise transmission plate (Evaluation of aerodynamic noise from the carbody). From the results, we confirmed that there are main noise sources near the traction motor and gear unit and that noises can be reduced by attaching a member that controls air flow to the bogie. Recently, based on the results of a field test using a 2-dimensional array device with many microphones placed in one plane, we studied the development of a method for evaluating the noise source distribution around the vehicle and the measures to reduce noise in the low-frequency range of 100 Hz or lower.

Structure-borne noises

Regarding structure -borne noises such as rolling noise and bridge noise, we conducted various measurements to elucidate the generating mechanisms of tread squeal noise when a vehicle passes through a curve and the impact noise generated when it passes over rail joints. These included simultaneous measurement of on-board noises and noises on the ground, surface roughness measurements of rail and wheel tread, and rail vibration tests (Structure-borne noise measure technique). We are constructing a physical model based on these experimental results. We are also studying a method for evaluating the effect of irregularity on the wheel tread of the Shinkansen vehicle on wayside noises.

Noise propagation

Regarding noise propagation, we work to extend the capabilities of the prediction

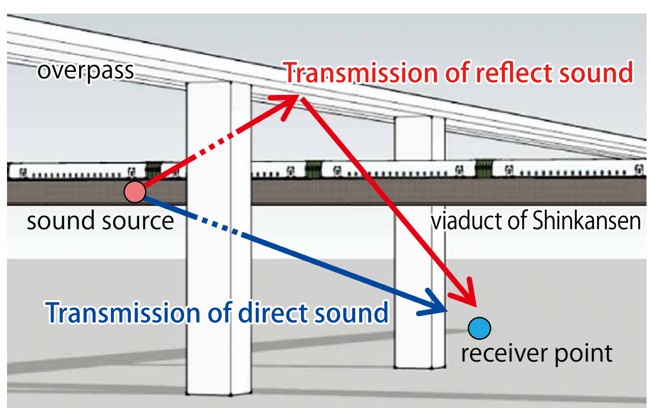


Structure-borne noise measure technique

method for the wayside noise. For example, we evaluated the noise distribution from acoustic scale model experiments and field tests for peripheral areas of cut sections, tunnel portals, and overbridges, and constructed a prediction model based on these results (Transmission model of wayside noise considering the reflect sound on the bottom of the overpass). We are also studying the conditions where multiple factors affect noise propagation (e.g., area where an overpass and buildings of wayside are combined, densely populated residential area).

Conclusion

We have conducted several field tests, acoustic scale model experiments, and simulations to construct a method for predicting wayside noises and evaluating the noise abatement effect of countermeasures. A deep understanding of the phenomena involved in the generation and propagation of railway noise is essential for the goal of reducing wayside noise; we will continue to make efforts in the future.



Transmission model of wayside noise considering the reflect sound on the bottom of the overpass