

Characteristics of interior noise of a Chinese high-speed train under a variety of conditions

Key words: High-speed train; Interior noise; Noise source identification; Contribution analysis; Various conditions; Noise characterization

Cite this as: Jie ZHANG, Xin-biao XIAO, Xiao-zhen SHENG, Rong FU, Dan YAO, Xue-song JIN, 2017. Characteristics of interior noise of a Chinese high-speed train under a variety of conditions. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 18(8):617-630. <http://dx.doi.org/10.1631/jzus.A1600695>

Measurement configurations

Table 1 Test conditions of the interior noise

Case	Coach	Speed (km/h)	Track	Line	Direction of TC01
1	TC01	260/280/300/310 320/330/350/385	Slab	On the ground surface	Head/End
2	TP03	200/250	Ballast/Slab	On the ground surface	Head
3	TC01/TP03	300/350	Slab	On the ground surface/In a tunnel	Head

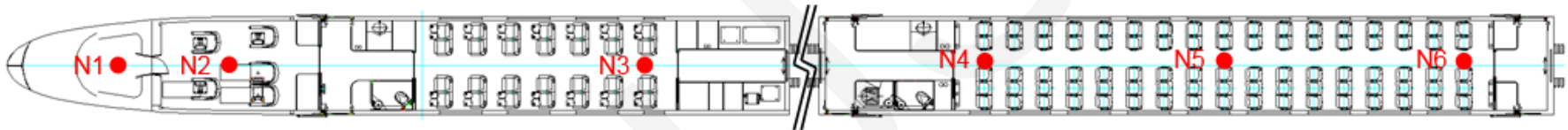


Fig. 1 Measuring points in the two coaches of a high-speed train (“•” refers to acoustic measurement points)



Approach of data processing

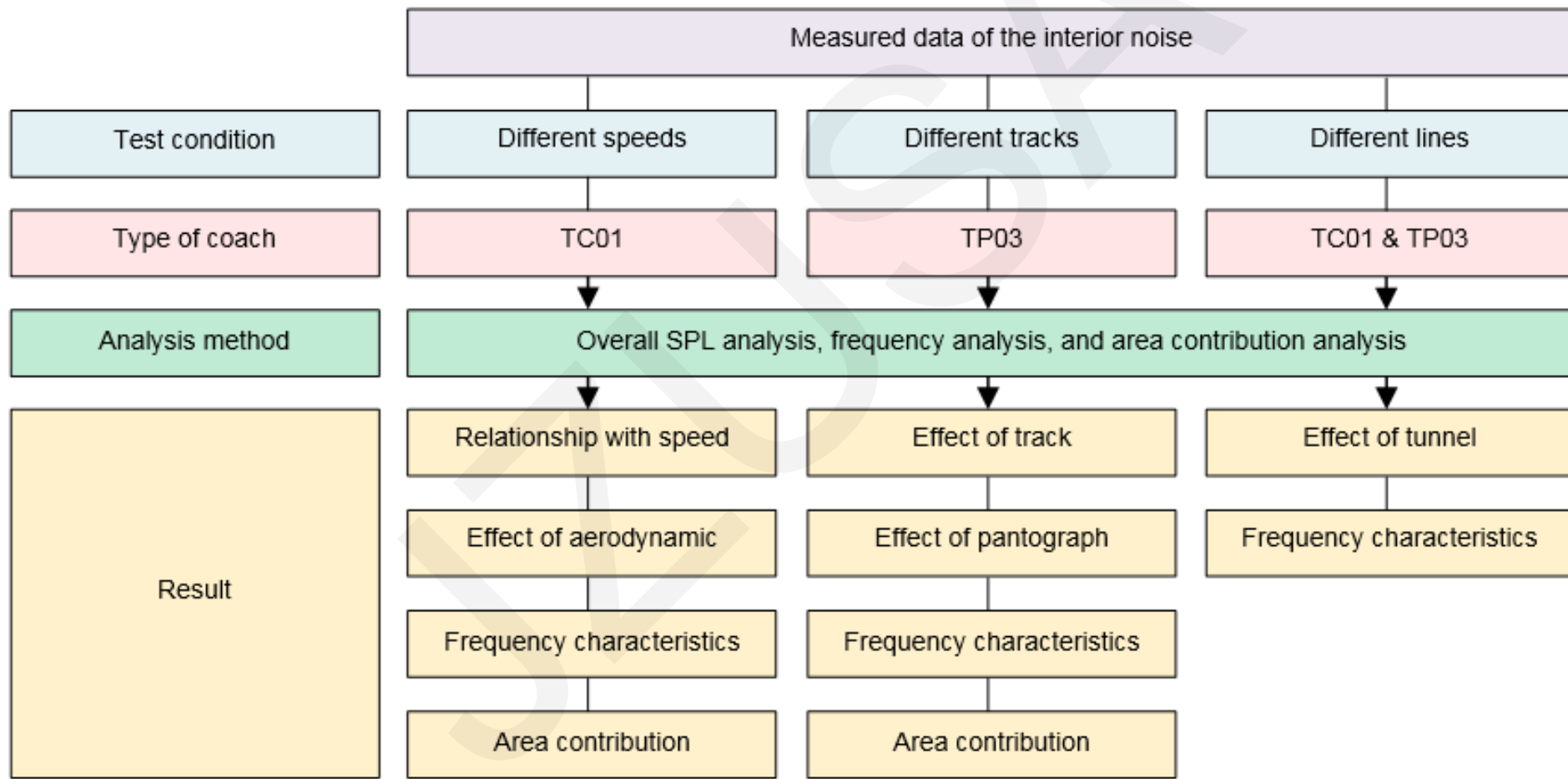


Fig. 4 Approach of data processing (SPL is sound pressure level)

Effect of train speed on interior noise

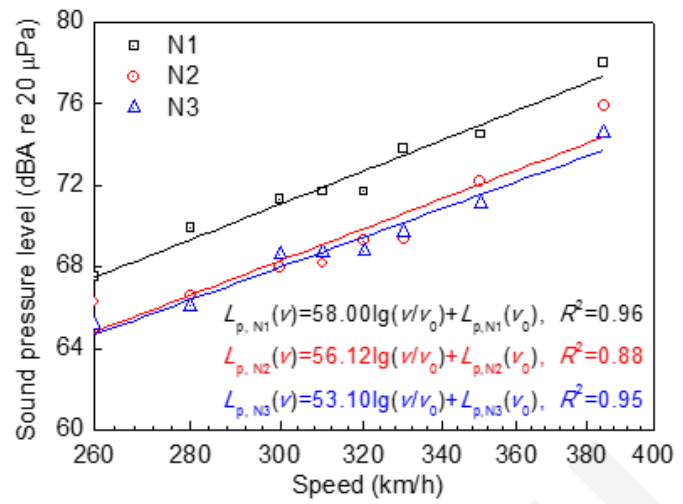


Fig. 5 Interior noise levels at different speeds (head car)

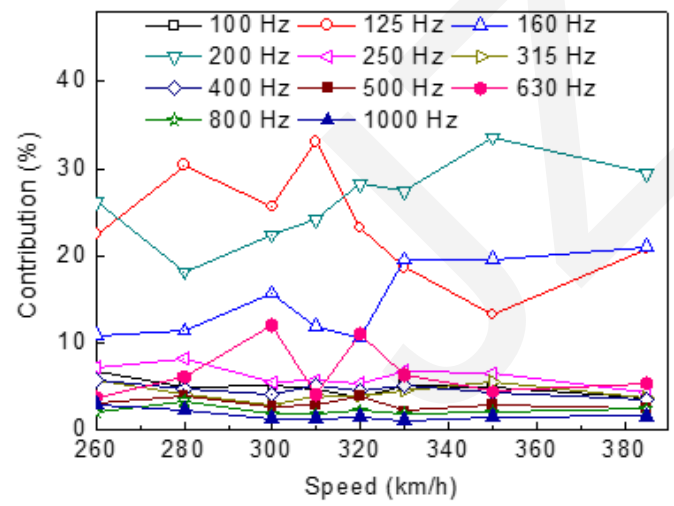


Fig. 8 Sound pressure contribution at different speeds (as head car)

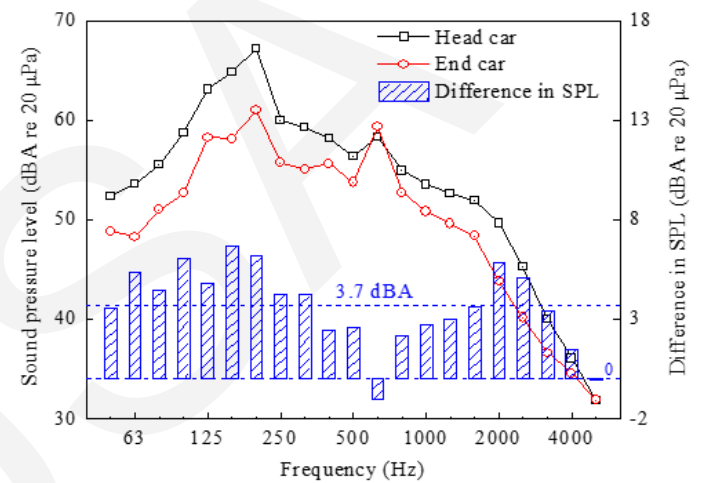


Fig. 7 Comparison of the interior noise in the VIP cabin between TC01 as head car and end car (350 km/h)

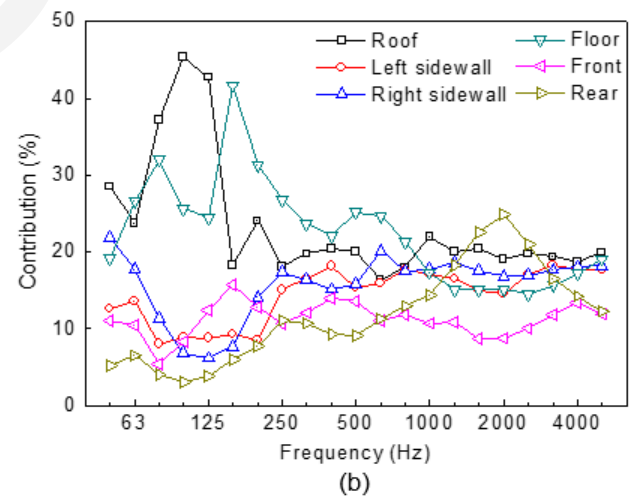


Fig. 12 Area contributions in 1/3 octave band spectrum in the VIP cabin: (a) overall source spectrum; (b) area contributions in different 1/3 octave bands

Effect of track types on interior noise

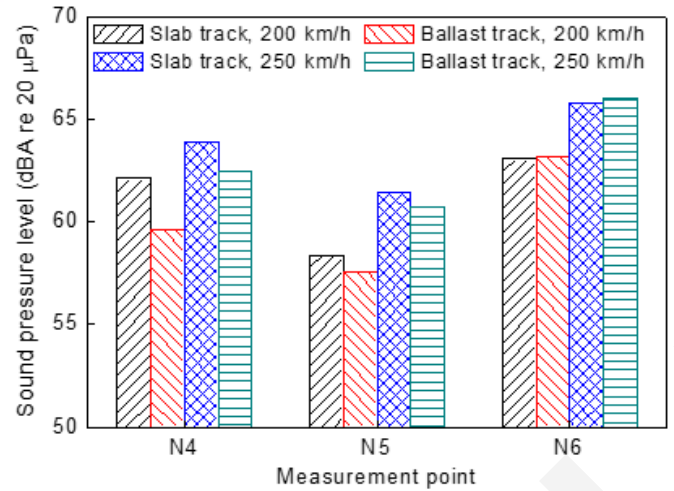


Fig. 13 Interior noise levels on different tracks

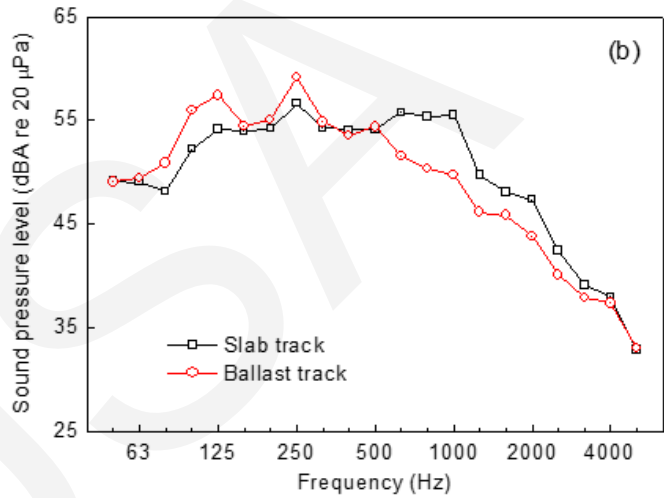


Fig. 14 Interior noise spectrums on different tracks at points N4 (a) and N6 (b) (250 km/h)



Fig. 15 Noise source identification result at the coach end of TP03 (50–5000 Hz)

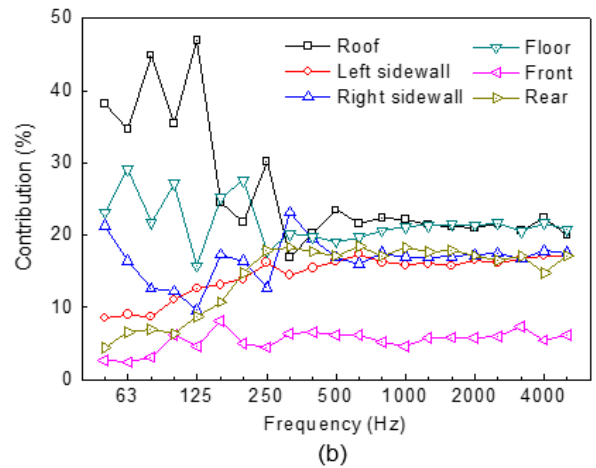


Fig. 17 Area contributions in 1/3 octave band spectrum at the coach end: (a) overall source spectrum; (b) area contributions in different 1/3 octave bands

Effect of tunnel on interior noise

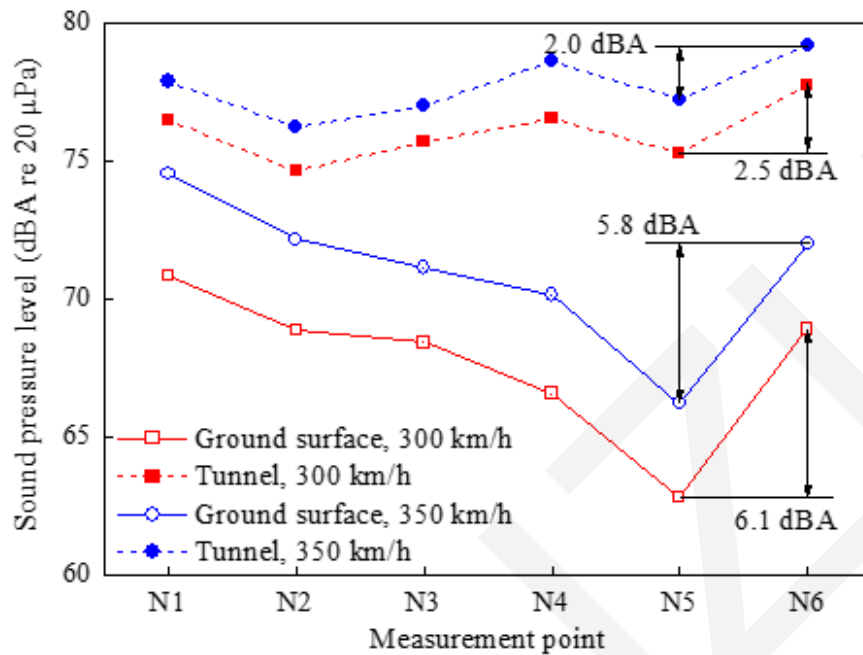


Fig. 18 Interior noise levels on different lines

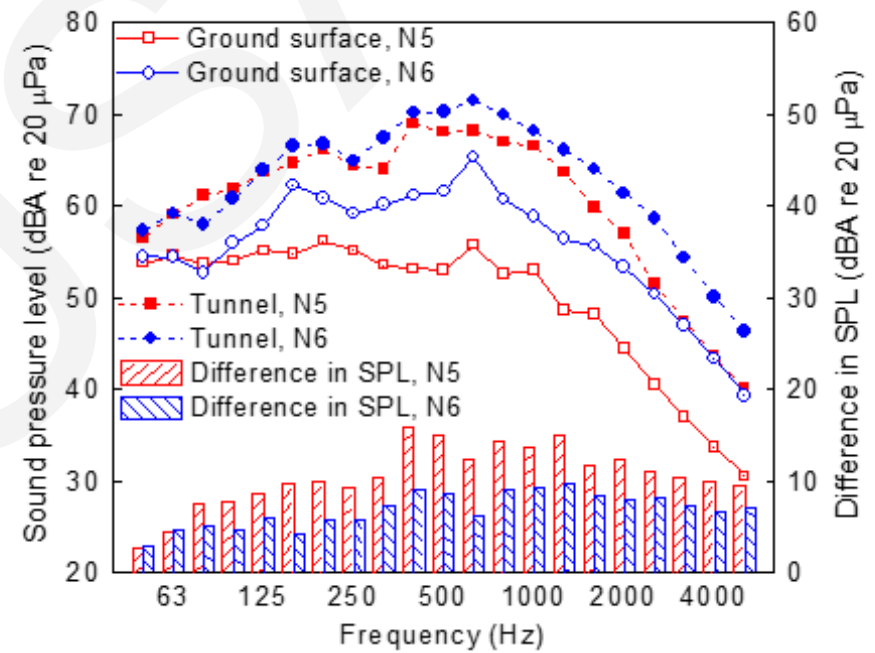


Fig. 19 Interior noise spectrum on different lines at 350 km/h

Conclusions

- ◆ Effect of train speed on interior noise: whether TC01 is used as head car or end car, the interior noise characteristics in the VIP cabin are more related to aerodynamic noise. The main sources are located on the roof and the floor.
- ◆ Effect of track types on interior noise: differences in interior noise between the slab track and the ballast track are train speed dependent. The higher the speed is, the smaller the difference is.
- ◆ Effect of tunnel on interior noise: sound reflections are created when a train runs in a tunnel, increasing interior noise to some extent. The effect of tunnel on the interior noise is more important for the middle coach than that for the head coach.