講演番号	163

文献番号	20226163

Development of the high accuracy tire models for deep understanding of the road noise mechanisms

Jiro Nakajima [1)] Tomoyuki Kaneda [1)] Hiroyuki Sawada [1)] Toshio Enomoto [1)]

Tatsuya Suma [2)] Hiromichi Ebisawa [2)]

1) Nissan Motor Co. , Ltd.
560-2 Okatsukoku, Atsugi, Kanagawa, 243-0192, Japan
2) ESTECH Corporation.
6-50-1 Hon-cho, Naka-ku, Yokohama, Kanagawa, 231-8315, Japan

KEY WORDS: **vibration, noise, and ride comfort, road noise, CAE simulation/full-vehicle simulation**[A3]

Since road noise is relatively more noticeable in EVs, there is an urgent need to improve road noise performance. In order to solve the road noise in the frequency range up to 400 Hz, which is mainly caused by solid propagation, as well as to improve performance while also addressing trade-offs with other performance factors such as electricity performance, it is important to enable quantitative evaluation of road noise and to gain a deeper understanding of the mechanisms that generate road noise. Therefore, in order to improve the prediction accuracy of road noise which is generated by vibrations between the road surface and tires that propagate from the suspension to the vehicle body and are then transmitted to the cabin as sound, the input accuracy from the road surface to the tires is important, especially the shape near the tire contact surface.

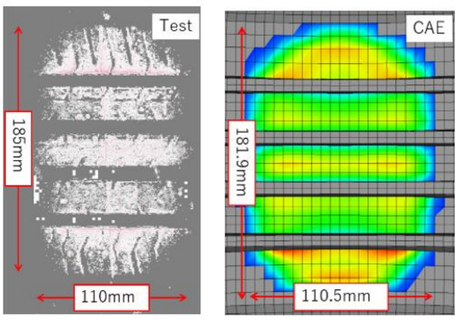
For the modeling of analysis by Full Vehicle, which is necessary for the evaluation of road noise, Full FEM and hybrid methods of FEM and test, and hybrid methods of mechanism analysis model and FEM have been proposed. Some analysis methods do not analyze the entire vehicle system, such as the Blocked Force Method, which separates the force transmission from the tire to the axle. In this study, the hybrid method of FEM and test is used to apply linear frequency response dynamic analysis to the entire vehicle model. This enables quantitative evaluation of the road noise spectrum during driving in the frequency range up to 400 Hz, where solid propagation is predominant, and also allows visualization of eigenmodes in the entire vehicle system, which is necessary for a deeper understanding of the generation mechanism. Furthermore, various analysis methods that have been developed in the past, such as mode contribution ratio, panel noise contribution ratio, and extraction of principal component modes, can be applied without modification, providing an effective means of analysis. In addition, the blocked force method cannot fully express strong coupling, and the hybrid method that combines mechanical analysis and frequency response analysis cannot visualize eigenmodes in the entire vehicle system, which is necessary for a deep understanding of the mechanism of occurrence.

Next, it was found that the current tire model has no problems for use at the daily level, such as relative comparison of road noise, but that several improvements are needed to achieve quantitative evaluation to carry out in-depth performance planning through desk studies and to gain a deeper understanding of the mechanism of occurrence. In modeling high accuracy tires to enable these the reproducibility of the contact surface between the tire and the road surface at the 1G indicated important. Also, the clarified that the following three points need to be improved from the existing tire model. ①Improve the reproducibility of the tire contact area at 1G, ②Improve the accuracy of the tire dynamic characteristics at 1G, and ③ Improve the reproducibility of both static and dynamic characteristics.

In this study, it was developed a tire model that satisfies these requirements.

As a result, the tire model was improved to a highly accurate tire model that can predict road noise performance with a high level of accuracy that enables a deep understanding of the mechanisms that generate road noise performance.

In order to further improve the accuracy of the model, it became clear that more detailed suspension joints that simulate driving conditions are necessary, and efforts to improve the accuracy by enhancing the model validity will continue.



Axle Load	
Test	4300N
CAE	4464N
Error	3.80%

Fig.1 Accuracy of static characteristics of tire

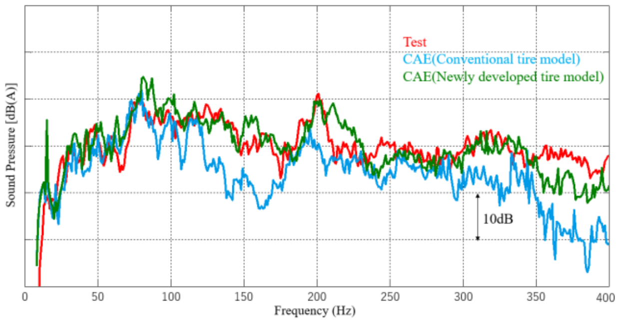


Fig.2 Sound pressure level at driver's ear

2022 JSAE Congress (Autumn) - Summarized Paper
Issued on October 7, 2022