

Prediction Method for In-Cabin Powertrain Noise in Electric Vehicles Using Powertrain-Bench Test Data

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KEY WORDS: Vibration, noise, and ride comfort, Idling vibration/idling noise/acceleration noise, Sound quality evaluation/ride comfort evaluation, Electric vehicle, Driving simulator, Transfer path analysis, Virtual prototyping, Powertrain-bench testing [B3]

The authors have been investigating a virtual NVH development process aimed at enhancing the efficiency of noise and vibration (NV) development for electric vehicles (EVs). This process utilizes an NVH driving simulator (NVH-DS) to enable virtual driving evaluations from the design stage prior to prototype vehicle construction. To support this process, a modeling technique for in-cabin noise has also been proposed, and its feasibility is currently being verified. In the latter stage of the process, it is necessary to predict the in-cabin electric powertrain (e-PT) noise of a completed vehicle using test data obtained from electric powertrain dynamometer (e-PT dyno) tests. In this study, the following three prediction methods, which utilize e-PT dyno data, were proposed:

- Method I: Adjusting Function Method
- Method II: Blocked Force Method
- Method III: Blocked Force Method with Adjusting Function Method

Using these approaches, in-cabin e-PT noise prediction models were constructed. These methods are based on an e-PT noise modeling approach derived from vehicle tests using component-based Transfer Path Analysis (TPA), whose experimental setup is shown in Fig. 1. The experimental setup for Method II is shown in Fig. 2. Figure 3 compares the in-cabin e-PT noise of the same B-segment production EV, where (a) represents the model obtained from the complete-vehicle test, and (b) - (d) show the predictions obtained by Methods I - III. Although differences in characteristics were observed among the methods, all successfully reproduced the major order components. The results confirm that the proposed methods are applicable to the virtual NVH development process previously described.

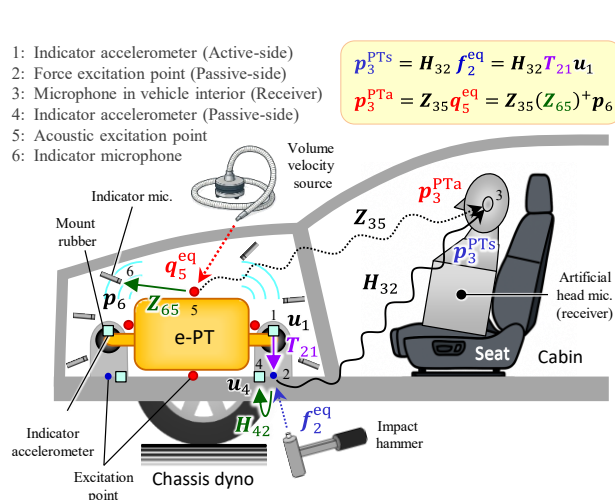


Fig. 1 Experimental setup for extracting e-PT noise in vehicle interior by TPA

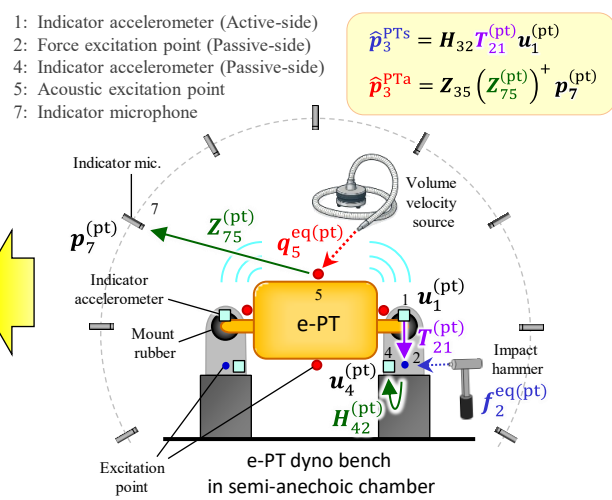


Fig. 2 Experimental setup for e-PT noise prediction method II (blocked force method)

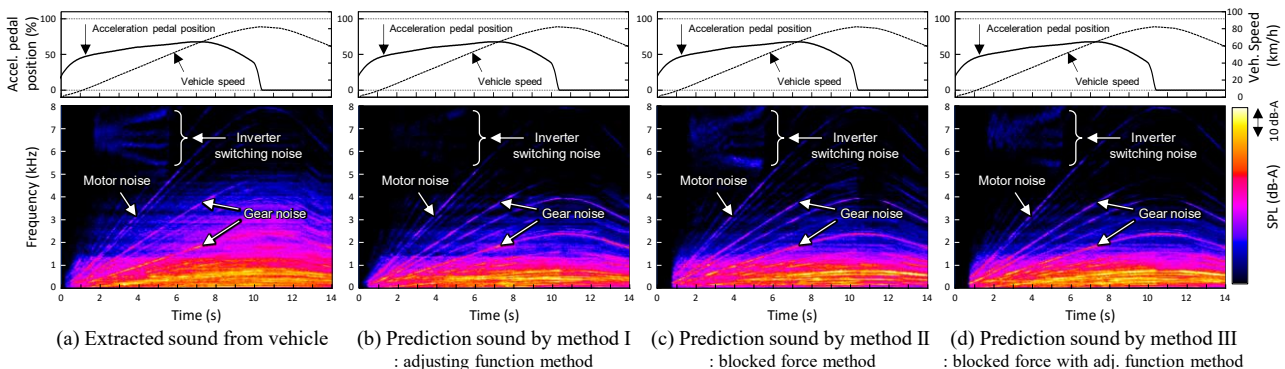


Fig. 3 Comparison of e-Powertrain noise in vehicle interior on NVH driving simulator under partial-load acceleration and deceleration