講演番号	137

文献番号	20225137

Extracting of High Contributing Body Vibration Mode to Road Noise using Operational Data Measured Separetely

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KEY WORDS: **Vibration, noise, and ride comfort, Road noise, Transfer path analysis,** Principal component, Operational TPA, Vibration mode [B3]

In recent years, hybrid and battery electric vehicles (HEV, BEV) have become popular in the market. Engine noise of HEV and BEV is small, compared with the conventional vehicle. Therefore, road noise becomes more salient and further reduction of vehicle interior noise is required.

To reduce road noise, it is important to identify the contribution of each transfer paths from their sources. And operational transfer path analysis (OTPA) and OTPA using a principal component model (OTPA with PC model) are proposed for efficient analysis. In order to extract the high contributing PC mode, acceleration data of the entire vehicle needs to be measured simultaneously using hundred of channels. Though this method has issues such as the enormous man-hours and resources needed to prepare and simultaneous measurement, and the deterioration of accuracy which occurs during the processing of the huge data. For resolution, a technique is proposed in which the measurement site is divided, each high contributing partial PC mode is extracted, and integrating these modes to obtain the entire high contributing PC mode. Theoretically, the integrated high contributing PC mode from this method should be identical with the PC mode calculated from simultaneously measured full data. But, accuracy of this method has not been verified when applied to random MIMO (Multi-Input Multi-Output) data such as road noise.

In this study, to confirm the applicability of the method, integrated high contributing PC modes of a C segment commercial HEV body shell for road noise was extracted. First, OTPA was performed using the simultaneously measured body shell data and high contributing transfer paths from the suspension to interior noise were obtained (Fig.1 a). Next the PC contribution and high contributing PC modes of the body were obtained by applying OTPA with PC model (Fig.1 b,c). Using the proposed method, the integrated high contributing PC mode was extracted from the data measured separately (Fig.1 d). Both results were compared (Fig.2) and the PC modes obtained from both methods were similar. Also, from this analysis, the effective parts to reduce interior noise were identified (Fig.1 e) and from actual vehicle tests by modifying to reduce the vibration of the identified parts, reduction of interior noise was proved (Fig.3). From these results, it was confirmed that the proposed method was capable to extract high contributing PC modes from separately measured data even for road noise and extract effective parts to reduce vehicle interior noise which proved the validity of the proposed method.

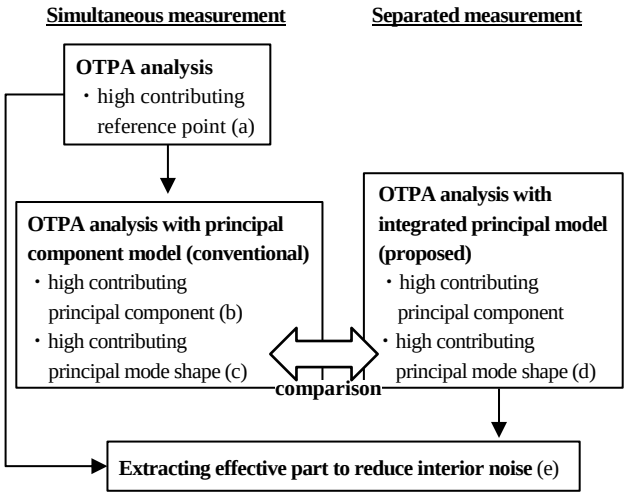

Fig.1 Application flow of the proposed method to the vehicle phenomenon.

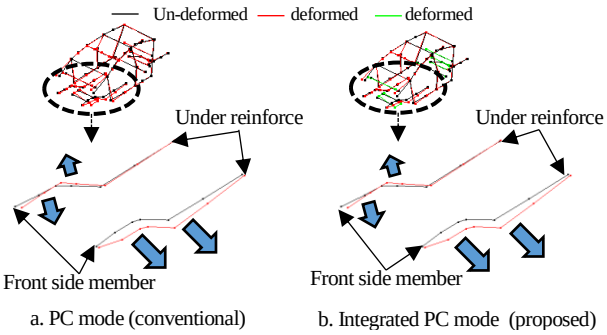

Fig.2 Comparison of conventional PC mode and integrated PC mode.

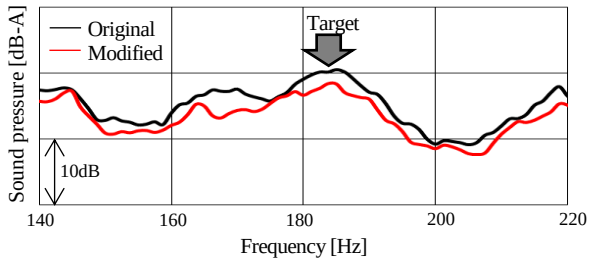

Fig.3 SPL at driver's ear.