Transfer Path Analysis for Reduction of Brake Grind Noise on Vehicle Level

Transferpfad-Analyse zur Verminderung von Grind Noise am Gesamtfahrzeug

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Abstract/Zusammenfassung

Friction processes during brake application usually cause dynamic forces, which can appear to be audible in the passenger's compartment. Disc/drum corrosion often leads to further increase of noise excitation and annoyance. Grind noise is strictly related to the friction processes needed to intentionally reduce vehicle speed. This low frequency noise phenomenon is audible especially at low vehicle speed, when masking from other sources like wind, road, or power train noise is significantly reduced. In the near future, grind noise will gain increasing interest due to application of full electrical and hybrid vehicle drives and the related decrease of engine noise.

Most studies on brake acoustics concentrate on optimization of the brake system to reduce noise excitation. With view on the fact that brake grind noise is related to the brake function itself, however, it is beneficial to investigate the potential for optimization on vehicle level. The most effective NVH optimization will be achieved by improving and matching the acoustic properties of body, suspension, and the brake system.

In a first step of this study, the main structure borne noise transfer paths have been identified by means of transfer path analysis. A detailed analysis of the relevant transfer paths shows critical sound transmission of the suspension system and its attachments to the vehicle body. The potential of this approach for brake noise optimization is demonstrated by an example. As a second step, the radiating body surfaces contributing to the perceived brake noise have been identified using panel contribution analysis. This helps optimizing the vehicle body structure and the trim package. The potential for improvements has been predicted virtually using a modified interior noise synthesis model. The results have been verified experimentally by principal modifications of the vehicle.