

## Advanced methods for the auralization of vehicle interior tire-road noise

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Besides powertrain and aerodynamic noise, tire-road noise is an important aspect of the acoustic comfort inside a vehicle. For the subjective evaluation of different tires or vehicles in a benchmark, authentic sound examples are essential. They should be recorded on a real road rather than on a roller dynamometer (avoiding artificial and periodic sounds, especially in the case of a small roller circumference and a smooth surface). The challenge of on-road measurements is the need for separating the components of the interior noise generated by rolling tires, aerodynamic flow and powertrain. This allows for individual judgment of the noise shares.

A common approach for eliminating the engine sound is shutting the engine off after acceleration to the desired maximum speed. Operational Transfer Path Analysis (OTPA) can then be used to auralize the tire-road noise at a certain receiver location, where an artificial head records the interior noise during this coast-down. Further signals are needed which are measured with a triaxial accelerometer at each wheel carrier and microphones applied near the tires. Because the aerodynamic flow is uncorrelated to tire-road excitations it is even possible to auralize the wind noise.

A coast-down with the engine switched off does not comply with customers' driving experience. Thus the analysis must be extended to dynamic driving conditions with the engine running. Furthermore, driving maneuvers with strong acceleration can influence the tire-road noise. For these applications the unwanted crosstalk of the engine to the signals measured near the tires must be eliminated to guarantee a tire-road noise synthesis without an engine noise share. This paper describes a new method based on Cross-Talk Cancellation (CTC) to auralize and independently evaluate wind, tire-road as well as engine noise of a dynamic driving condition with only a small additional measurement effort.

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