Acoustics of Electric Vehicles

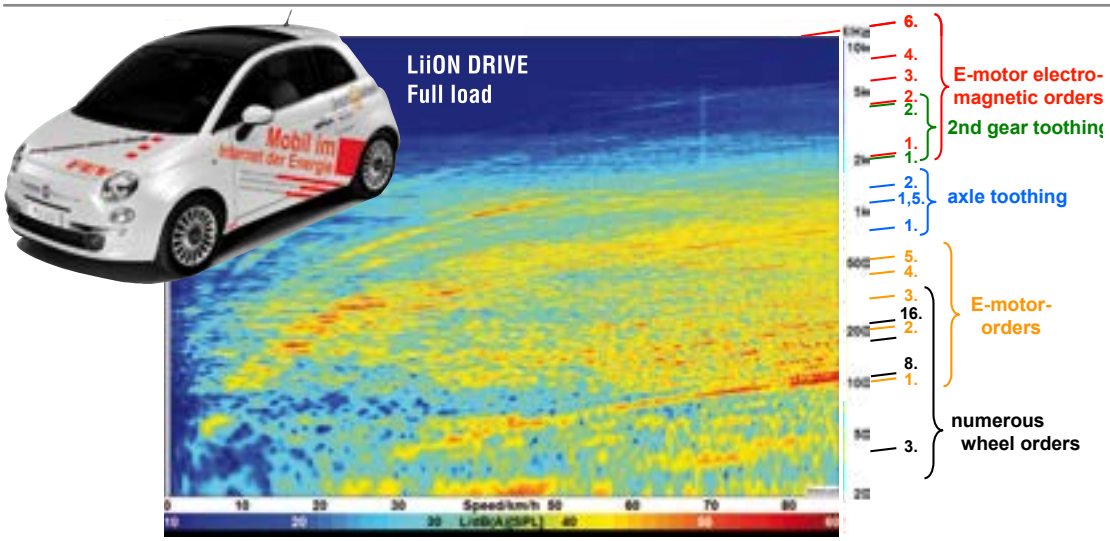

Fig. 1: Interior Noise of LiiON DRIVE at Full Load Acceleration

Electrification of the powertrain will change the noise pattern of future vehicles. While electric drives produce less noise than combustion engines, the noise generated by electric vehicles is far from ideal. The electric components often cause high-frequency noise levels, which are perceived as uncomfortable or annoying. In addition, the masking effects of the combustion engine are missing, so that auxiliary units, rolling and wind noise appear more pronounced.

The interior noise levels of the electric Fiat 500 LiiON DRIVE prototype, developed by FEV, were examined. The noise levels were then traced back to the individual responsible components (Fig. 1). The comparison with its combustion engine powered base model shows that this vehicle produces 12 dB(A) less at full load, but doesn't leave an equally dynamic impression. A subjective evaluation of a variety of electric vehicle noises, which were virtually modified in the acoustics laboratory, demonstrated that the reduction of the high-frequency noise levels of the electric motor and transmission, in particular, produces a more agreeable noise impression. One option for the sports car market segment is the improvement of the dynamic impression through the addition of load-dependent low-frequency electric motor orders, e. g. through active systems.

The limited driving range of electric vehicles can be expanded significantly through the installation of a range extender, which is a combination of a combustion engine and a generator. The noise contribution of this module should stay below the level of the purely speed-dependent electric vehicle noise. This can be achieved through the selection of an appropriate engine concept, such as a Wankel engine combined with suitable mounts and encapsulation. The operational strategy of the range extender yields further degrees of freedom for the NVH optimization.

A noticeable operation of the range extender below 30 km/h should be avoided. The adaptation of the range extender speed to the vehicle speed above 30 km/h can make maximum use of the masking effects caused by rolling and wind noise and also contributes to a more dynamic noise impression (Fig. 2).

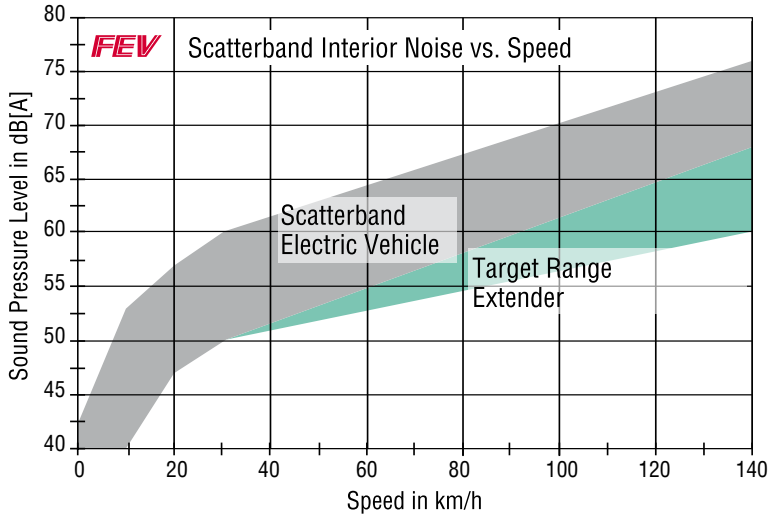

Fig. 2: Target Band for Range Extender Interior Noise Level

During previous projects FEV was able to gather a wealth of experience with the acoustic development of electric vehicles, which we can now apply to our clients' projects in the field of electric mobility.

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