Abstract

Generally speaking, cylinder pressure development in the combustion engine is regarded as a key variable for describing processes taking place inside the engine. The use of cylinder pressure sensors, however, increases the cost of production. In diesel engines, combustion noise is also particularly dominant in the low engine speed and load range. For this reason an engine management system, based on structure-borne sound, is developed that uses virtual sensors to deliver the combustion variables of cylinder pressure and provide an objective characteristic value of diesel knocking noise.

The first step in developing the virtual cylinder pressure sensor involves determining suitable structure-borne sound positions by means of coherence analysis and then examining them in the time and frequency range. This reveals signal components of combustion and injection in the structure-borne sound signal. In the next step, these are extracted and form the basis for the virtual sensor. In conjunction with control unit variables, models estimate the required combustion variables. The virtual cylinder pressure sensor is validated on the basis of a steady-state operating point and load increase.

The diesel noise rating is calculated on the basis of the loudness and modulation spectrum from the airborne-sound signal. Sensing airborne sound directly in the vehicle is not practicable. Instead, the approach taken calculates loudness and modulation directly from the structure-borne sound signal. In combination with control unit variables, the virtual noise sensor calculating the diesel noise rating of the airborne-sound signal with good results.

Finally, the engine management system based on structure-borne sound is put into operation at an operating point selected with the aid of center of heat release control and simultaneously determined diesel noise rating. Comparing cylinder-pressure-controlled engine operation with engine operation controlled on the basis of structure-borne sound reveals no significant differences.