

Abstract. This dissertation covers the development of algorithms oriented to improve the emission control system of Diesel engines. For this purpose, the inclusion of on-board sensors like temperature, NO_x and NH_3 sensors allows performing on-board diagnostics to the after-treatment systems focus of this work, which are the DOC and the SCR system. Then, the target is to meet on-board diagnostics regulations in order to keep emissions below a regulation threshold over time.

Experimental tests, including gas analyzer measurements, allow having a wider view of the species in the exhaust line. Complementary, new and aged units are used in order to have the experimental effect of ageing on the catalysts. Then, the effect of temperature, exhaust mass flow, species concentrations and ageing is analyzed for DOC and SCR, in combination with the assessment of some relevant sensors measurements. As a result, the characteristics, opportunities and limitations extracted from experimental data are used as the basis for the development of models and diagnostics techniques.

The assessment of temperature sensors measurements, along with the development of heat transfer models is required to feed temperature dependent functions. In this sense, the slow measurement of the DOC upstream temperature sensor is improved in transient conditions by means of a data fusion technique, based on a fast model and a Kalman filter. Then, a 1D and a 0D lumped heat transfer models are presented, in which the upstream inputs are assessed in relation to its use. On the other hand, a technique to estimate the temperature increase due to post-injection pulses oxidation is also presented.

Both DOC and SCR models are proposed in order to estimate the effect of ageing on emissions, in which an ageing factor is modelled as a tunable parameter that allows varying from new to aged states. On the one hand, a 0D lumped model is developed for DOC in order to estimate the HC and CO species slip, which is validated in a WLTC and is then used for simulation. On the other hand, a 1D and a 0D models are developed for SCR, which are then used to feed the diagnostics strategy and for simulation.

Finally, diagnostics strategies are presented for total failure or removal of DOC, as well as for efficiency estimation of DOC and SCR. On the one hand, the former strategy is separated into passive and active diagnostics, in which post-injections are used in active diagnostics in order to excite the system and confirm a total failure, in case. Then, the DOC efficiency estimation is done by means of an indirect technique in which the light-off temperature is detected and an emissions increase is related by means of the DOC ageing model. On the other hand, an observer to estimate the SCR ageing state is developed, which is based on an extended Kalman filter. However, in order to avoid associating low SCR efficiency to ageing, an indicator of the injected urea quality is developed to run in parallel.