Abstract. The dissertation covers the problem of the online estimation of diesel engine exhaust concentrations of NO_x and λ^{-1}. Two information sources are utilised:

- on-board sensors for measuring NO_x and λ^{-1}, and
- control oriented models (COM) in order to predict NO_x and λ^{-1}.

The evaluation of the static accuracy of these sensors is made by comparing the outputs with a gas analyser, while the dynamics are identified on-board by performing step-like transitions on NO_x and λ^{-1} after modifying ECU actuation variables. Different methods for identifying the dynamic output of the sensors are developed in this work; these methods allow to identify the time response and delay of the sensors if a sufficient data set is available. In general, these sensors are accurate but present slow responses.

Afterwards, control oriented models for estimating NO_x and λ^{-1} are proposed. Regarding λ^{-1} prediction, the computation is based on the relative fuel-to-air ratio, where fuel comes from an ECU model and air mass flow is measured by a sensor. For the case of NO_x, a set-point relative model based on look-up tables is fitted for representing nominal engine emissions with an exponential correction based on the intake oxygen variation. Different corrections factor for modeling other effects such as the thermal loading of the engine are also proposed. The model is able to predict NOx fast with a low error and a simple structure.

Despite of using models or sensors, model drift and sensor dynamic deficiencies affect the final estimation. In order to solve these problems, data fusion strategies are proposed by combining the steady-state accuracy of the sensor and the fast estimation of the models by means of applying Kalman filters (KF). In a first approach, a drift correction model tracks the bias between the model and the sensor but keeping the fast response of the model. In a second approach, the updating of look-up tables by using observers is coped with different versions based on the extended Kalman filter (EKF). Particularly, a simplified KF allows to observe the parameters with a low computational effort.

Finally, the methods and algorithms developed in this work are combined and applied to the estimation of NO_x and λ^{-1}. Additionally, the dissertation covers aspects relative to the implementation of the methods in series engines.