

Abstract. Internal combustion engine is affected by a continuous technological evolution for improving its performance while satisfying the each time stricter environmental legislation. In the case of diesel engines this affects mostly NO_x and particulate matter emissions.

Systems for emission abatement (common-rail direct injection, variable geometry boosting system, exhaust gas recirculation, particulate matter trap, catalyzers, etc.) need a sophisticated electronic control. In recent years, on-board emissions sensors are available for the first time, and it allows reformulating the engine control system, which has been historically based on using intermediate variables, as the air mass flow. This Doctoral Thesis explores the potential of engine control concepts based on the measurement of the raw NO_x concentration, applied to the exhaust gas recirculation control and, in a more innovate approach, to the coordinated control of the injection and the exhaust gas recirculation. Furthermore, the capacity of identifying models able to predict the behavior of the engine allows the application of model predictive control techniques. For achieving these objectives, the following elements are combined:

- An experimental set-up including a real time system for software prototyping, ECU bypass and data acquisition. This set-up is used for integrating the measurement from innovate sensors, programming the different control algorithms and validate them through experimental tests.
- The identification of control oriented models, able to predict the behavior of the different relevant variables when modifying the engine actuators. These models allow selecting input-output pairing, developing model based control algorithms, and compensating the effect of different control actions on the engine torque.
- The experimental evaluation on closed-loop NO_x emission control based on the available models and sensor set. Different approaches are compared, ranging from PID control of the exhaust gas recirculation, to model-based predictive control of the fuel and air paths.

The Doctoral Thesis demonstrates the feasibility of using the NO_x measurement for the control of turbocharged diesel engines.