# Data-driven approach for predicting a real driving NOx emission from diesel engine vehicle

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With growing attention to air pollution related to transportation, automobile pollutant regulations, e.g. EURO 6d, require automotive companies to satisfy the real driving emission (RDE) standards for their manufactured vehicles. This motivates engine researchers to develop pollutants, e.g. nitrogen oxide, estimation models for after-treatments equipped automobiles to take clues for designing new emission control strategies or monitoring.

The objective of this study is to predict NOx emission in engine-out and tailpipe with data-driven approaches. The subject diesel engine vehicle included 3 after-treatment systems, a lean NOx trap, diesel particulate filter, and selective catalytic reduction. We first carefully analyzed and selected crucial features for prediction from raw on-board-diagnostics (OBD) data with mutual information estimation. Then we built a neural networks-based estimator with those processed datasets. Especially for the tailpipe section, however, Attention algorithm from natural language processing (NLP) was applied to capture the blurred correlation between OBD data and NOx emission.

For the engine parts, we found about 10% improvements in R-squared (R2) score with mutual information-based feature engineering, compared to the vanilla neural networks-based predictions without optimizing the input variables. NLP-motivated algorithms showed a 40% increment in prediction performances in the tailpipe from the conventional deep neural networks. The proposed approaches could be applied to the real-time monitor for specific real-driving after-treatment systems included vehicles, with low computational costs and domain knowledge. This study also implies the differences in the emission characteristics between the engine and after-treatment systems, which motivate the careful algorithms search or feature engineering for developing a much more accurate and explainable data-driven NOx emission estimation model.

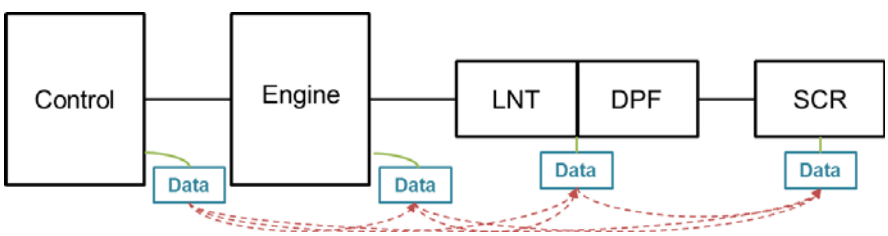


Figure. 1 Configuration of the test diesel engine vehicle.