Review of European Master's of Automotive Engineering thesis
SCR efficiency model using a neural network and a pseudo 1-D model
by Marion Lorieul

The diploma thesis deals with the subject of creating a simplified model of the Selective Catalytic Reduction (SCR) system using a pseudo 1-D model and a neural network. The model is intended to be part of the engine and exhaust aftertreatment control system on a production automobile, and to be used in the process of control of the SCR catalyst for reducing nitrogen oxides (NOx).

The topic fits well in the area of Master's studies in Automotive Engineering, and is a rather difficult one, as it bridges modeling and experimental work, and crosses into two other areas not covered by the course of study, catalysis and neural networks. Successfully addressing a SCR model using neural networks is a topic more suitable for a Ph.D. dissertation than for M.S. thesis; it was understood that the extent of the work done during the internship and described in the thesis would be commensurate to the M.S. level.

Marion Lorieul has taken up on the work exceptionally well. The thesis begins with carefully crafted, logically structured, and technically correct introduction into all relevant aspects, touching multiple topics: diesel engines, environmental problems related to diesel exhaust, emissions reduction, and simulation and modelling. More detailed introduction is then given on SCR systems, their control, and 0-D model employed by the control system. Two alternatives are then proposed as simple enough to be computationally feasible within the engine and aftertreatment control system: a pseudo 1-D model and a neural network.

Model constraints and requirements, parameters, and desired outcomes are discussed comprehensibly and thoughtfully. The section on neural networks contains insightful discussions and well justified reasoning for the choices that were made. Experimental data on multiple driving cycles, including legislative cycles, research cycles mimicking different driving patterns, and real driving data are collected, and organized into three distinct sets, which are used for calibration and validation of the model and for actual test run of the model.

Nicely flowing, detailed descriptions, well organized into logical blocks, demonstrate both excellent writing capabilities and broad understanding of the concepts involved.

The final discussion is very realistic. The work done is valuable, but the topic is not exhausted: there are open-ended questions, and calls for more work to be done, with suggestions for future directions.

There are few minor formal errors: date of transition to Euro 5c on page 21, missing results on page 38, inconsistency between Fig. 2.7 and 2.8 in cycle names, axis labels in Fig. 2.7 and 2.8, Fig. 4.1.-4.4. not introduced in the text, or EQMA not defined in the abbreviations section. Y-scale ranges in Fig. 4.5 and 4.6 are too large, however, these graph appear to have come out of a special software.

Overall, the quality of the thesis demonstrates high level of underlying knowledge, engineering judgment, and analytical and writing skills.

I recommend the thesis for defense and, with respect to the complexity of the topic addressed and the overall quality of the work, I classify it as A – excellent.

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Michal Vojtisek

Thesis advisor
Associate Professor of Mechanical Engineering
Institute for Automobiles, Combustion Engines and Rail Vehicles
Faculty of Mechanical Engineering
Czech Technical University in Prague
Technicka 4, 166 00 Prague 6, Czech Republic
Tel. +420 – 774 262 854
michal.vojtisek@fs.cvut.cz

Questions:

- Please explain the negative NOx removal efficiency in Fig. 4.5 and 4.6 on pages 57-58.
- What metric is evaluated in Table 7 on page 58?
- In Table 8, training times of tens and hundreds of seconds are listed. How many iterations are typically performed?