

I. IDENTIFICATION DATA

Thesis name:	Detection of high emitters through roadside sampling: Comparative analysis of particle metrics and vehicle operating conditions and spacing
Author's name:	Pratyush Subhasit
Type of thesis :	master
Faculty/Institute:	Faculty of Mechanical Engineering (FME)
Department:	Department of Automotive, Combustion Engine and Railway Engineering
Thesis supervisor:	Prof. Michal Vojtíšek, Ph.D.
Supervisor's department:	Department of Automotive, Combustion Engine and Railway Engineering

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>Evaluation of thesis difficulty of assignment.</i>	
<p>The technical topic of remote sensing of vehicle exhaust emissions by roadside sampling is rather difficult one. The experimental campaign, conducted within H2020 project CARES (City Air Remote Sensing), brought together top research groups from the EU to investigate capabilities and limits of current knowledge and technology, in an effort to identify the relatively small number of malfunctioning vehicles responsible for major share of total emissions of particulate matter. Working on a real research project, with no correct answers in any textbook, is always challenging, and Mr. Subhasit has, on his own request, taken such challenge.</p>	

Satisfaction of assignment	fulfilled
<i>Assess that handed thesis meets assignment. Present points of assignment that fell short or were extended. Try to assess importance, impact or cause of each shortcoming.</i>	
<p>The assignment has been satisfied in its entirety. Mr. Subhasit has addressed each question or point in the assignment, investigating these on a level reasonably corresponding to his education and experience. The presence of many questions not fully answered stems not from a lack of reasonable effort and diligence, but from a research uncertainty associated with pushing the technological limits. Likewise, findings that some parameters are not favorable, such as rather long minimum interval between two vehicles, should not be interpreted as poor work of the student, which has focused on technical evaluation of the setup and not on its design, but as legitimate answers.</p>	

Activity and independence when creating final thesis	A - excellent.
<i>Assess that student had positive approach, time limits were met, conception was regularly consulted and was well prepared for consultations. Assess student's ability to work independently.</i>	
<p>Mr. Subhasit has worked independently on the preparation of the thesis and the underlying work. He was not able to participate in the experiments due to coronavirus restrictions (group size limit & limits on international travel) and his work was limited to analysis of experimental data. He has always been prepared for progress meetings, met deadlines, communicated clearly, and took a good amount of initiative throughout the project. Mr. Subhasit demonstrated interest and positive attitude at all times throughout the thesis work.</p>	

Technical level	A - excellent.
<i>Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.</i>	
<p>The thesis is remarkably extensive, even if the last 20 of 125 pages are tabulated results of results of each of 629 vehicle passages which were analyzed in the thesis. The first chapter provides general background into vehicle emissions and their measurement. The second and third chapter describe the experiment and the instrumentation. The analysis, which is Mr. Subhasit's own work, constitutes, with 43 pages, the bulk of the thesis, followed by discussion and conclusions. The analysis focuses on the ability of several instruments, sampling from two locations, to detect exhaust plumes from vehicles passing at several speeds and acceleration levels and with varying intervals between two consecutive vehicles. The analysis also aims at identifying high emitters, this term being used loosely as there is no clear definition of a high emitter.</p>	

The findings themselves (not their description, but what has been actually discovered) are in many cases ambiguous, inconclusive, and, at times, not very positive. One instrument was found not to be working correctly, several other instruments were working near their detection limits, and mixing of plumes from different vehicles poses a considerable challenge and limitation to the approach. These are legitimate conclusions not limiting the quality of the thesis; the assignment was to evaluate, and not to design, an experimental approach.

The student has learned considerably and this was not an easy topic at all. Not being able to participate in the experiment, due to reasons outside of the student's control, make this work considerably more difficult. While some improvements could still take place, Mr. Subhasit has done, for master's level, excellent work.

Formal and language level, scope of thesis

B - very good.

Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.

The scope of the thesis is commensurate to the work presented, with both being rather extensive. The 34 figures and 38 tables in the main text are well readable, appropriately chosen, and reasonably convey the message intended. The text is logically organized into chapters. The language level is best described as technical English – reasonably structured, comprehensible, but with some stylistic and language shortcomings. Writing on a complicated subject requires careful wording, so that the subject being described – certain result, trend, comparison, qualitative statement - is accurately and clearly identified. For example, in Tables 35 and 36, it is not readily clear whether the results are from all vehicles or a selected one.

Selection of sources, citation correctness

B - very good.

Present your opinion to student's activity when obtaining and using study materials for thesis creation. Characterize selection of sources. Assess that student used all relevant sources. Verify that all used elements are correctly distinguished from own results and thoughts. Assess that citation ethics has not been breached and that all bibliographic citations are complete and in accordance with citation convention and standards.

A total of 35 sources are cited in the thesis. The majority of these are technical literature primarily from the internet. The rather small number of peer-reviewed papers can be at least partially attributed to the scarcity of literature on the investigated topic. The selection of sources is appropriate (ref 2 is a marketing literature the use of which is typically discouraged, but the information referred to is background information which is presented correctly) and the sources are cited correctly.

Additional commentary and evaluation

Present your opinion to achieved primary goals of thesis, e.g. level of theoretical results, level and functionality of technical or software conception, publication performance, experimental dexterity etc.

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Summarize thesis aspects that swayed your final evaluation.

Overall, Mr. Subhasit has done remarkably well in analyzing data from roadside vehicle emissions measurements within an extensive international experimental campaign. In his thesis, he evaluated over 600 individual vehicle measurements, searching for high emitters, and addressing issues including the effect of location from which the exhaust plume is sampled, the interval between vehicles, or the instrument detection limit. Considering the immense complexity of the subject and the shortcomings in experimental data – one instrument has not measured correctly, several instruments were measuring close to their detection limit, combined effects of various factors such as speed and acceleration – the work, 125 pages with appendices, 34 figures, 38 tables – far exceeds the extent typical for a master's thesis. The work is technically sound, all shortcomings are relatively minor. Mr. Subhasit has worked diligently and has learned considerably.



SUPERVISOR'S OPINION OF FINAL THESIS

I evaluate the submitted thesis with classification grade **B - very good**.

Questions:

1. Please identify vehicles that, in your opinion, suffered from malfunction or tampering during some, but not all, parts of the test.
2. Using your own results, please identify passages during which you believe a) the SCR functionality has been disabled or b) the particle filter has been bypassed.
3. In the data, please identify a possible commanded enrichment, and suggest how it can be, using data from this passage or other passages, differentiated from a malfunction.

Date: **4.2.2022**

Signature: