Review of diploma thesis „Optimization of the calibrations of the start for a mass production Flex-fuel direct injection engine“, submitted by: Valentin Raute

This work reports on ethanol start procedure optimization when ethanol as an alcohol fuel produced from renewable resources is used. The thesis is well sectioned, well arranged and contains adequate amount of schemes and graphs illustrating the topic.
Due to different chemical energy content and evaporation characteristics the engine starting parameters have to be changed.
After examples of ethanol use impacts and benefits on engine characteristics a detailed tools and possible strategies and parameters description follows. Compared to previous part the result description is significantly shorter. This is mostly coming from available time and confidential requests. Anyway, the student should persuade the commission that the amount of research work corresponds with master thesis grade.

p. 12 - there is no information about nature of ethanol share expression (mass/volume) is involved. Volumetric mixing is standard and is assumed throughout this work.
p. 14 - there is a strong the difference in total engine efficiency reported on Figure 1. One can conclude this is instant effect of the fuel. Some more details related to cited study [2] should be included, because parameters (compression ratio, fuel enrichment, spark timing, boost pressure) were definitely optimized.
p. 16 - what is ethanol share range, which can be reported by the ethanol sensor? The mentioned concentrations suggest utilization for high ethanol shares only.
p. 26 - the lack of Y-scale makes the traces less understandable. Addition notes with values at given time (e.g. 14 s) and the grid size should be useful.
p. 37 - no dwell time compensation
p. 46 - was the engine flushing with cooled liquid considered to speed-up cooling speed?
p. 46 - "Moreover the vehicle pressure environment was approximately 1 bar" please comment
p. 45-55 - Usage of various point shapes would be beneficiary for various points (not only circles), because used colour sometimes tend to be difficult to differentiate. Mainly for non-starting conditions the usage of "zero appear" starting points may be misleading.
p. 54 - Lot of effort has been devoted to split injection timing which has more parameters. For faster optimization is better to start with more simple injection strategies (1 injection) and use the resulting timing as a basis for calibration of more complex strategies in order to make narrower optimization window.
Numbering
p. 55 highest point = highest start time?

Questions:
Which ways to increase the cooling speed were considered? E.g. removing the coolant thermostat with forced engine coolant flow through cooler or motoring the vehicle on chassis dynamometer to cool down the combustion chamber with considering engine oil heating up due to circulation may be helpful. Was rate of temperature decrease investigated before the tests to minimize the time between two tests? 2 hours dwell time seems to more than necessary after tens of second engine operation.
What was the repeatability of the tests? Mainly the overshoot seems to be more or less random with varying some parameters. Also for judge significance of observed changes a repeatability insight should be included for some operation parameters optimization.

A direct comparison of resulted starting strategy for E95 and neat gasoline should be included too. This comparison is expected to be valuable for estimation of starting parameters for other mixtures and other temperatures.
What changes of which optimized parameters are expected when the temperature decrease?
Is similar approach feasible for another alcohols used as engine fuels (e.g. methanol, butanol)?

I recommend the thesis to be subjected to the defense in front of a committee. Assuming the questions above will be satisfactorily answered I suggest grade C.

Prague, September 8, 2017

Ing. Martin Pechout, Ph.D.
Department of Vehicles and Ground Transport
Czech University of Life Sciences
Kamýcká 129, Prague, Czech Republic .....