ČVUT
ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE

REVIEWER'S OPINION OF FINAL THESIS

I. IDENTIFICATION DATA

Thesis name:	**Hill Climbing Algorithm for Fuel Consumption Optimization of HEV vehicles**
Author's name:	**Kar Anurag**
Type of thesis:	master
Faculty/Institute:	Faculty of Mechanical Engineering (FME)
Department:	Department of automotive, Combustion engine and Railway Engineering
Thesis reviewer:	Ing. Rozhdestvenskiy Dmitry Ph.D.
Reviewer's department:	CTU in Prague Faculty of Transportation, Department of Vehicle Technology 16116

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment — **challenging**

Evaluation of thesis difficulty of assignment.

The task of FC optimization for HEV vehicles is a highly important and challenging for today's automotive industry. The task covers both theoretical and practical activity.

Satisfaction of assignment — **fulfilled**

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.

The work covers all questions stated in the assignment including theoretical research, development and implementation of the system, and evaluation of the results.

Method of conception — **correct**

Assess that student has chosen correct approach or solution methods.

Student approach to the engineering tasks corresponds to the modern methods and processes used today in the Automotive R&D. He researched and used tool, algorithms, and information already available and continue the development on the foundation.

Technical level — **A - excellent.**

Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.

Student show the ability to select and use new software and methods efficiently and proved the ability to implement developed algorithms in the selected programing language (MATLAB/ Simulink). Presented graphs and tables shows the ability of the student to analyze and present the outputs of his 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 thesis is written in a formal technical English language, however, has several minor flaws such as usage on unscientific expressions "seems to be" and missing references and units on graphs [pages 45, 47]

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.

The list of references proves that the student preformed a deep research and used modern resources relate to the topic of the thesis, all the refences are correctly indicated in the text (except page 47). The list itself is formatted correctly, one minor comment regarding online resources (they should include time and the date when the resource was avaliable)

ČVUT
ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE

REVIEWER'S OPINION OF FINAL THESIS

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.

The task of the FC optimization is challenging and in a high demand among modern automotive R&D. Student proved to be able to use materials and novel software available today to develop and validate new algorithms and provided a guidance on how to continue his research which provides a background for future students. He showed the ability to present and analyze complex multidimensional data in an efficient and easy to understand way. It would be beneficial to use some sort of version control system during the development, thus will allow other researchers to access the source code.

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Summarize thesis aspects that swayed your final evaluation. Please present apt questions which student should answer during defense.

I evaluate handed thesis with classification grade **A - excellent.**

1. Why PSO was chosen, were there any other algorithm considered (GA, NN), implemented or tested? How do they differ in terms of computational speed and result accuracy?
2. Is there any other algorithm or optimization to developed one, which can be used to making it suitable for real-time predictive applications?
3. Page 26 "do not allow the engine to be switched off during downhill" - does it mean we cannot imply fuel cutoff, was it considered in terms of FC and RB efficiency to disconnect the ICE using the eclutch or it is always connected with the fuel cutoff?
4. Page 48 "From Figure 26, it can be inferred that a bee population of 20 – 30 converge to optimal solution within 30 iteration" figure axis are cost / time / population no iteration is presented; time axis has no units. Is it a wrong picture?
5. Page 48, a combination of 50 bees with 50 iterations **seem to be** an ideal choice for further optimizations, seems to be not an engineering approach, Please explain the choice, is there a way to automatically chouse number of iteration and population ?
6. Page 49, Unclear Table 12 result? please explain the data in the tables and its meaning.
7. Can you think of a method to combine your algorithm in with Neural network and machine learning?

Date: **31.1.2021** Signature: