

I. IDENTIFICATION DATA

Thesis name:	MODELLING,SIMULATION AND VALIDATION OF ENGINE MODELS FOR IMPLEMENTATION OF MODEL PREDICTIVE CONTROL ON SI ENGINE AIRPATH
Author's name:	Arulkumaran Mathivanan
Type of thesis :	master
Faculty/Institute:	Faculty of Mechanical Engineering (FME)
Department:	Department of Automotive, Combustion Engine and Railway Engineering
Thesis reviewer:	Shota Nagano
Reviewer's department:	Technical senior Manager, Model Based design, Toyota Motors Europe NV/SA

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>Evaluation of thesis difficulty of assignment.</i>	
Please insert your commentary.	
<p>Arul is in charge of model validation for MPC controller development. In this activity , he needed to develop the competency not only simulation skill but also tasting skill.</p> <p>In terms of testing, he have to learn how to work the Toyota control logic and engine / turbo charger with each actuator. Data analysis skill was needed as well in order to evaluate model accuracy correctly. In case model is inaccurate, Route cause analysis and developing countermeasure should be done for improvement.</p> <p>Considering above points, this activity is challenging for him.</p>	

Satisfaction of assignment	fulfilled with minor objections
<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>	
Please insert your commentary.	
<p>Arul's assignment is model validation for MPC controller development. This means detailed engine model and mean value engine model should be validated in steady state condition and transient condition. In the thesis, he compared between engine test results and simulation results for validation, and most data were satisfied with our target accuracy. On the other hand, some data were not satisfied with target. In this case , more detail rote cause analysis is needed to develop the countermeasure for model improvement but missed detail one.</p>	

Method of conception	correct
<i>Assess that student has chosen correct approach or solution methods.</i>	
Please insert your commentary.	
<p>For model validation, generally the Key performance index (KPI) is defined in order to judge if model improvement is needed or not. This is the most difficult and important point in his assignment. Arul could define KPI based on vehicle performance data to take into account customer impact.</p>	

Technical level	C - good.
<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>	
Please insert your commentary.	
<p>Arul could learn GT-power usage in short term and significantly improved his MATLAB knowledge and skills to proceed his assignment efficiently. Especially in model validation, he have to analysis a lot of data to calculate KPI and make graphs. He developed automatic KPI calculation tool w/MATLAB to improve efficiency.</p>	

Formal and language level, scope of thesis

C - good.

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

Please insert your commentary.

At first, contents are existing in his thesis but needed to restructure to ensure his story. Through a lot of communication, he could improve step by step. Finally, Arul wrote up the good structured & clear thesis.

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.

Please insert your commentary.

Arul could distinguish his results and thoughts to citations. All bibliographic citations were mentioned in the end of his 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.

Please insert your commentary (voluntary evaluation).

-Experimental

This is the first time for Arul to test turbo charged engine with Toyota control logic. There are some troubles happened during engine bench test. But in each case, he could contact not only his team members but also technician, calibration team members to solve the problem as fast as possible. He could learn detail engine behavior and bench control method through these experiences.

-Simulation

When Arul started his assignment in Toyota Motor Europe(TME), his MATLAB skill is basic level. But he could significantly improve his competency thanks to proactive communication with team members.

-Presentation

We have weekly meeting to share the progress, blocking point and next steps. The beginning of his assignment, it's difficult to grasp his progress because lack of clear messages. But through daily working, Arul achieved big improvement. He could finalize the thesis with good output and keep in mind what is the final target of the project.

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.

-questions

- what is the problem of current engine control
- why he cannot use detailed model for linearized model directly.
- how to define the test condition
- what is the role of WGV
- how to define the criteria of KPI.

I evaluate handed thesis with classification grade **C - good**.

Date: **28.1.2020**

Signature:

