

University of Wales Trinity Saint David

School of Engineering

Powertrain & Sustainability

M6X01206

Zhangwei Guo

1805078

21/03/2020

Contents

1	Introduction	1
2	Task One-Process and comment on the data	2
3	Task Two – Comparison of different vehicle types	8
4	Task 3 – ‘Ideal’ Vehicle	9
4.1	Hybrid Electric Power	9
4.2	Stop-Start.....	10
4.3	Supercharger	11
4.4	Flywheel.....	11
5	Task 4 – Vehicle specification	14
6	Reference.....	15

1 Introduction

In order to deepen the understanding of the knowledge learned in the course, trying to demonstrate knowledge of alternative power providers to enable specification of a system which meets the vehicle's performance and emission requirements, the author tried his best to finish this report. A test of three different vehicle types which is performed over a 30 km distance encompassing a range of road types and environments has been done and the raw data gathered from the vehicle's OBDII port also been obtained (Williams, Assignment Specification, 2020). Even all the data has been provided with both CSV and LFG file, the author chose to finish the analysis through Excel with CSV file.

The first task needs the author processes the raw data into usable format using Excel and determine and evaluate the accuracy and validity of the data.

After the analysis of these three types of vehicles, comparison of them from several different aspects with nearly the same fuel economy figure to make it more fair and reasonable.

The author should pick one of these three vehicles trying to model the ideal vehicle with a range of technologies based on the drive cycle.

The last task needs the author to make proposal with proper technical judgement and current academic research to determine the vehicle specification economically and politically as a technical director (Williams, Assignment Specification, 2020).

All these calculations are carried out based on EXCEL, hence the excel data will also be submit to demonstrate author's work.

2 Task One-Process and comment on the data

When it comes to processing the raw data, first of all, the relevant information needs to be consulted to determine the meaning of each column of data in the table on account of their names are abbreviations. After that, quite a lot of data has to be removed as only several aspects of the vehicle should be analyzed but the data from the OBDII includes everything. For these three types of vehicles, all the data and quantities been kept as shown in figure 1.

Frame Nu	AUX.ROT	AUX.GPS	AUX.GPS	AUX.GPS	SAE.RPM	SAE.VSS	CALC.VSS	CALC.DIST	CALC.ACC	CALC.ENG	CALC.ACC	CALC.ENGINE_TORQUE	N路m	kg-路m
Frame Nu	Vehicle R	GPS	Altitu	GPS Horiz	GPS Vertic	Engine RP	Vehicle Sp	Corrected	Distance t	Current a	Calculated	Accelerati	Calculated engine torque	
10	0	114	5	4	883	0	0	0	0	7	0	72		
11	-1	114	5	4	883	0	0	0	0	7	0	72		
12	-1	114	5	4	883	0	0	0	0	10	0	109		
13	-1	114	5	4	883	0	0	0	0	10	0	109		
14	-3	114	5	4	883	0	0	0	0	10	0	109		
15	-3	114	5	4	880	0	0	0	0	10	0	109		
16	-5	114	5	4	880	0	0	0	0	10	0	109		
17	-2	114	5	4	880	0	0	0	0	10	0	109		
18	-2	114	5	4	880	0	0	0	0	12	0	128		
19	-6	114	5	4	880	0	0	0	0	12	0	128		
20	-10	114	5	4	880	0	0	0	0	12	0	128		
21	-10	114	5	4	887	0	0	0	0	12	0	128		
22	-21	114	5	4	887	0	0	0	0	12	0	128		
23	-25	114	5	4	887	0	0	0	0	12	0	128		
24	-24	114	5	4	887	0	0	0	0	12	0	128		
25	-24	114	5	4	887	0	0	0	0	13	0	136		
26	-21	114	5	4	887	0	0	0	0	13	0	136		
27	-22	114	5	4	887	0	0	0	0	13	0	136		
28	-18	114	5	4	882	0	0	0	0	13	0	136		
29	-19	114	5	4	882	0	0	0	0	13	0	136		
30	-21	114	5	4	882	0	0	0	0	13	0	136		
31	-21	114	5	4	882	0	0	0	0	13	0	141		
32	-17	114	5	4	882	0	0	0	0	13	0	141		
33	-10	114	5	4	882	0	0	0	0	13	0	141		
34	-10	115	5	4	882	0	0	0	0	13	0	141		
35	-10	115	5	4	884	0	0	0	0	13	0	141		
36	-7	115	5	4	884	0	0	0	0	13	0	141		
37	-6	115	5	4	884	0	0	0	0	13	0	141		
38	-6	115	5	4	884	0	0	0	0	13	0	143		

Figure 1 Data been kept

Trying to make the excel working properly, several points of the data have been removed at the beginning on account of the missing of quantities.

All the analysis for three types of vehicle have been finished and several diagrams made from the data of Volvo are as follows

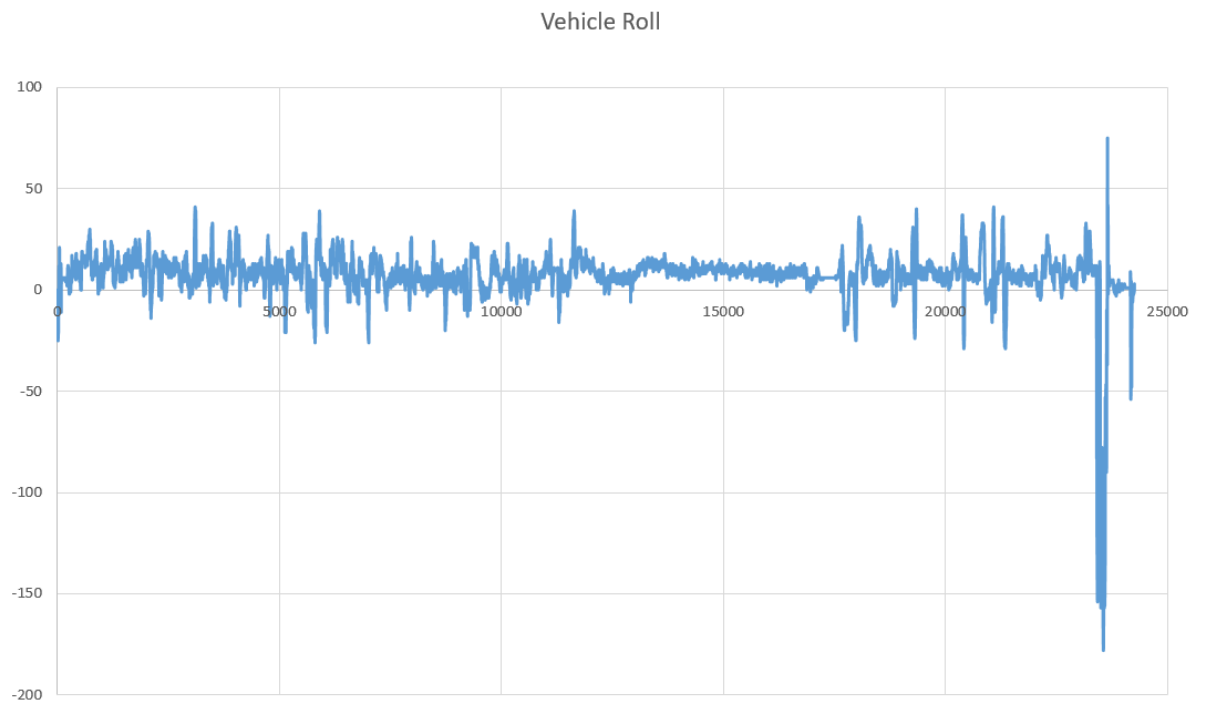


Figure 2 Vehicle Roll

From the roll of vehicle, how stable the vehicle can be obtained from whole process.

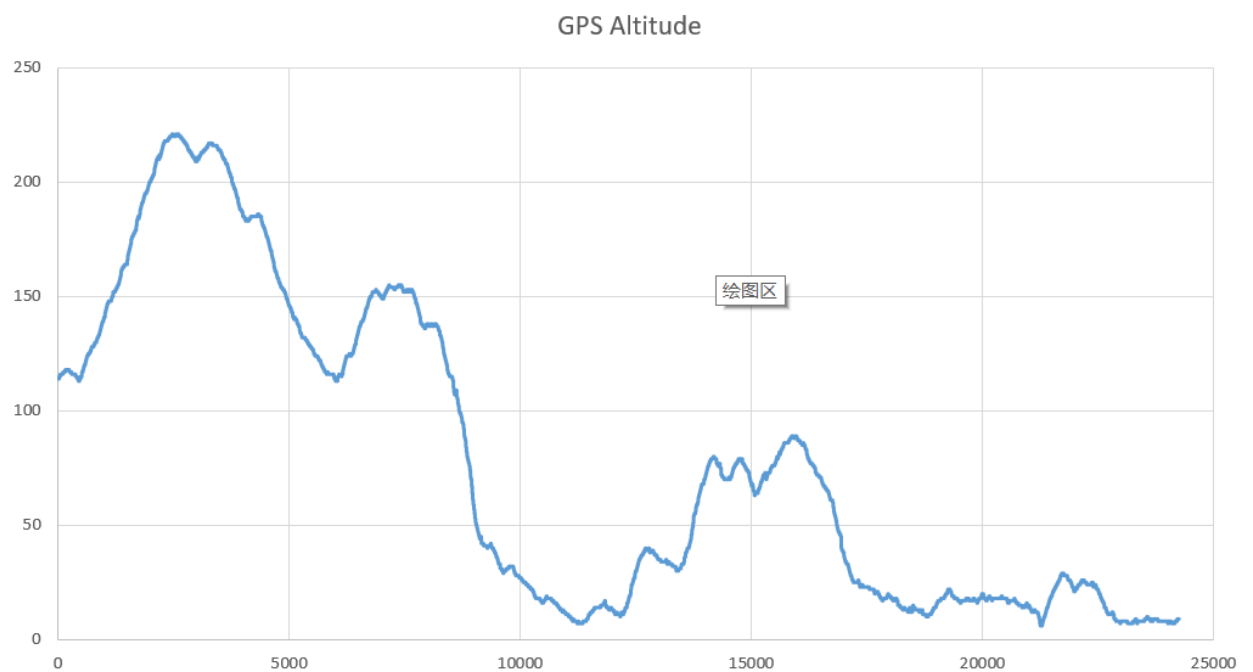


Figure 3 Altitude

The vehicle is going up or down can be seen from the diagram above.

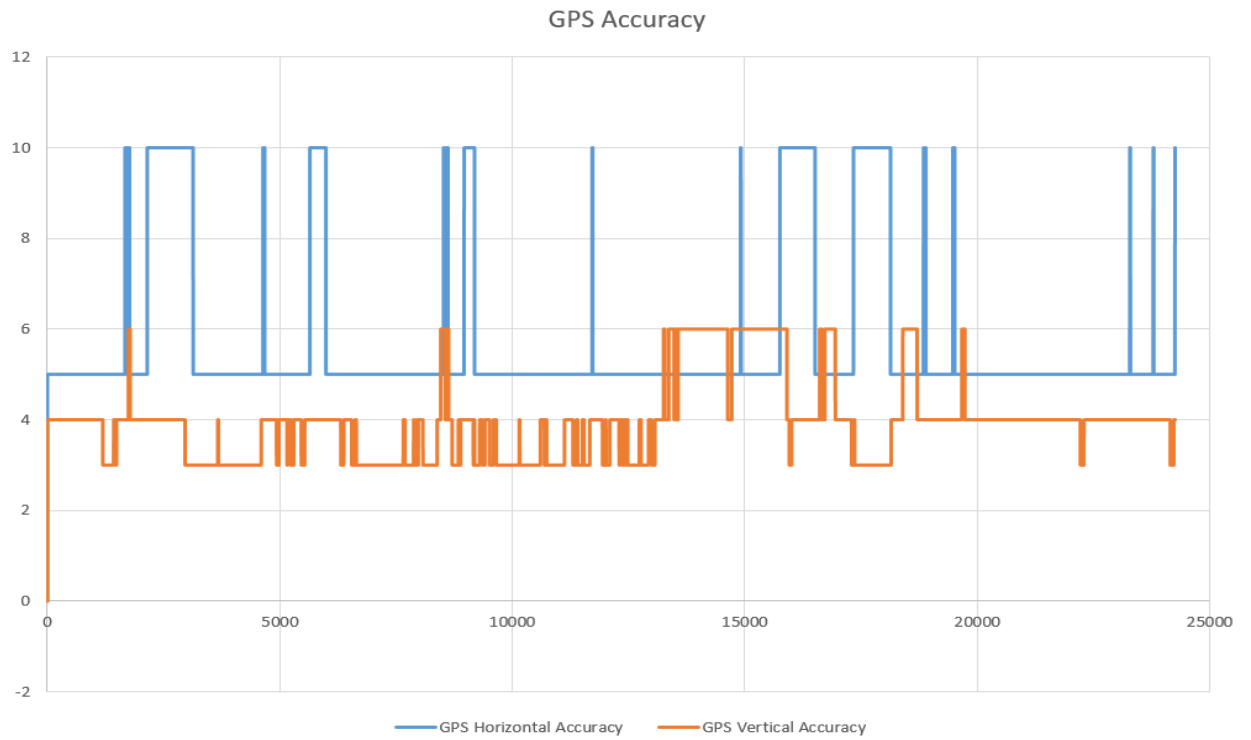


Figure 4 Horizontal and Vertical Accuracy

From the accuracy chart, accuracy of both horizontal and vertical can be controlled within 10.

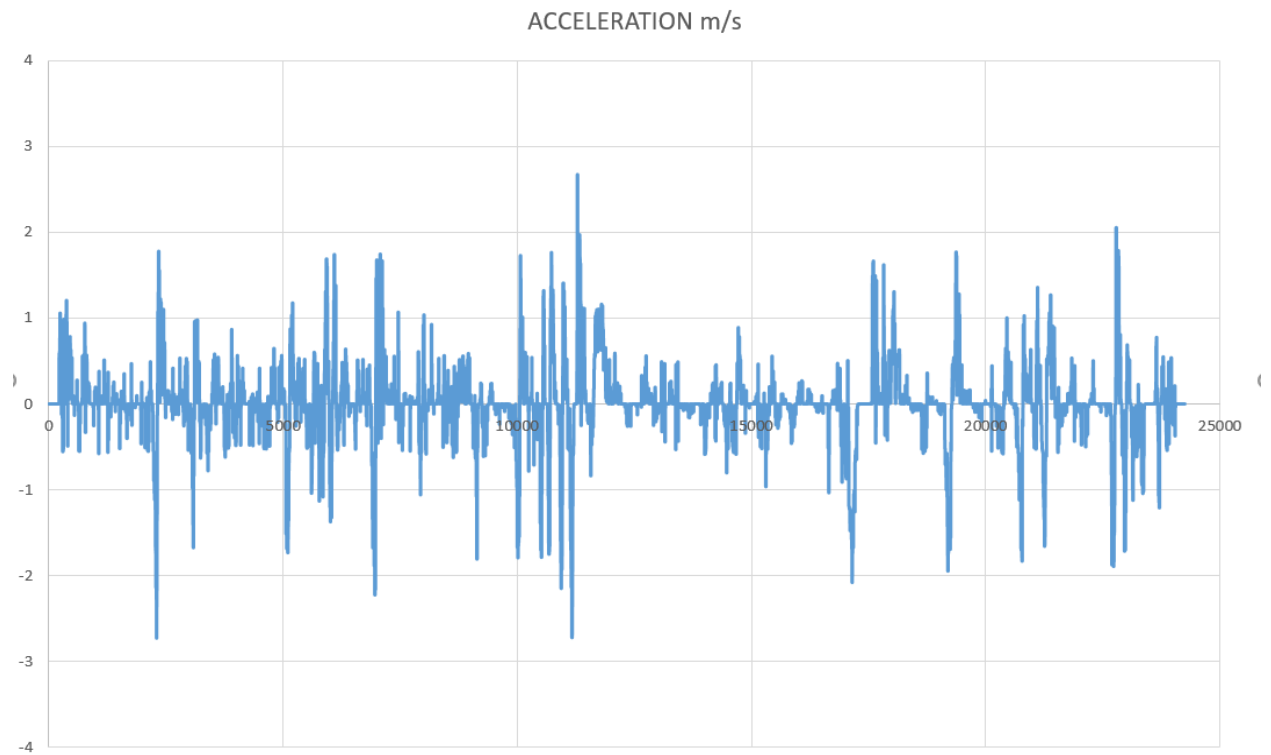


Figure 5 Vehicle Acceleration

The acceleration of different conditions can be obviously obtained.

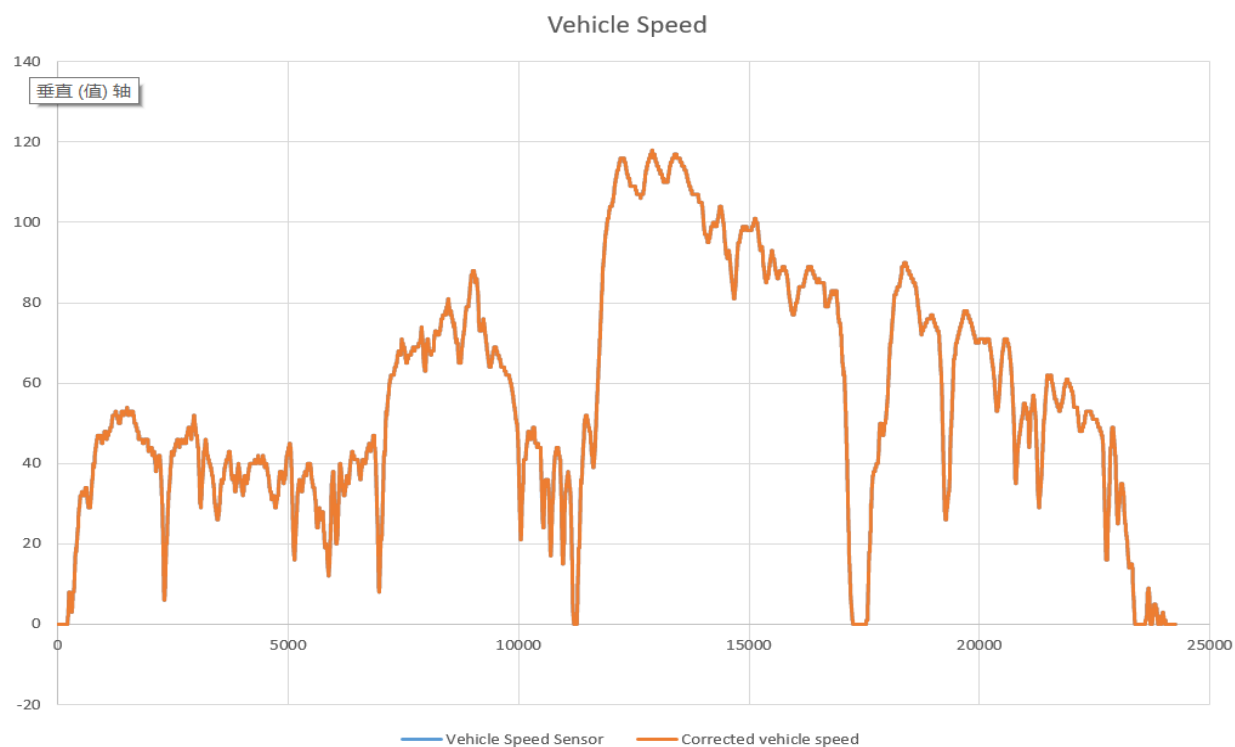


Figure 6 Vehicle Speed

The change of vehicle speed can be seen easily and the data from speed sensor shows a well correspond with the corrected one.

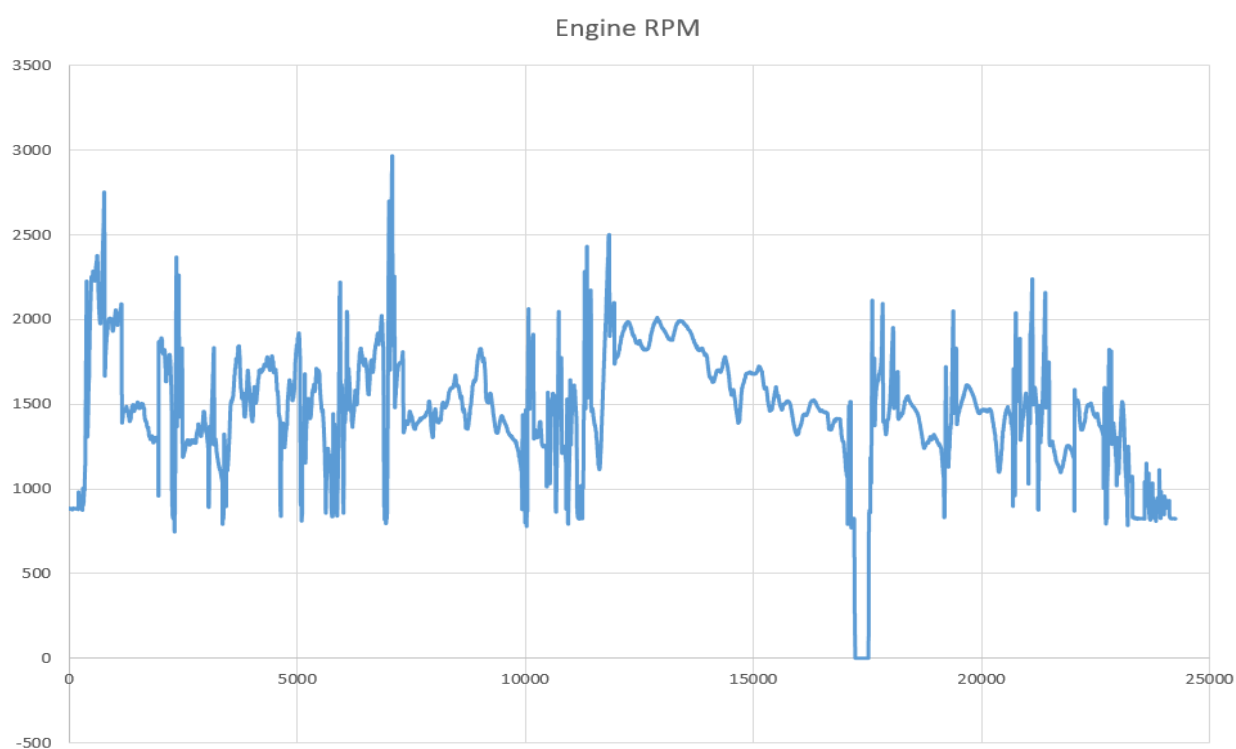


Figure 7 Engine Speed

From engine speed diagram, how fast the engine is working in different conditions and the change of the RPM can be obtained easily.

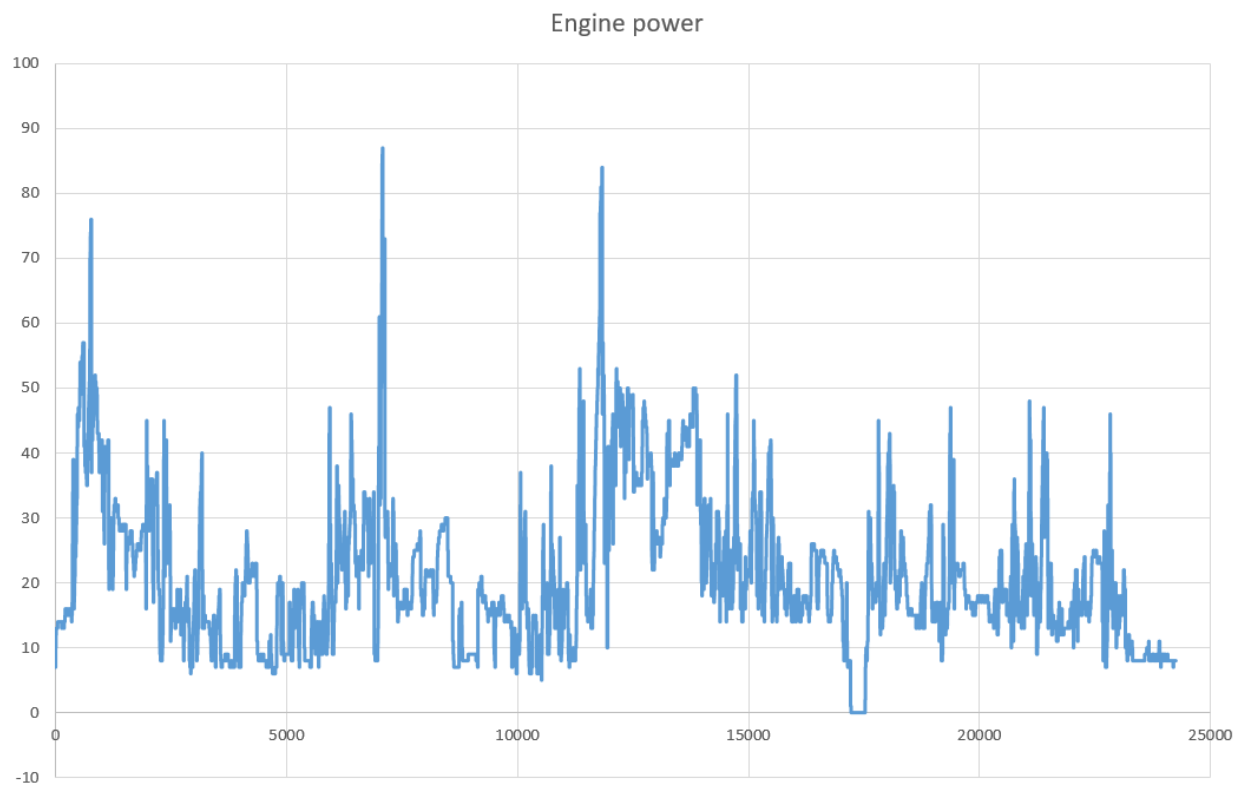


Figure 8 Engine Power

From the power chart above, how hard the engine is working can be obtained.

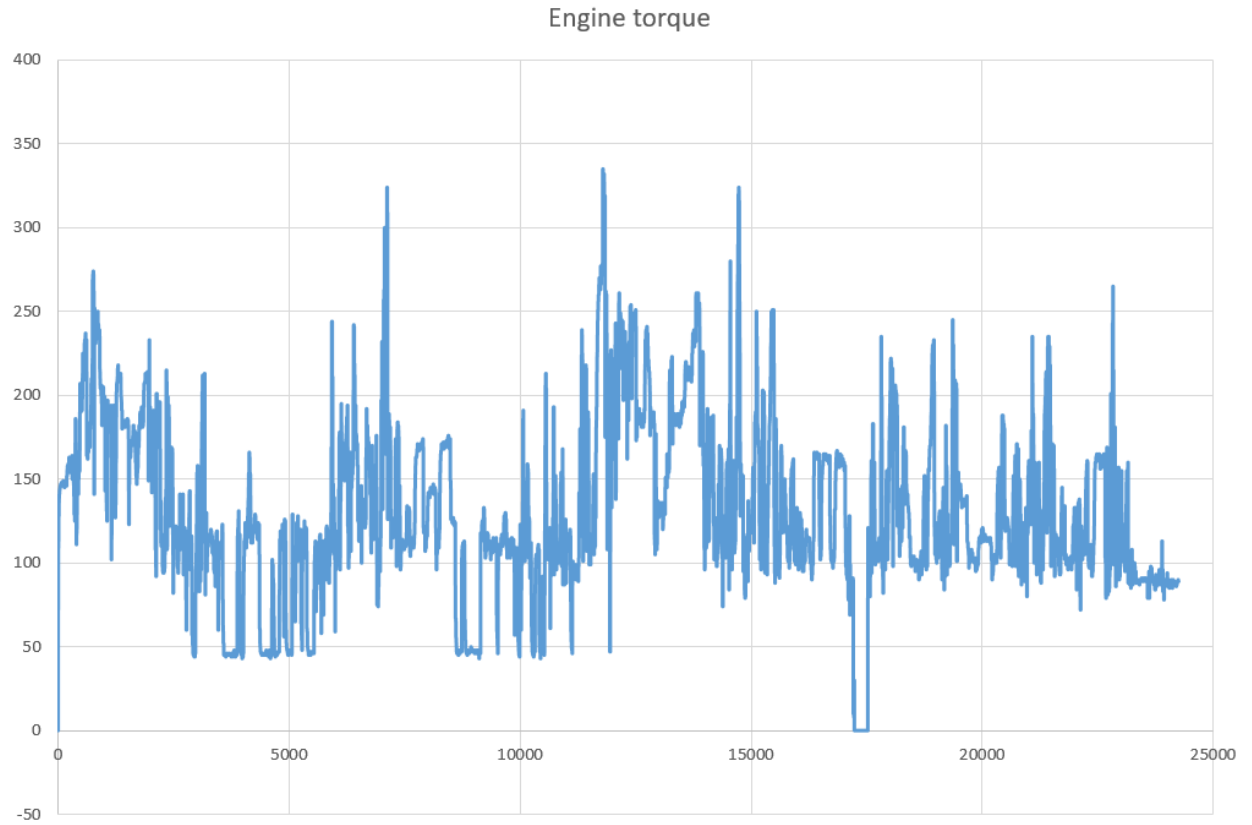


Figure 9 Engine Torque

The engine torque shows the output of power and how powerful the engine is.

From the basic analysis of the data from these three types of vehicle, all channels provided by the application software are valid and real.

The accuracy and validity is enough of these three groups of data for several reasons. First of them is the diagram of GPS accuracy shows both of the horizontal and vertical accuracy are under 10. After that, the speed of vehicle shows highly correspond between corrected and tested from sensor. Finally, the calculated acceleration is quiet similar with the current data.

3 Task Two – Comparison of different vehicle types

When it comes to comparison of these three types of vehicles, the diagrams of GPS show the routes of these testes are quite similar even using the same way. For the engine load, the engine of tiger works much harder than the other two as the RPM is higher and engine from Volvo works more easily than Aygo under similar speed and conditions. As to the drivability, the vehicle roll diagrams shows the angle of tiger is normally between minus 100 to minus 50 which far more big than Aygo and Volvo and Volvo is the most stable one with the quantity around 20. Consider with both of the efficiency and performance, aygo is the best one under similar situations.

4 Task 3 – ‘Ideal’ Vehicle

Trying to model the ideal vehicle for 60km daily commute using the GPS data as the basis of the drive cycle and the results of initial analysis with the base of Toyota Aygo.

4.1 Hybrid Electric Power

First of all, as the daily commute is only 60 km but the reaches of several small vehicles using electric as power have achieved 80miles like Fiat 500 EV (87miles), Chevy Spark EV (82miles) and Honda Fit EV (82miles) (Johnson, 2014) as shown in figure 10, electric could be used as the power.

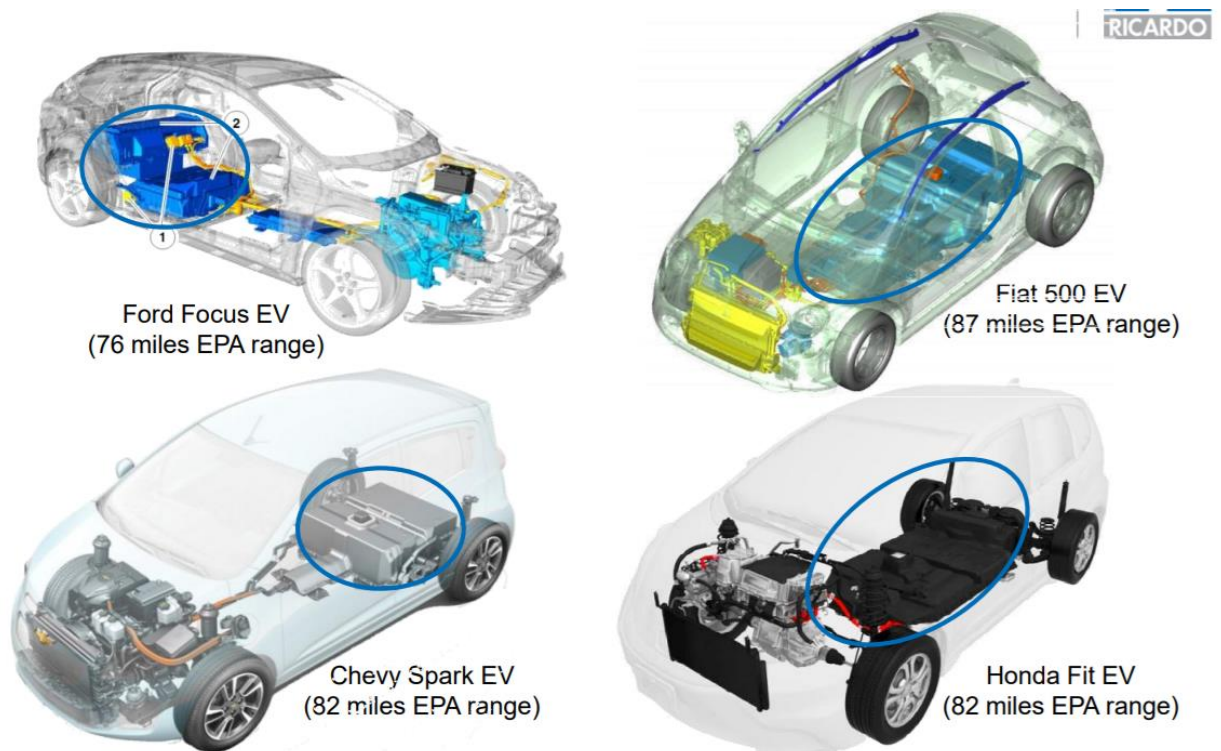


Figure 10. Range of several electric vehicles

But according to reports recently, the replacement of Toyota's mini scooter Aygo will be completed by the end of 2021 or 2022. The new generation of Aygo will launch a hybrid electric vehicle or plug-in hybrid system. The original version will also be retained. Matt Harrison, vice president of Toyota Europe, revealed the Aygo timetable and said that given Aygo's outstanding sales performance in Europe (annual sales of about 100,000 units), Toyota will continue to

develop the product. The next-generation of Aygo will be launched with both fuel-powered models and electric-powered models. However, the electric drive version is likely to use a hybrid electric or plug-in hybrid system instead of a pure electric powertrain. Matt Harrison also explained that the reason why pure electric powertrains are not used is mainly because the manufacturing costs of pure electric models are too high, resulting in terminal selling prices that exceed consumers' affordable budget for purchasing scooter models (Zhao, 2020). So even go for the electric power, a hybrid electric or plug-in hybrid system is better than a pure electric powertrain.

4.2 Stop-Start

The stop-start feature is very useful when vehicle travels within city. The automatic start-stop system works as follows:

As long as the brake pedal is directly pressed during driving, the engine will stop automatically after the vehicle is completely stopped for about two seconds. If the brake pedal is kept depressed, the engine will remain off. In order to solve the problem of too tired to always hold the brake, as long as the AUTO HOLD electronic handbrake is also turned on, the engine will only start after pressing the accelerator pedal lightly, and the right foot does not need to keep holding the brake. When the signal light turns green, the driver depresses the clutch and immediately starts the "start stop" and quickly starts the engine. The driver geared up and stepped on the accelerator to start the vehicle quickly. With the support of efficient battery technology and the corresponding engine management program, the start-stop system can work normally at lower temperatures and can be activated with a short warm-up process.

Automatic start-stop technology is mainly used in traffic jam situations. In this case, the engine is mostly hot, and the fuel consumption of a hot car is very low. The engine can usually start at a speed of 350 rpm, which is nearly half lower than the idle speed. Assuming there is no load other than the internal resistance of the engine and the loss of necessary equipment such as the gearbox, the fuel consumption must be less than the idle speed. As for the point of view which assumes frequent starts cause wear problems to the engine, the interior of the engine is mainly lubricated by the oil film. In view of the short automatic start and stop time, the oil pumped by

the oil pump will not all flow back clean. Sufficient oil will remain on the friction parts. There is no adverse effect on the lubrication of the friction parts within time. The last problem is vehicle battery's life and reliability issues. The battery for ordinary cars is different from the battery for hybrid cars. A starter battery usually been used which is designed with temporary high current discharge in mind, but it cannot be used for a long time or it will be damaged quickly. But there no worries if using this technology with hybrid vehicles.

4.3 Supercharger

If garage or parking space is available, applying for a 40A meter or increasing the existing meter separately, connecting the on-board charging cable to charge through 220V40A special socket at home is possible. It only takes few hours for charging if the battery range is 80 miles. Much quicker with charging speed can meet daily needs and the cost of circuit modification is very low as well.



Figure 11 Supercharger at home

4.4 Flywheel

As the ideal vehicle already has the hybrid system with converters and inverters, it is very easy if the flywheel system wants to be put together.



Figure 12 Porsche 911 GT3 R Hybrid

For the flywheel system on Porsche 911 GT3 R Hybrid, Decisions were taken to only recuperate brake energy, and to keep the hybrid system separate from the combustion engine's driveline, ruling out a purely mechanical flywheel (Power, 2010).



Figure 13 Flywheel at rear



Figure 14 Flywheel at front

As to the daily commute with many corners and the vehicle has to go down and up within 60miles, flywheel system could make the use of energy with higher efficiency.

5 Task 4 – Vehicle specification

The UK government aims to ban the sale of new petrol and diesel cars, including hybrids, by 2035 under a revised strategy to tackle climate change that implements green policies five years earlier than originally planned (Williams, Petrol and Diesel Ban 2035, 2020).

As the hybrids cars will be banned from 2035 only 8 years left, the company should go for electric motorcycles instead of cars as motorcycling is a cleaner and more efficient way of travelling makes it easier to meet the political and be economical to the environment. If more people were to use motorcycle instead of car then congestion would be greatly reduced, also reducing emission from vehicles that are stationary and sat in traffic, tackling the problem in two different areas (Williams, Motorcycles in 2035, 2020).

The entire motorcycle fleet in the UK almost is petrol but some of them have met ultra-low emission requirements especially many small motorcycles and scooters. Powered two wheels move through traffic quicker, help reduce congestion for all road users and take up less space to park that is why it should be encouraged as a sustainable option (Williams, Combustion, 2020).

There are two problems left one of them is inadequate at providing enough range for most commuters. Another one is the time it takes for charging which makes it difficult to be used for a long distance ride. But one of the announcements coming from the government outlined a heavy investment into electrical energy storage and making appliances more efficient (Williams, Motorcycles in 2035, 2020). That means some technologies could be transferred and been used on electric motorcycles in the future.

6 Reference

JohnsonNeil. (2014). Introduction to EV powertrain function and performance. Associate Chief Engineer Hybrid & Electric Vehicle, (页 27).

PowerHybridsWilliams. (2010). Wheel of Fortune. Electric & Hybrid Vehicle Technology, 72-73.

WilliamsOwen. (2020 年 03 月 22 日). Motorcycles in 2035. 检索来源: moodle:
https://moodle.uwtsd.ac.uk/pluginfile.php/344433/mod_resource/content/1/MCN.pdf

WilliamsOwen. (2020 年 03 月 22 日). Petrol and Diesel Ban 2035. 检索来源: moodle:
https://moodle.uwtsd.ac.uk/pluginfile.php/344429/mod_resource/content/1/ICE%20Ban%202035%3F.pdf

WYang LeiLi, Chuxuan Wang and Yunqing ZhangQiang. (2017 年 03 月 28 日). Loads Analysis and Optimization of FSAE Race Car Frame. SAE INTERNATIONAL, 页 12-18.

ZhaoZongdi. (2020 年 02 月 10 日). Next-generation Toyota Aygo to launch electric-powered model. 检索来源: Home of Motor:
<https://www.autohome.com.cn/news/202002/970385.html#pvareaid=3454480>