# Modeling and Analysis Technical Performance of BLDC Motor (Electric Motorcycle)

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**Abstract.** The project will discuss about the modeling of a direct drive BLDC Motor electric motorcycle drive system for technical performance evaluation, where the operating cycle profiles used are based on actual road tests. It will explain how the measurement data can be processed and coupled with the "usual" model of a direct-drive dc-drive system, thereby extending common modeling approaches. Then, the different riding profiles will analyze with the dyno meter test. The results both illustrate the ability of such low-cost drives to serve for commuting purposes with moderate driving styles and their limits to support rather sporty rides.

## INTRODUCTION

In this world, there are three type of the motor which is hydraulic motors, electric motor and pneumatics motors. Electric Motors were isolated into four sorts which are Stepper, Alternator Current (AC) Motor, Direct Current (DC) Motor, and Servo Motor. Really, DC Motor has a variable trademark and they generally utilized for a framework that has a variable speed drive. Brushless DC (BLDC) motor is a type of DC motor. It contains stator and changeless magnet in the rotor. It can work in a self-controlled mode which is the present streaming to the stator winding was control by a rotor position sensor and an inverter[l].These days, BLDC motor was utilized as a part of different sort of motor in light of their focal points. A portion of the favourable circumstances are the BLDC have a higher productivity, high torque to dormancy proportions, more prominent speed capacities and higher effectiveness. BLDC is utilized as a part of numerous applications, for example, in car apparatuses, mechanical technology, movable speed drives and different modern furthermore local applications. For instance, an elite framework, BLDC motor is utilized as a part of an electric motorcycle to control the speed of the motorcycle.

Nowadays, it is widely acknowledged that cycling is one of the best ways for people to reach health and fitness. People who cycle regularly live longer than those who did not undergo such a healthier life [1]. This simple fact means that it is unlikely cyclists are more vulnerable to health problems than the general population to the issue of healthcare, which can be life-threatening. In fact, cycling is also often used for work (and by extension, to the school and in the ordinary course of another) and it has proven to be the most effective for the individual can do to improve health and increase longevity, and this applies even to people who are already active in sports and other physical. [2]. Cyclists will usually have that level of fitness equivalent to being 10 years younger. [3] Moreover, transport systems can endanger our health and also expensive, it's definitely worth hundreds of billions of dollars each year in traffic accidents, air pollution, and physical activity. But health is usually not taken into consideration in transport policy and planning, although transport is one of the factors which affect the economic and social health of human

health and society. Opportunities are wide open to improve the selection of alternative transport supports such as walking and cycling, and it also can improve the health status. [4]

## EXPERIMENT SETUP

First, this data analysis more focuses into the objective of this project and do the comparison from the actual and simulation. This actual is come out from Dyno Test and actual road test. Besides this test is more focusing on performance of the BLDC Motor (Electric Motorcycle). After that, by doing the simulation in MATLAB SIMULINK this result should be compared and maybe have different in a graph. Moreover, many factors can be possible into this problem. An electric bike basically has four segments which are the motor, control transmission framework, and control framework and power source as appeared in Figure. 1. The squares appeared in Fig. 1 end up plainly basic to build an electric bike, in which an electric motor is fuelled by a battery which is a DC source [5] and the speed as indicated by rider's request is shifted utilizing controller and driver circuit. The speed order is given through throttle whose yield is given to the contribution of motor controller and driver piece. With rider's heap contribution on the cruiser can expand the drive limit, decrease the torque required and raises speed.

### Design of Experiment


**FIGURE 1.** (a) Block Diagram.

The system configuration was shown in table-1. Demak D-force Motorcycle 160cc was used in this simulation with default component and rear wheel system was installing the 5kW electric motorcycle conversion kit.

**TABLE 1.** To Demak D-force Motorcycle

| Component | Description |
|---|---|
| Model | Demak D-force 160cc |
| Motor | 5kW BLDC Motor |
| Battery | Li-ion 72V 40AH |
| Transmission | 2 Speed |
| Control Strategy | Throttle, Electric lock |
| Weight | 150kg |

## Experiment Procedure

There are three stages of completing the project. The first one is to choose the suitable controller and identify all the components needed and wiring installation to integrate hardware. The second stage is involving the integration between hardware and software with the controller. Finally, is for testing and data analysis to verify the objectives of this project. Figure 2(a) shows the general flowchart of the project. Figure 2(b) and figure 2(c) is interface of sabvoton motor controller and dyno test.

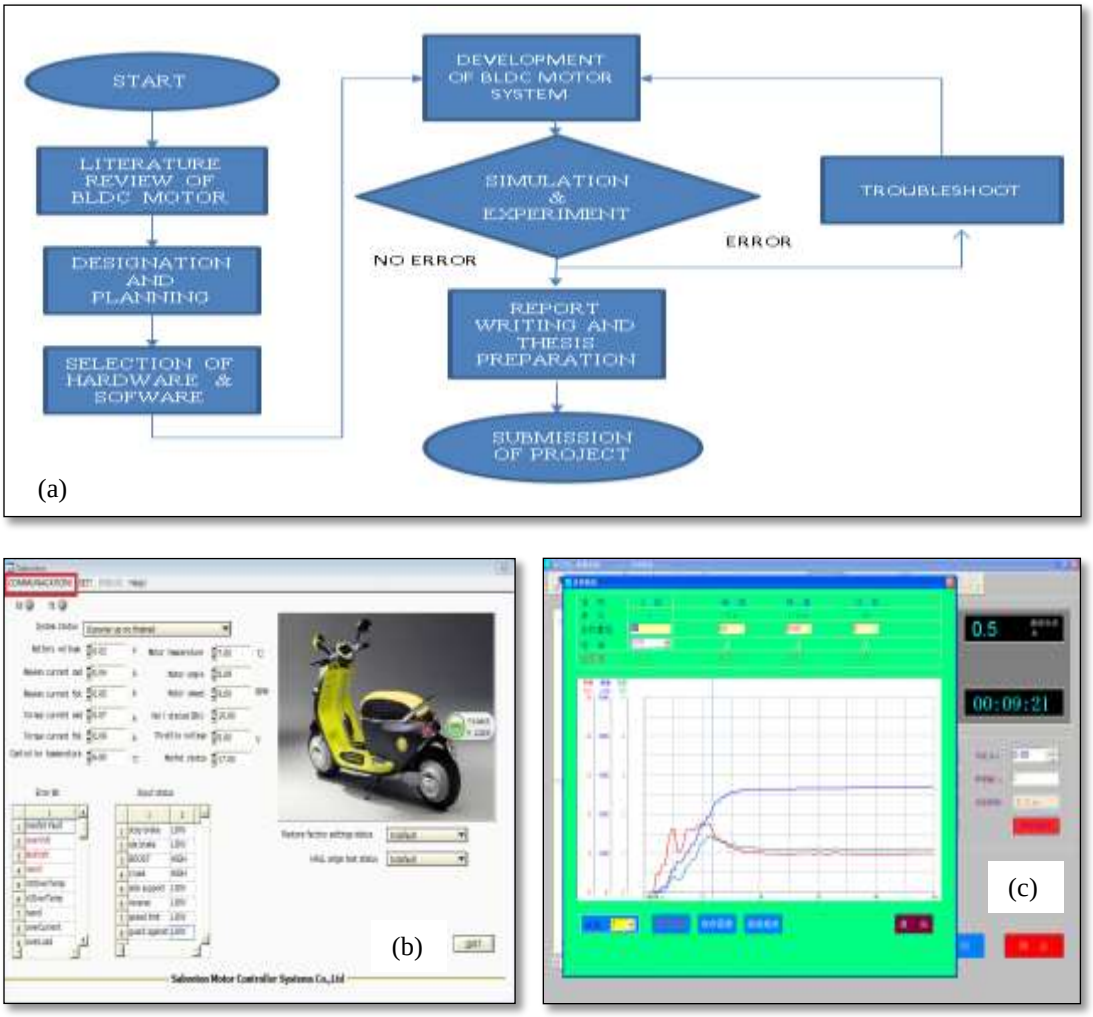



**FIGURE 2.** (a) Flowchart of Project. (b) Sabvoton Motor Comtroller Interface. (c) Dyno Test Interface.

## RESULT AND ANALYSIS

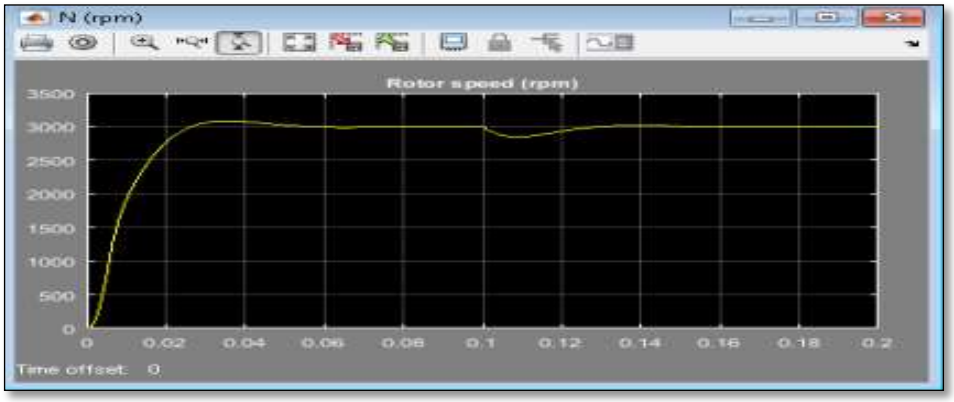
There is having three tests which are for hardware Dyno Meter Test and actual road test and for the software which is MAT LAB Software Simulation. All tests are more focusing in term of performance the electric motorcycle which is RPM, Speed, and Power. First, do an actual road test. This purpose of the test is to measure the top speed for low and high speed by Speedometer App. These Apps can be downloaded from Google play store. This is a free app and easy to use. After that, run the electric motorcycle to the Dyno Meter test to get the RPM And Power. Test for high speed is about 74km/h and low speed is about 54km/h.

The data has been collect from 0A – 0.7A as a load for riding profile are stated in abstract. During run this Dyno test, Panel and Computer Dyno should be setting first to get an accurate data. After that, this test is the combination of low and high speed to get the graph RPM, Torque, and Power. In the graph result, the blue colour is for rpm, green for power and red colour for torque. Table 2 and table 3 will show the result from Mat lab Software and dyno test.

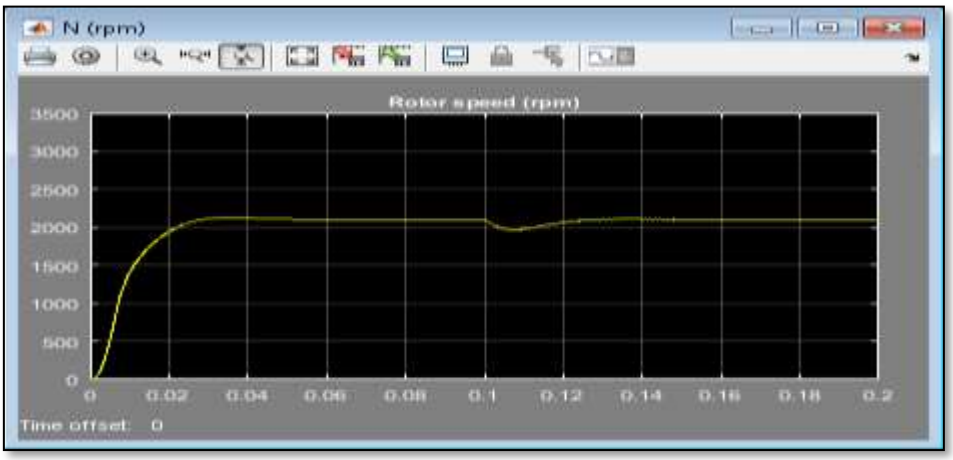
### Simulation Result

**TABLE 2.** Mat lab Result for Low and High Speed (No Load)

No Load High Speed (Max RPM: 3000)




No Load Low Speed (Max RPM: 2400)

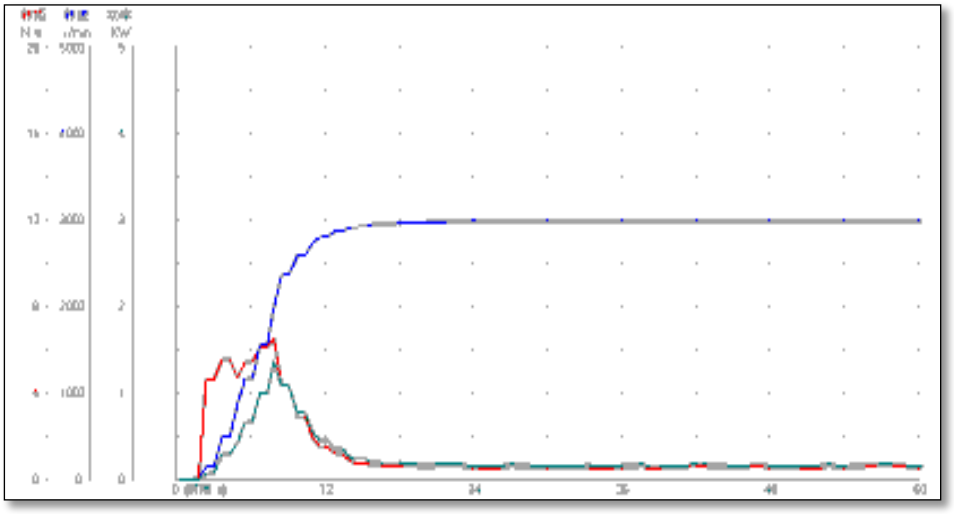


## Dyno Test Result

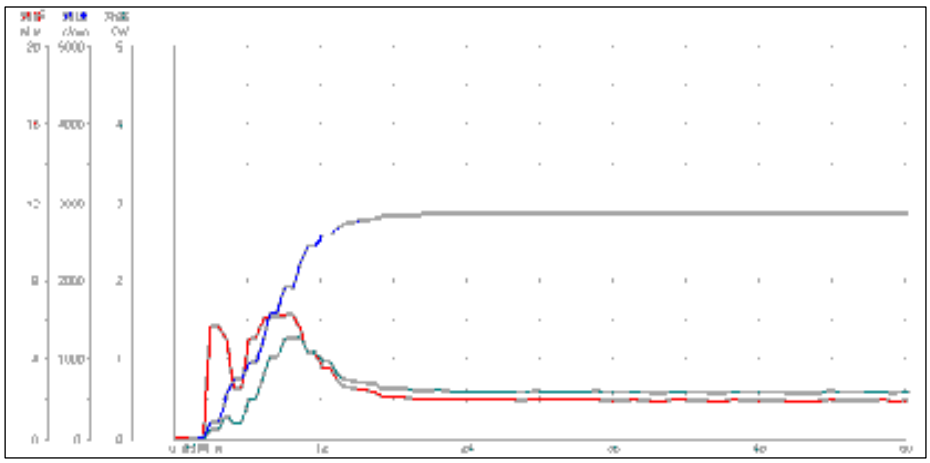
**TABLE 3.** Dyno Test Result for Low and High Speed

**High Speed (74km/h)**

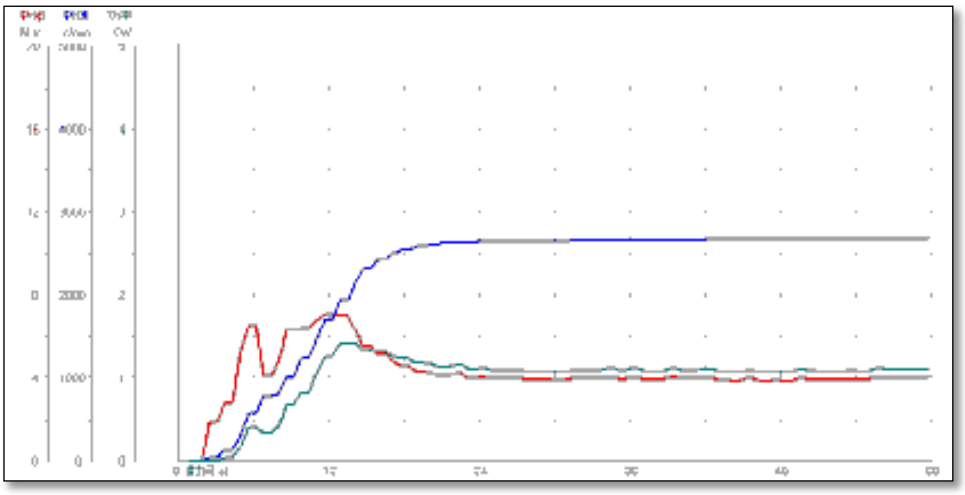
No Load: 0A (Max RPM: 2979, Max Power: 1.31Kw)



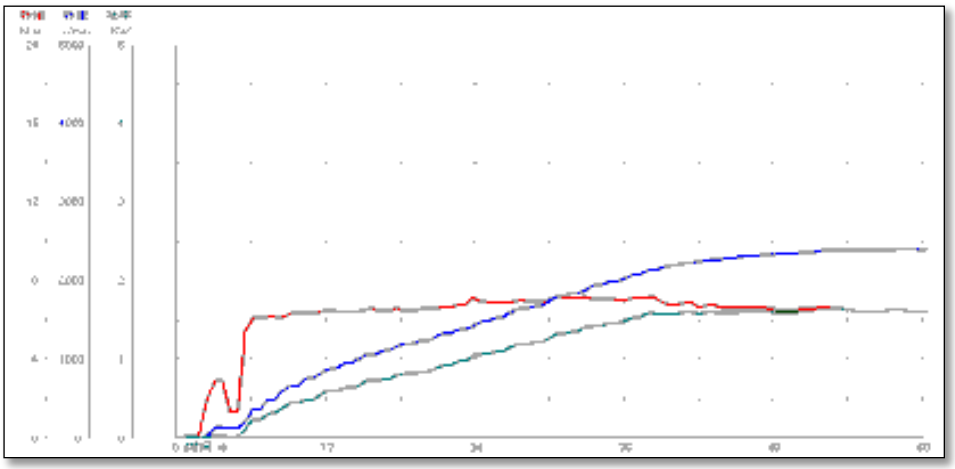
Load 1: 0.3A (Max RPM: 2866, Max Power: 1.29Kw)



Load 2: 0.5A (Max RPM: 2672, Max Power: 1.43Kw)

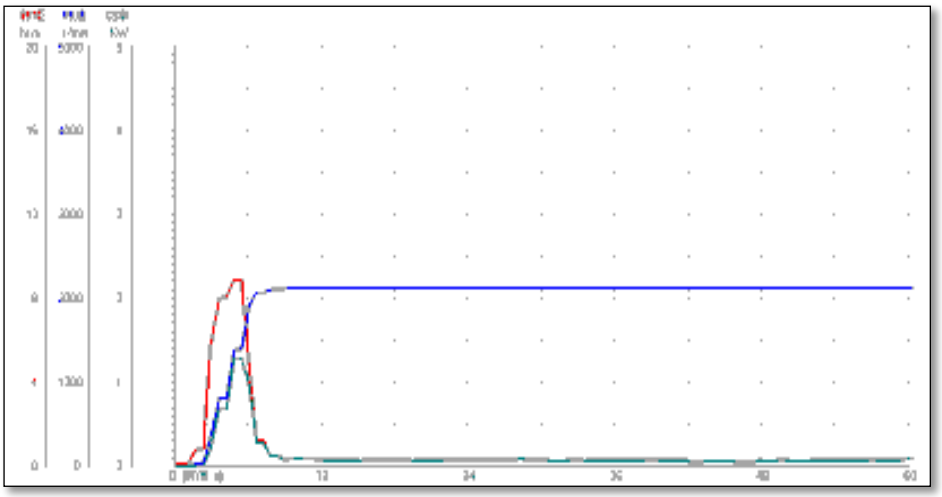


Load 3: 0.7A (Max RPM: 2388, Max Power: 1.65Kw)

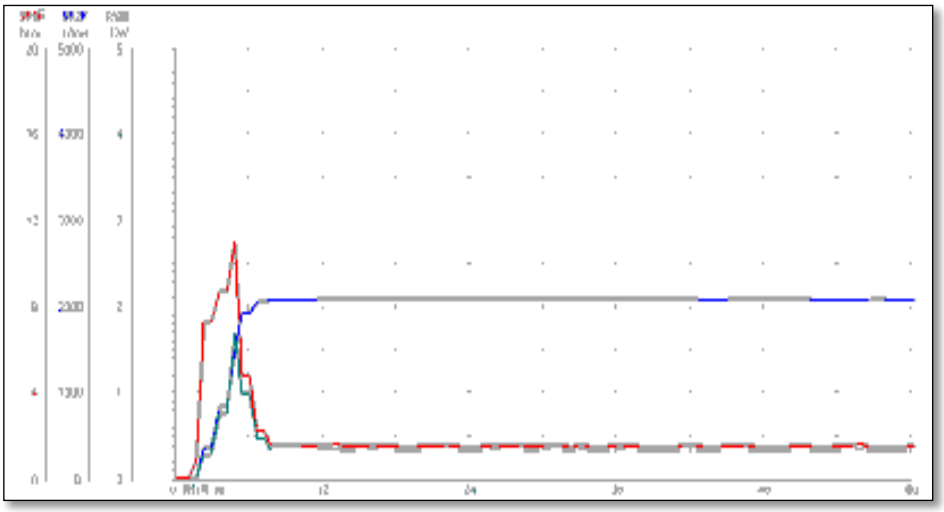


**Low Speed (54km/h)**

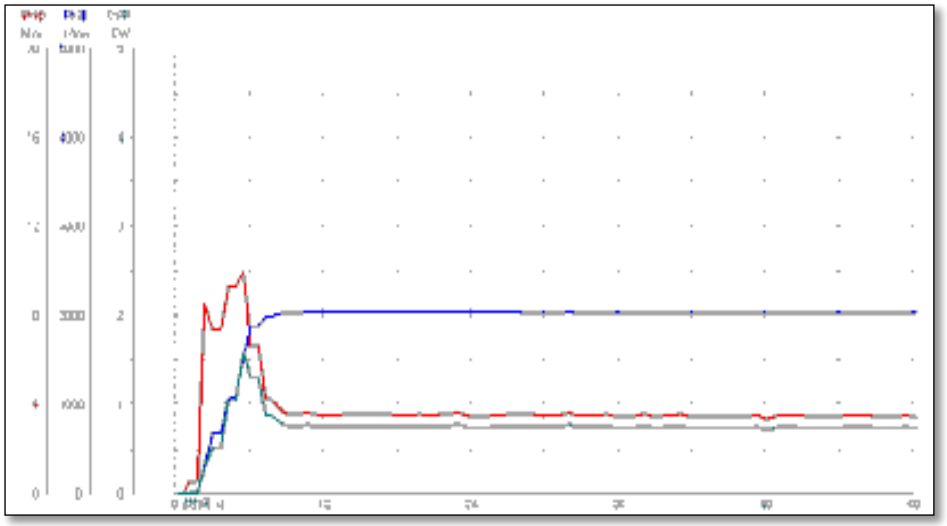
No Load: 0A (Max RPM: 2110, Max Power: 1.28Kw)



Load 1: 0.3A (Max RPM: 2085, Max Power: 1.69Kw)



Load 2: 0.5A (Max RPM: 2033, Max Power: 1.58Kw)



Load 3: 0.7A (Max RPM: 1951, Max Power: 1.74Kw)

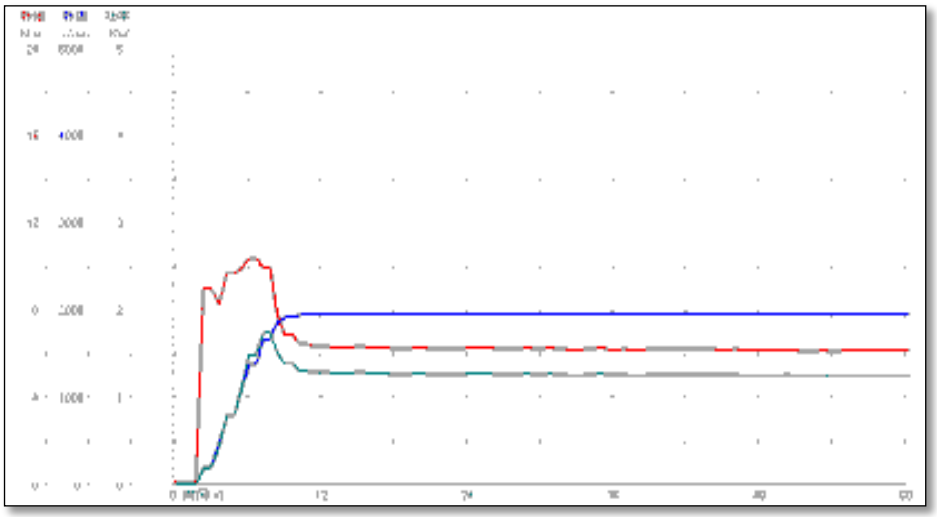


Figure 3. show the development of electric motorcycle, back to basic formula when current load keeps higher, power also keep going upward. This is because by assuming the voltages are constant. Besides, basically in theory also state that torque and power curve will keep remains steady. Load 1 and load 2 in order low or high speed has clash to the theory in term of power, but for the starting power it not considers because of it still transient and not stable.


**FIGURE 3.** (a) The Development of Electric Motorcycle

## CONCLUSION

From the objective Electric Motorcycle has been testing experimental this is actual road test and also dyno meter test for actual road test, it just runs to get max km/h for two-mode low and high speed. Dyno meter test more focuses on speed performance and starting from no load (0A) until (0.7A) load. After that, modeling Mat lab simulation for speed performance has been designing and it would be ±5% difference.

## ACKNOWLEDGMENTS

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