Range Improvement of Electric Vehicle by Regeneration Braking Model

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***Abstract*- over the years we are using conventional source of energy for the vehicle. In the current time period because of increased use of fossil fuels, the availability of fuels are decreased and so the cost for fossil fuel is increased day by days. One of the impact of using conventional vehicle is increased carbon dioxide emission and pollution, due to this global warming is increasing. So we go for EHV, this are ecofriendly but range of is determined by soc(state of charge) ie limit to an extent. There for use regenerative braking.**

Index Terms- Electric Vehicle, Regenerative braking, EV range, series regeneration method, brake management module, EV efficiency, coasting, and drive cycle, Anti-lock Braking System, Proactive coasting control.

1. INTRODUCTION

There has been a steady rise of use in renewable energy, following the environmental damages that are caused by the usage of fossil fuels. Among them, solar energy is widely regarded as the best source of energy because of its availability, low running, and maintenance cost and cleanliness. So we go for an alternative called electric vehicle. So can reduce the emission of carbon dioxide. Due to the emission of carbon dioxide it causes the global warming so move towards the sustainable electric mobility. They are efficient in comparison with conventional vehicle on the energy figures.

The process of recovering energy from braking and storing to a high voltage battery for the future use is termed as regeneration. The principle is "Law of Conservation of Energy". Battery of vehicle is costly, battery cost consists of half the price of the EV. The major barriers of the electric vehicles are cost of the battery and the limited range. Overcoming these barriers it's indispensable that electric vehicle should be designed to make it commercially viable and sustainable on its own. Due to the braking charging and discharging take place this can cause damage to the lifelong of the battery.

The regenerative techniques to improve the range of EHV, namely series regenerative braking and proactive coasting.

2. QUDRENT MECHANISM

Electric range or soc cause a major problem to be addressed, addition to higher battery cost, so energy management is required. Regeneration has major role in EHV. The operation at different quadrants is shown in Figure 1.

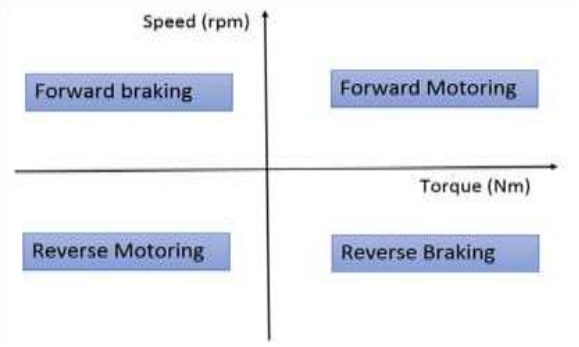

Figure 1: Four quadrant operation

In addition, with higher cost for battery, management of energy is a most relevant factor. Also regeneration is crucial feature in electric power train, helps to save energy. Regenerative is possible in second and fourth quadrants.

3. REGENRATIVE SERIES

The process in which output is transformed to electrical energy by generator. The formed electricity either charges battery, it can propel wheels via the propulsion unit. Series method controls wheels frictional torque electronically based on regenerative torque mechanism possible. The

supervisory control unit decides frictional force to be applied based on power that is acceptable by high voltage battery.

During this process engine attached to generator connection is turned off and the traction motor is operated as a generator powered by mechanical energy. The power generated is charged to batteries, used for further propelling. The sharing of breaking is represented in Figure 3a, 3b for parallel and series respectively.

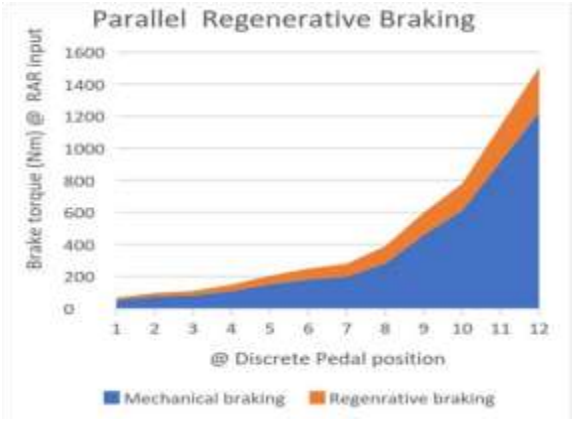

Figure 3 a: Parallel braking EHV

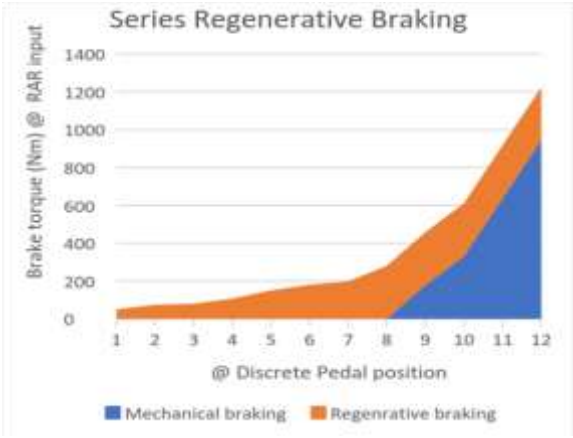

Figure 3 b: Series braking EHV

4. MECHANICM OF SERIES CONTROL

Series braking consists a driver pedal input which is to calculate the brake force required and is given to vehicle controller, which consist of brake management module (BMM)(Figure 4.1) it manages torque sharing between frictional and regenerative according to movement of the vehicle . Brake management module is connected with ABS controller and to battery system. ABS controller is connected with an ABS modulator values. The brake management module communicates with the battery management system (BMS) to get battery voltage and state of charge. A traction controller which gives speed and torque of vehicle at the current instant and communicate to vehicle controller. Based on the torque and speed available vehicle system limits it is then calculated the regenerative torque that can be applied to the vehicle and communicates the required frictional braking torque to the anti-lock braking system unit

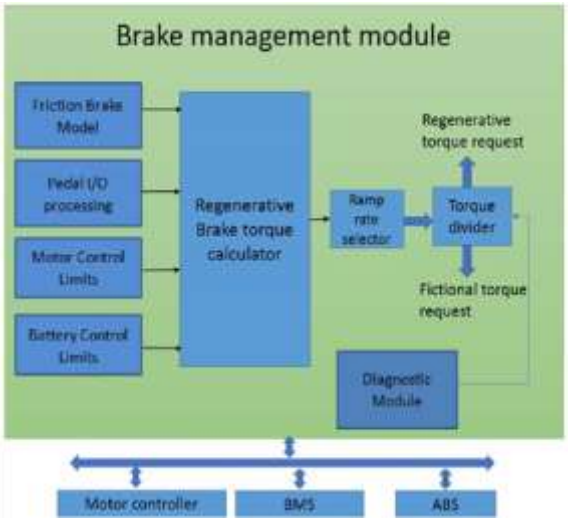

Figure 4.1: BRAKE MANAGEMENT MODULE

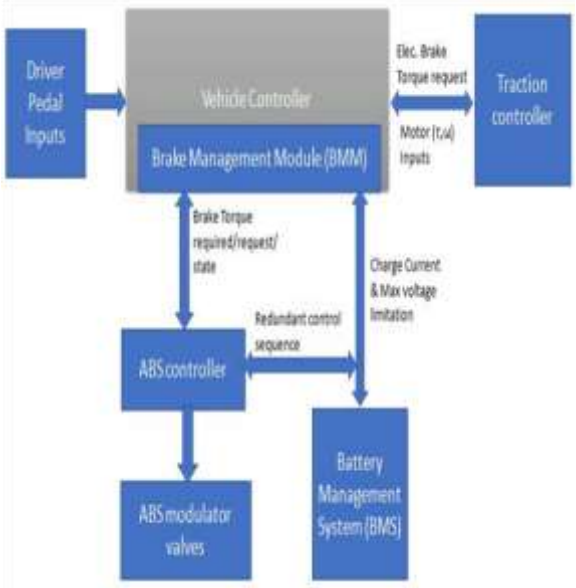

Figure 4.2: Series regenerative control

5.BRAKE PEDAL EFFECT PARAMATERIZATION

The important factor in series braking strategy is it should have the same driver brake effort and feel to

ensure safety. Hence the equivalence between the pedal percentage and motor brake torque should be formulated. The current test is used to understand parameterize the brake pedal effect on the regenerative braking. This test aims at finding the equation between the pedal percentage and motor torque till its peak value. Electric motor peak torque will be lower compared to the conventional braking maximum torque.

When the brake pedal torque equals the max regeneration torque possible from the traction system. This is the pedal position from which the conventional braking should be applied for the ideal conditions. It is also called as Conventional Braking Starting Point 0 (CBSP0). This starting torque is the actual braking torque applied by the conventional brake system. The vehicle controller also limits regeneration based on the battery and motor limits defined by its individual performance curves. In turn the CBSP will be shifted to lower pedal angles in any of the following conditions and will be, if the motor speed is above the rated speed, if battery charge current limit lower than electric regenerative power, state of charge (SOC) greater than its threshold to charge, if motor torque is lower than peak

6. COASTING METHOD

The regeneration is limited mainly by the electric vehicle power train components as the braking torque are much higher to be cater to. This can be improved by the improved coasting regeneration. The method described here is called proactive coasting, which has a higher coasting torque applied comparable to the regeneration through braking. In which the torque applied depends on the vehicle velocity. So the coasting power is directly proportional to the vehicle kinetic energy as shown in equation (1) through (3), for the given vehicle weight.

$Tc=k*v.$ (1)

$Pc=Tc*\omega.$ (2)

$P \alpha v2.$ (3)

Tc – Coasting torque (Nm)

v- Vehicle velocity (m/s)

k- Coasting scale factor (Ns)

Pc=Instantaneospower regenerated through coasting (W) ω - vehicle speed in rad/s.

7. SUMMERY

The paper presents regeneration percentage may be influenced by number of factors such as braking process, type of strategy, hardware used, operating drive cycle and control strategy etc. irrecoverable damages formed by battery can be avoided. As a result we can enhance braking recovery efficiency. Braking constrains are rectified. To study the impact of series regenerative mechanism method commercially. It also aim at apply Design of Experiments (DoE) analyze proactive coasting and its effects.

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