# Electric Vehicles and its Battery Management

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***Abstract*: -** Battery management systems (BMS) are used in electric vehicle to monitor and control the charging and discharging of rechargeable batteries which makes the operation more economical. Battery management system keeps the battery safe, reliable and increases the senility without entering into damaging state. In order to maintain the state of the battery, voltage, current, ambient temperature different monitoring techniques are used. For monitoring purpose different analogue/digital sensors with micro controllers are used. This paper addresses state of charge, state of health, and state of life and also maximum capacity of a battery, by reviewing all these methodologies, future challenges and possible solutions.

*Keywords: Battery management system, state of charge, state of health, state of life.*

## INTRODUCTION:

Electric vehicles (EV) are playing a key role because of its zero-emission of harmful gases and use of efficient energy. Electric vehicles are equipped by a large number of battery cells which require a effective battery management system (BMS) while they are providing necessary power. The batteryinstalledinaelectricvehicleshouldnotonlyprovide long lasting energy but also provide high power. Lead-acid, Lithium-ion, -metal hydride are the most commonly used tractionbatteries,ofallthesetractionbatterieslithium-ionis most commonly used because of its advantages and its performance. The battery capacity range for a electric vehicle is about 30 to 100 KWH ormore.

Battery management system (BMS) makes decisions based on the battery charging and discharging rates, state of charge estimation, state of health estimation, cell voltage, temperature, current etc.

## PROPOSED METHODOLOGY:

Energyandenvironmentalproblemsarethemostdangerous problems faced by the world automotive industry.to overcome these problems world has accelerated to the new energydevelopment.

## BATTERY MANAGEMENT SYSTEM (BMS):

Battery management system (BMS) is the crucial system in electric vehicle because batteries used in electric vehicle should not be get overcharged or over discharged. If that happens, it leads to the damage of the battery, rise in temperature, reducing the life span of the battery, and sometimes also to the persons using it. It is also used to maximizetherangeofvehiclebyproperlyusingtheamount of energy stored in it.Battery management system is essential for following reasons

1. Maintainthesafetyandthereliabilityofthebattery
2. Battery sate monitoring andevaluation
3. To control the state ofcharge
4. For balancing cells and controlling the operating temperature
5. Management of regenerative energy

BMS BLOCKDIAGRAM:

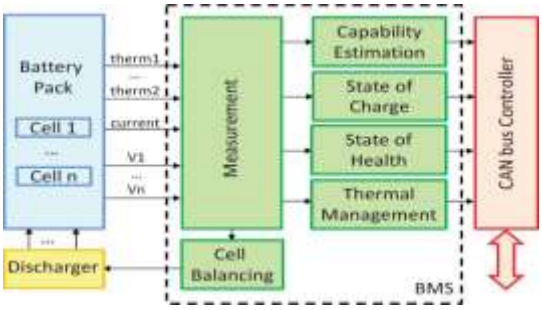


Figure 1 BMS block diagram

## STATE OF CHARGE ESTIMATION:

State of charge is defined as the available amount of battery as the percentage of rated capacity of the battery. State of chargegivesacrucialsupporttobatterymanagementsystem to assess the state of the battery which helps the battery to operate within the safe operating range by controlling charging and discharging. It also increases the life span of the battery. State of charge cannot be estimated directly. It is calculated by using the equation

$$\square\square\square = 1 - \frac{\int \square\square\square}{\square_{\square}}$$

Where I =current and

$C_{n=}$ maximum capacity that the battery can hold

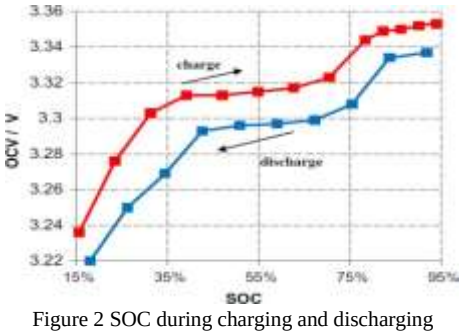


Figure 2 SOC during charging and discharging

There are various methods to estimate the state of charge. Following are the list of state of charge estimation method

1. Coulomb counting SOC estimationmethod
2. Fuzzy logic SOC estimationmethod
3. Impedance spectroscopy SOC estimationmethod
4. Kalman filtering SOC estimationmethod
5. Open circuit voltage SOC estimationmethod

Among all these various methods Kalman filtering method has been successful for the estimation of SOC for EV'S.

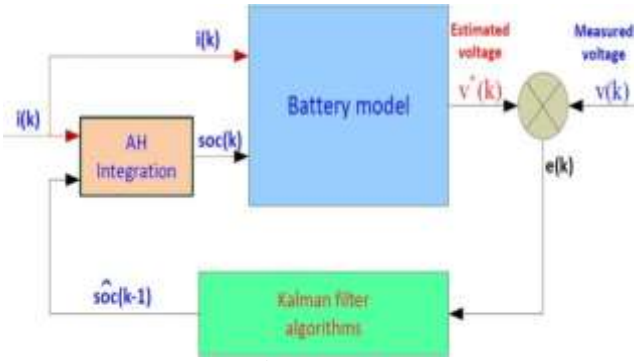

Figure3 Kalman filtering SOC estimation model

**State of Health Estimation:**

State of health estimation describes the state of the battery with respect to the newly manufactured battery. It gives information regarding the available amount of discharging capacity during its lifetime. The SOH in EV use to describe the ability to drive the specific distance.

AccordingtoPattipati*etal*capacityfadeandpower fade together combined as health characteristics. capacity fade describes reduced driving range with a fully charged battery and power fade describes decrease in acceleration capacity. Power fade occurs when the impedance in the cell increases during aging. Hence, total impedance ($R_{HF}+R_{tc}=R$). where $R_{HF}$ and $R_{tc}$are frequencyresistance and the transferresistance.

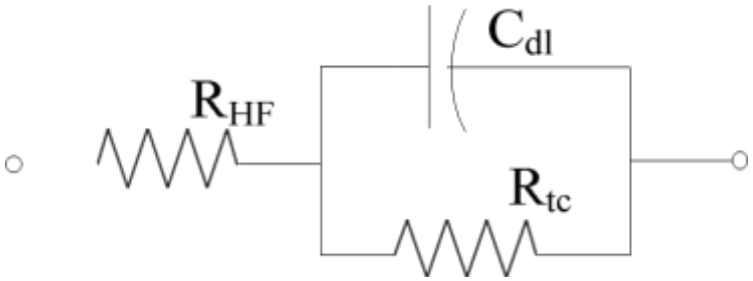

Figure 4 circuit model for a lithium-ion battery

$$P=\frac{\square^{2}}{\square}$$

$$PowerFade=1-\frac{\square\square\square\square(\square)}{\square\square\square\square(0)}=1-\frac{\square(0)}{\square(\square)}$$

$$CapacityFade(\%)=1-\left(1-\left(\frac{\square\square\square\square\square\square\square\square(\square)}{\square\square\square\square\square\square\square(0)}\right)\right)*100$$

STATE OF LIFE (SOL):

TheremainingusefullifeofabatteryisknownasSOL.RUL of a battery using a for different thresholds of capacity fade *C* (*i*) and power fade P(i) is given byequation

$$RUL(k)=h(\{\square(\square),\square(\square)\}^{\square}_{\square=1})$$

where k is the k th week, approximately for an end-of-life criterion23%powerfadeand30%capacityfadeistheRUL

ESTIMATION OF MAXIMUM BATTERY CAPACITY:

The maximum capacity of the battery describes the performance and future life of the battery. The maximum capacity of a battery is calculated by:

Capacity = $\int\square\square\square$

Where I is the current

## BATTERY CAPACITY ESTIMATION USING VARYING LOADS AND ENVIRONMENTAL TEMPERATURES:

Degradationofabatterydependsuponchargeanddischarge cycle, environmental conditions and specific materials. The status of the battery is predicted when discharging at constant current and constant temperature. Here are few experimental factors of a lithium ion battery at different discharge rates andtemperatures.

| Discharge Rate | Temperature |
|---|---|
| 0.5C (350 mA ) | 25 °C |
| 0.5C (350 mA) | 50 °C |
| 1C (700 mA) | 25 °C |
| 1C (700 mA) | 50 °C |

Table1 Experiment factors—different discharge rates and temperatures.

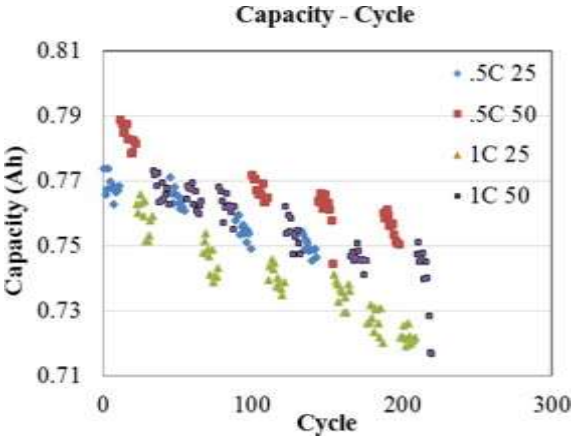


Figure 5 Discharging capability alternating at different discharge rates and at different temperatures.

## CHARGING AND DISCHARGING OF LI-ION CELL USING BMS:

Lithium-ion batteries are highly reactive, smaller in weight and has the highest energy. Charging and discharging of lithium-ion batteries are very faster than the other batteries. Lithium-ion cells should be operated beyond its safe operating voltage range to avoid combination of many chemical reactions, rise in temperature which leads to cell venting and generation of fire. Hence, Battery management system (BMS) is used which allows the battery to operate with in their safety zone.

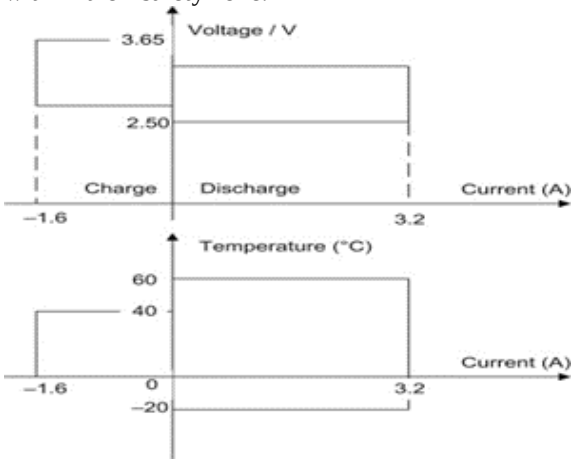


Figure 6 Safe operating area charging and discharging

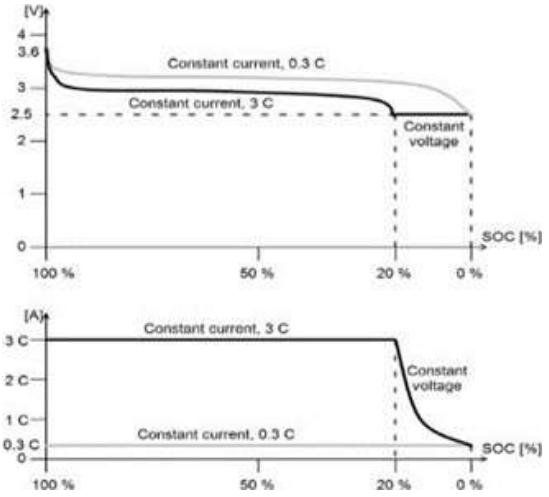


Figure 7 Charging and discharging of lithium-ion batteries

## ADVANTAGES:

1. It improves the batteryperformance
2. It enhances the life span ofbattery
3. It controls the charging, discharging and temperature ranges and keeps them with in their range.
4. It predicts the batteries capabilities in nearfuture

## RESULT:

Based on this work, specific challenges faced by BMS and their solutions were presented as a foundation for future research. Based on the particular situation,different strategies can be applied to upgrade and optimize the performance of BMS in EV'S.

## CONCLUSION:

In this way we are developing the system model for battery management in electric vehicle by controlling the crucial parameters such as voltage, current, state of charge, state of health, state of life, temperature. It is every important that the BMS should be well maintained with battery reliability andsafety.ThispresentpaperfocussesonthestudyofBMS and optimizes the power performances of electric vehicles. Moreover, the target of reducing the greenhouse gases can greatly be achieved by using battery managementsystem.

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