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Lithium-ion battery pack design for EVs

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ABSTRACT

For decades, the earth has been plagued by global warming. Although technology is rapidly evolving with the burning of fossil fuels to generate energy, resources are running in the opposite direction and greenhouse gases are being released into the surrounding atmosphere. Thus, the concept of renewable energy has gained the Simulink platform. With the rapid development of Lithium-Ion Battery Technology in the electric vehicle (EV) industry, the cell life of the battery is increasing dramatically. To convert ICE vehicles into electric vehicles it is important to build a battery pack for that vehicle. When building or upgrading a Battery pack we must consider many factors. tremendous their peace, environmental friendliness, and high efficiency. As the main source of energy for EVs, battery storage systems (BSSs) are important. Within this industry, Li-ion batteries are very popular in the EV industry. The purpose of this paper is to clarify the battery model for EVs and to upgrade to MATLAB.

Keywords: *Lithium-ion, Hybrid Vehicle, Battery Pack Design, Cooling System, Battery Management System (BMS).*

1. INTRODUCTION

Lithium-ion batteries are a family of rechargeable batteries that absorb lithium ions between two electrodes during cycling. These batteries have emerged as the preferred power storage device for EV applications due to high power density compared to other batteries. Lithium-ion batteries are more economically viable than hydrogen fuel cells as the associated infrastructure — the network of charging stations — has a much lower cost compared to hydrogen filling stations. Lithium is popular as an anode material as it is highly electropositive (normal electrode strength = −3.04 V) and is very light metal (equivalent weight = 6.94 g / mol), both of which are important in high power bonding. A rechargeable lithium-based battery was first introduced in the 1970s using lithium metal as a negative electrode and titanium sulphide as a positive electrode. Such a battery system has been found to have poor cycling behavior such as dendritic growth due to lithium plating over repeated cycling creating potential risks of short circuits and explosions. Lithium metal was then replaced by a second insertion device such as a negative electrode to avoid lithium plating problems. A lithium-ion battery operates by reassembling lithium in active components through the coupling process, in which ions are either relegated or placed in a hollow conductor without significantly altering their structure. LixMO2 form family (where 'M' is Co, Ni, or Mn) was proposed in the 1980s and has since gained widespread acceptance as a function of cathodes. The current generation of lithium-ion batteries contains a cathode made of metal oxide with a horizontal structure, such as lithium cobalt oxide, or a tunnel structure, such as lithium manganese oxide. A negative electrode is usually a graphic carbon. Given its high energy content (5 times greater than lead-acid, and twice as much as Ni-MH), it has become a standard energy source for a wide variety of electrical equipment, from personal electric vehicles to cars and satellites. In addition, lithium-ion batteries have low self-discharge, long cycle life, and a wide range of operating temperatures. However, lithium-ion batteries are also more expensive than other types of batteries and require more complex power control units to prevent deterioration or thermal escape due to misuse. Lack of overcharge or decay tolerance has resulted in large battery packs with limited useful capacity to extend battery life in EV operation. Permanent weight loss also occurs at higher temperatures. High initial costs and useful power limits resulting in driver distance concerns are two major barriers to EV adoption. To avoid these problems, the cost of lithium-ion battery needs to be reduced by increasing production volume and stable production methods. Useful capacity can be enhanced by the design of a highly refined battery and power consumption equipment. A battery management system (BMS) is any electrical device that controls a rechargeable battery (cell or battery pack), such as to protect the battery from operating outside the operating environment, to monitor its status, to calculate secondary data, report that data, control its environment, verify and / or measure it . BMS will also control the charge of the battery by redirecting the received power (i.e. from the renewable brake) back to the battery pack (usually consisting of a number of battery modules, each composed of a number of cells). Battery temperature control systems may be inactive or inactive, and the cooling area may be air, liquid, or some other type of phase change. Air cooling has the advantage of its simplicity. Such systems can operate, rely solely on the circulation of air, or operate, using fans for air flow. Commercially, Honda Insight and Toyota Prius both use active air conditioning in their battery systems. The biggest disadvantage of cooling the air is your inefficiency. Greater power must be used to apply the cooling method, which is much higher than the effective liquid cooling.Additional components of the cooling system also add weight to the BMS, reducing the efficiency of the batteries used for transport. Liquid cooling has higher natural cooling power than air cooling as liquid cooling materials tend to have higher thermal conductivity than air. Batteries that can be immersed directly in a cool or cool environment can flow into BMS without direct contact with the battery. Indirect cooling has the potential to create large thermal gradients throughout the BMS due to the large length of the cooling channels. This can be reduced by pumping a cooling object quickly through the system, creating a trade-off between pump speed and temperature.

2. COMPONENTS OF THE BATTERY PACK

1. Cells (Different from factors & chemistry types).
2. BMS (Electronics to manage the battery)
3. Connection system (Connector, pigtail, wires)

Cells

Lightweight cells began to be developed in the 1800s. They are also called galvanic cells, since the Italian scientist Luigi Galvani invented them. A special chemical reaction that occurs within an electrical cell, is the result on oxidation and degradation of internal substances cell. This generates electricity. Ordinary batteries work like this. Some cells produce electricity without the use of chemical energy. For example, solar cells generate electricity when exposed to sunlight. Zinc plate and copper plate dipped in dilute solution which contains acid or salt is an example of chemicals cell based reaction. The solution acts as an electrolyte (conductor). When two plates are connected to a current wire with a wire, electrical power will pass; this because oxidation and reduction processes occur in this chemical reaction turning the zinc plate into a the wrong electrode and the copper plate on the straight electrode, so the electrons flow from zinc to copper.

Figure: Cell

3. BATTERY MANAGEMENT SYSTEM

A battery management system (BMS) is any electronic system that manages a rechargeable battery (cell or battery pack), such as by protecting the battery from operating outside its safe operating area, monitoring its state, calculating secondary data, reporting that data, controlling its environment, authenticating it. Battery Management Systems (BMS) are used to monitor and control power storage systems, assure the health of battery cells, and deliver power to vehicle systems. Isolation products have numerous uses inside BMS in the electrical domains of Electric Vehicles (EV) or Hybrid Electric Vehicles (HEV).

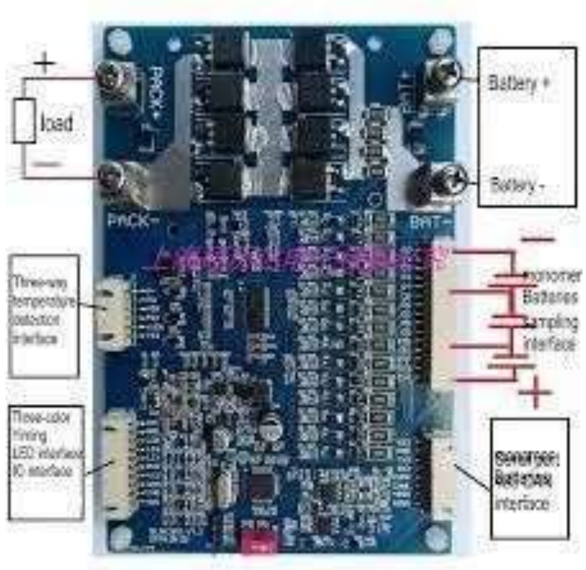
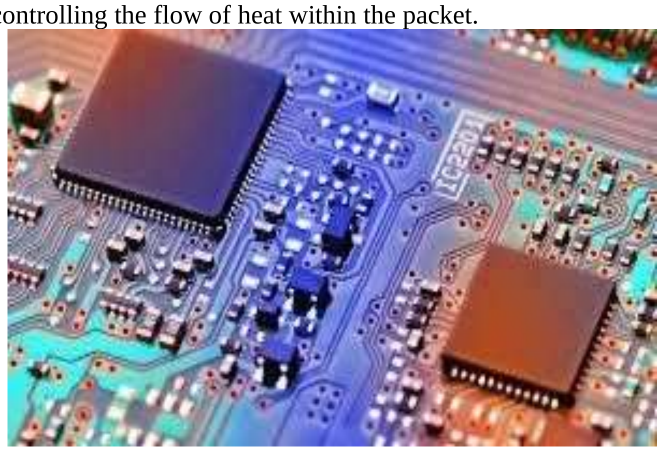


Figure: Battery Management System Connection system

The connection system converts the cell into a battery pack. There must be a connection between the cell and the BMS to connect to each other. Nickel strips are the preferred method of connecting a battery cell to a control system. A thin layer of nickel can withstand high current values, is flexible, strong, and can be attached to a cell without the use of high temperatures.

4. THERMAL MANAGEMENT:

Thermal control is a method of monitoring and controlling the temperatures generated by closed electrical devices. Control can be achieved with technological advances and components with well-known thermodynamic structures and heat transfer.Thermal management is a major problem in the construction of high power, especially for automotive applications. As part of a battery system, you may need to provide air or water cooling pipes, pumps or fans, and high-temperature heat exchangers or heaters to operate at low temperatures. The structure of the cells must be consistent with controlling the flow of heat within the packet.



5. CONCLUSION

This work outlines how to optimize battery design by combining a numerical improvement framework with a physics-based electro-chemical cell model. Considering the indirect nature and the combined number of development problems, a mixed-method approach was developed. The optimizer-free gradient-free optimizer is first used to determine the approximate value of the appropriate design and to obtain a variant of the total number design. The design is then filtered and gradient-based improvements are used. Such a framework is very useful in finding the best original designs, from which additional refinement can be made by calculating additional details such as degradation methods and production parameters. Comparisons between the original and the best designs show a complete improvement of 13.9%, 18.7% and 18.0% with battery weight, volume and cost, respectively. Proper designs also improve the performance of the real drive cycle. Improvements in battery pack structures can be interpreted as a 23.1% increase in distances per unit weight, a 32.8% increase in distance per volume per unit, and a 31.4% increase in per unit cost. The electro-chemical cell in this case is considered normal and additional mechanisms for decompression should be considered in the future.

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7. REFERENCES

[1] B. Scrosati, J. Garche, Lithium batteries: status, prospects and future, J Power Sources 195 (9) (2010) 2419–2430 .
[2] M. Alamgir, A. M. Sastry, Efficient batteries for transportation applications, SAE Paper (2008) 21– 0017
[3] W. Gu, C. Wang, B. Liaw, The use of computer simulation in the evaluation of electric vehicle batteries, J Power Sources 75 (1) (1998) 151–161.
[4] Cooper, Development of a lead-acid battery for a hybrid electric vehicle, J Power Sources 133 (1) (2004) 116– 125.
[5] Y. Liaw, M. Dubarry, From driving cycle analysis to understanding battery performance in real-life electric hybrid vehicle operation, J Power Sources 174 (1) (2007) 76–88.
[6] J. Newman, Optimization of porosity and thickness of a battery electrode by means of a reaction-zone model, J Electrochem Soc 142 (1) (1995) 97–101.
[7] C. Fellener, J. Newman, High-power batteries for use in hybrid vehicles, J Power Sources 85 (2) (2000) 229–236.
[8] W. Du, A. Gupta, X. Zhang, A. M. Sastry, W. Shyy, Effect of cycling rate, particle size and transport properties on lithium-ion cathode performance, Int J Heat Mass Trans 53 (17) (2010) 3552–3561.
[9] Y.Lyu, A.R.M.Siddique, S.H. Majid, M. Biglarbegian, S.A. Godsden, S. Mohmud.
[10] Electric vehicle battery thermal managementthe system with thermoelectric cooling Energy Reports Volume 5, November 2019, Pages 822-827
[11] Kulkarni, A., A. Kapoor, and Arora, S., Battery Packaging and System Design for an Electric Vehicle.2015, SAE Technical Paper.

