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A Review on Regenerative Braking Methodology in Electric Vehicle

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Abstract : Electric cars will be an interest in the market soon. Today, existing braking technologies are used. This braking technology consumes a lot of energy during braking in the form of heat. Therefore, regenerative braking is the most important method of focusing because it is an energy saving method. Increase the efficiency of electric vehicles by reducing waste of energy. In electric vehicle regenerative braking mode, the kinetic energy of the wheels is converted into electricity and stored in the battery or capacitor. This method has been improved using flywheels, DC-DC converters, supercapacitors. In this paper, various kinds of controllers have been studied to improve the energy saving of electric vehicles.

Index Terms - Regenerative braking, generator, brake controller, energy conservation, flywheel, ultra capacitor.

I. INTRODUCTION

Nowadays, electric cars are popular because they know that they are eco-friendly vehicles that emit zero air that causes depletion of the ozone layer. Toxic gases are emitted from the vehicle and do not pollute the atmosphere. In recent years, electric vehicle population starts to increase with market demand. In addition, the government is more serious about electric vehicle production. All humanities are working to save natural and natural resources such as oil and gas on the planet. In the 20th century, vehicle technologies such as control technology and integrated technology have developed aggressively. Anyway, the limits of mileage are still obstacles to the development of electric cars.

This problem has been solved using regenerative braking. This method is one of the ways to improve the mileage because it can increase the mileage of the EV by 8-25%. This technology has replaced traditional vehicle braking systems because most conventional braking systems use a mechanical friction method to always dissipate kinetic energy into heat energy to achieve a stopping effect. Studies show that in urban operation, 1/3 to 1/2 of the energy required to operate a vehicle is consumed during braking. From an energy point of view, kinetic energy is surplus energy when the electric motor is in a braking state, which dissipates energy into heat and loses total energy. This wasted energy can actually be converted into useful energy for hybrid and electric vehicles. Therefore, regenerative braking has been implemented in the automotive braking system to regain wasted energy. Total energy savings also depend on driving conditions and are generally more effective at speeds than at high speeds, but braking rarely occurs.

There are several advantages of regenerative braking taken over the traditional braking system such as:
•More control over braking
•More efficient and effective in stop-and-go driving conditions
•Prevents wear on mechanical brake systems
•Better fuel economy in this work, the working principle and some braking controller for the regenerative braking has been reviewed.

II. LITERATURE REVIEW

The literature search focused mainly on topics related to electric vehicles (EV), hybrid electric vehicles (HEV) and fuel cell powered hybrid electric vehicles (FCHEV). We reviewed the books related to simulation, critical analysis, and empirical research in detail using available software. In addition, a system based on alternative energy sources has been attempted to some extent. However, more emphasis is placed on literature related to fuel savings objectives rather than on environmental savings on global warming and studies undertaken to reduce the components of harmful emissions. The most important documents to mention here, this paper details the requirements and potential benefits of infrastructure development, challenges and opportunities for the design and deployment of emerging infrastructures associated with plug-in electric vehicles (PEVs). From battery manufacturing to communication and control between the vehicle and the grid, the authors have been able to maximize the benefits of the opportunity to reduce fuel consumption, which is crucial to providing safe, clean electricity.

Holms et al (2010) described the operation of an electric vehicle and compared it with existing internal combustion engines and hybrid electric vehicles. The report provided details of the advantages and disadvantages of electric vehicles, along with future technological prospects.

Eberhard et al. (2005) tested a Tesla Roadster EV with a lithium-ion battery for energy-efficient from well to wheel and emissions from the well to the wheel in a paper on the "21st century electric vehicle". Compared to natural gas engines, hydrogen fuel cells, diesel engines, gasoline engines and hybrid gas / electric vehicles, the energy efficiency from the well to the wheel is high and the Tollla Roadster EV has very low emissions from the well to the wheel.

Santos et al (2006) studied power converters and controls for electric traction, and discussed solutions in this paper during development. Focus was on strategy and configuration issues of the power converter (controller), protection and control of the power train. The study vehicle used 11 KW - 48 V DC motor. Because this motor requires a high current value of about 200A, it was important to consider stability issues in the proposed architecture. DC-DC power converters have been discussed in detail to achieve energy conservation and low power consumption according to motor operation requirements in forward and reverse operation of the vehicle. This paper describes the reason for the need / importance of the variable output current control of the converter rather than the voltage control under the intuitive correlation of throttle control and torque. ICE guarantees the protection and safety of motors, controllers, and several electrical and mechanical components. The current control method, especially the sliding mode control, was discussed.

Chetan Kumaar Maini (2005) pointed out in his paper the potential need for the design and development of a globally competitive compact electric concept vehicle for India and concluded that EVs are the best solution to reduce urban pollution and a significant social and economic benefit and will result in the implementation of EVs and HEVs. The report also describes the role of governments and communities around the world in promoting and accelerating EV programs.

Marinescu et al., (2010) FISITA F 2010 A-089 presented aspects of a diesel electric hybrid concept car. The diesel powertrain is mounted in a classical position on the front side and the powertrain is mounted on the rear side. Performance tests of prototype vehicles with electric power units and diesel powertrain, a four-wheel drive concept, have not yet been performed in the laboratory.

The proposed model-based integrated power transfer control for energy management and emission management for reduced hazardous tailpipe emissions and reduced operational emissions of hybrid electric vehicles is presented in this paper. Kessels et al. (2010) FISITA SF 2010 A-096 the cost of the vehicle was considered important. This case study is presented for a heavy-duty hybrid electric vehicle equipped with SCR-deNOx, and until the time temperature of the system after treatment is low, the proposed control system focuses on emissions management and the subsequent treatment system is hot enough Energy management will take the place of control. The results demonstrate a trade-off between operating costs and emissions derived from the proposed integrated powertrain control.

Carlson et al (2008) conducted dependence studies by evaluating differences in fuel averages for two models of hybrid electric vehicles at previously defined urban driving routes at wide ambient temperatures (-14 ° C to 31 ° C) At ambient temperature. Given the fuel mileage provided by HEV, performance changes for low and high temperature effects on HEV operational efficiency have been investigated for roads in pre-defined cities on the road compared to existing vehicle technology. The results showed that battery power control limits and engine operation vary dramatically with temperature.

Chau et al. (2002) dealt with various aspects of the vehicle in order to derive maximum fuel economy, minimum emissions, minimum system cost and excellent driving performance. In this paper author focused on power management strategies for drive trains. Power flow control for various HEVs is also elaborated.

Uzunoglu et al. (2007) in his paper describe the design and modeling of fuel cell / ultra-capacitor (FC / UC) based hybrid vehicle power systems, as well as the development of power flow control strategies, simulation models. FC supplied basic power and UC supplied additional power during peak power demand or load switching. To develop a fairly accurate model to overcome the FC-related difficulties, we have explored large, very complex and costly FC technology systems to improve system efficiency for vehicle applications using proton exchange membrane fuel cells (PEMFCs). Attempts have been made to develop model / executable options that can supply power under transient operating conditions such as start-up, sudden load change and acceleration.

Ahluwalia et al. (2005) noted that the standard US drive cycle used for fuel consumption works at 20% of the rated output of the engine. He said the fuel cell is more efficient at partial load than rated load. The authors have been working to evaluate the feasibility of FCEV fuel economy improvement by direct hydrogen compression FC system as an energy conversion device and Hybridization of energy storage system (ESS) of lithium ion battery pack and sedan vehicle in other drive Hybridization degree DOH).

This work was done by keeping the combined power rating of the FC system and the ESS constant. As a result, the FC system has been reduced in size as the degree of hybridization (DOH) increases by increasing the ESS. Fuel economy of hydrogen fuel cell vehicles was found based on mileage per gallon equivalent (mpgge).

Ogburn et al. (2000) described the design and construction of a fuel cell hybrid electric vehicle conversion. The model was developed using an adviser on a small fuel cell stack and the model verification was completed with Virginia Tech - FCHEV in EPA (US Environmental Protection Agency) city and highway driving cycle. Compared to the model v / s test data of the total fuel cell system energy production, the total energy consumption of the vehicle energy storage system and the total vehicle electric energy usage within 10%, the accuracy of the overall vehicle fuel efficiency is within 1% I have noticed driving cycles and within 6% on the highway.

Assanis et al. (2001) described a method for integrating vehicle and engine simulations in this article. The feed-forward model of engine simulation has been modified to allow connection with vehicle models, and an engine component adjustment routine has been added to facilitate engine sizing studies. Within the proposed performance criteria, a design optimization framework was used to find the optimal overall engine size, battery pack and motor combination for minimum fuel consumption. The researchers completely skipped the emission model.

Hofmman et al (2004) pointed out that the influence of design specifications on secondary power sources (with an understanding of motors considered as secondary power sources) could improve fuel economy, emissions, comfort, driving and safety (Eg, rated power, storage capacity, and energy conversion efficiency), including the efficiency of brake energy recovery. This paper describes problem statements and realized output drive functions (relationships related to drive train topology, technology, or control) to determine optimal hybrid drive train topology and component technologies aimed at improving specific drive functions. The paper also focuses on the sensitivity analysis of design input variables. They concluded that fuel economy increases significantly with increasing secondary power rating, battery size and energy conversion efficiency.

Burke, (2007) described the application of batteries and Ultracapacitors to electric energy storage devices for electric vehicles and charge-hold hybrid electric vehicles. The study focused on lithium-ion batteries and carbon / carbon ultra-capacitors. This describes the energy density and power density characteristics of battery and ultra-capacitor technologies. Comparing simulation results for energy consumption, fuel economy, and grid power usage in federal and highway driving cycles, EVs using lithium-ion batteries can be engineered to accelerate to 240 km with accelerations comparable to conventional ICE vehicles.

III. OVERALL CONCLUSIONS

Regenerative braking is one of the most important systems in electric vehicles because it can save up to 8% to 5% of waste energy. Regenerative braking systems have been enhanced with advanced power electronic components such as ultra-capacitors, DC-DC converters (Buck-Boost) and flywheels. Ultracapacitors, which help improve the transient state of the car during startup, provide a smoother charging characteristic of the battery and improve the overall performance of the electric vehicle system. Buck-boost converters help maintain power management in regenerative braking systems, such as boosting acceleration. Finally, flywheels are used to improve the power recovery process through automotive wheels.

In conclusion, regenerative braking is a tremendous concept developed by engineers. In the near future, regenerative braking techniques may be further developed by using other methods by the fuzzy controller or the PID controller.

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