

Hybrid Drive Train Based Auxillary Storage Systems

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ABSTRACT

The HESS technique is quite intriguing and beneficial for both short- and long-term variations. Since the vehicle depends on energy storage systems, it is essential to choose the optimum ESS for the application. The SOC of the vehicle directly affects the economy and the emission rates. In this work the parallel HEV is modelled by using ADVISOR and Different SOC limits are taken for testing the performance and fuel economy for the same designed driving cycle. With the simulation results we will be able to specify best upper and lower limits of SOC such that vehicle will achieve best fuel economy and emission performance. The simulation is performed by taking repetitive velocity profiles (drive cycles) of four different curves i.e. UDDS, ECE, FTP and HWFET. The ability controller for parallel hybrid cars is mentioned in this study in order to maximise fuel efficiency.

Keywords: *Electric Range; Drive Cycle; Peak Power; Emission Rate; Fuel Economy.*

1.0 Introduction

The new topology of the battery combined with the bidirectional ac/dc-dc/dc converters for PHEVs is being studied by researchers[1] The suggested architecture can be used in four different ways, including bidirectional power transfer between the battery and the dc connection and charging and discharging the battery from/to the grid. An electric motor that draws electricity from a rechargeable battery propels electric vehicles (EVs). The performance requirements for many EV specs much surpass what traditional battery systems are capable of due to the high voltages and currents involved in the system as well as the advanced charging algorithms, however, as battery technology advances, charging these batteries becomes increasingly difficult. There are two different types of architectures—direct and indirect architectures—that can be used to link EVs to the grid. The EV and the grid system operator only have one communication channel to use under the direct architecture[2]. The indirect architecture, on the other hand, calls for communication between the grid operator and a middle system (sometimes referred to as an aggregator). In this essay, we focus on the earlier design. Electric vehicles (EVs) engage in continuous charge-discharge cycles when they connect to the grid to carry out various V2G services. The expense related to the EV batteries' deterioration needs to be examined and assessed, therefore these cycles may be of major concern to the owners of the vehicles. In light of this, the battery cycle life (CL) must be taken into account while talking about the battery's deterioration. Without losing

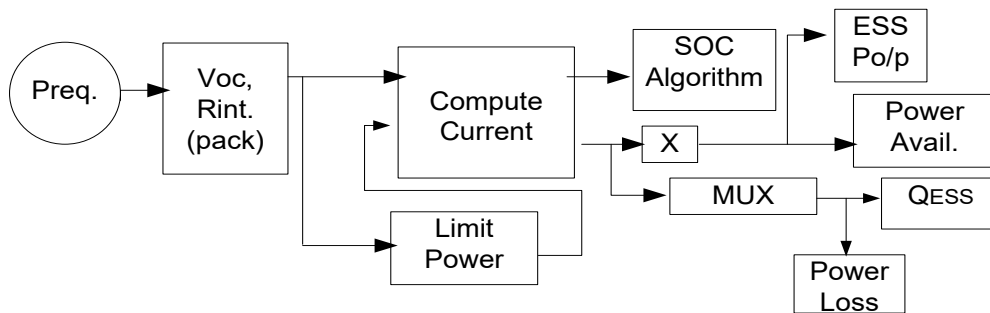
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other attributes like performance standards, safety, cost, comfort, and quality, for example, the fuel efficiency of the new generation of cars can be increased by roughly three times. In order to attain these objectives, the design and individual components must be optimised, but the energy management strategies used to control the system are also very important[3]. The ability controller for parallel hybrid cars is mentioned in this study in order to maximise fuel efficiency.

2.0 System Configuration

Figure 1: Schematic Block Diagram of ESS Model



The system configuration is shown in the schematic figure, where the battery pack is represented by the charge reservoir and the remaining charge is the circuit parameter[4]. The charge that an ESS contains is thought of as a constant amount, and the coulombic efficiency is what determines how well batteries are refilled. The battery can only provide the maximum amount of power that the corresponding circuit or controller can accept under the constraints of the minimal voltage requirements.

3.0 Energy Storage Systems

3.1 Li-Ion batteries

The electrolyte in Li-Ion is a lithium salt dissolved in an organic solvent. Low memory effect, high specific power of 300 W/kg, high specific energy of 100 Wh/kg, and extended battery life of 1000 cycles are all promising features of Li-ion batteries. The lithium-ion battery is recyclable, performs well at high temperatures, and has a high energy density [5]. Because of these excellent features, lithium-ion batteries have a good chance of replacing NiMH batteries as next-generation automotive batteries.

3.2 Lead -acid batteries

For HEV applications, the lead–acid battery has various advantages. They are currently being produced in large quantities, resulting in a relatively low-cost power source. Furthermore, due to its widespread use over the past 50 years, lead–acid battery technology is a mature process. The battery's negative active material is spongy lead, the positive active material is lead oxide, and the electrolyte is diluted sulfuric acid [6]. The battery's life cycle would be reduced if it was operated at a high rate of state of charge (SOC). Both positive and negative materials are converted to lead sulphate for discharge. on the other hand, it is not appropriate for discharges exceeding 20% of its rated capacity.

3.3 Nickel-metal hydride batteries

The NiMH battery has double the energy density of a lead–acid battery. NiMH components are non-toxic to the environment, and the batteries may be recycled. The electrolyte in a NiMH battery is an alkaline solution and the positive electrode of a NiMH battery is nickel hydroxide, whereas the negative electrode is a designed alloy of nickel, titanium, vanadium and other metals[7]. The NiMH battery is safe to use at high voltage and offers a number of benefits, including the ability to store volumetric power and energy, a wide operating temperature range, long cycle life and resistance to discharging and overcharging.

3.4 Ultra -capacitors

An insulator separates two parallel plates on which the charges are stored in Ultra Capacitors. The positive electrode's applied potential draws negative ions in the electrolyte, whereas the negative electrode's applied potential attracts positive ions. Because the electrodes have no chemical changes, UCs have a long cycle life but a poor energy density. Low internal resistance provides UCs tremendous efficiency, but if the UC is charged at a very low SOC, it can cause a big burst of output currents. Researchers are looking into several ways to expand the surface area of the electrodes in order to improve the energy storage capacity of UCs even more. Low internal resistance provides UCs tremendous efficiency, but if the UC is charged at a very low SOC, it can cause a big burst of output currents [8].

3.5 Fuel cells

The cell have the reactants and the product formed is flowed out. The proper flow of reactants is required for the generation of electricity by having oxidant as cathode and fuel at the anode. This reaction is happened in the presence of electrolyte . there are numerous possibilities for combining anode and cathode reactant which is fuel and oxidant. The conversion efficiency is higher with higher flexibility of fuel and operation is also quiet with minimum recover possibility of heat.

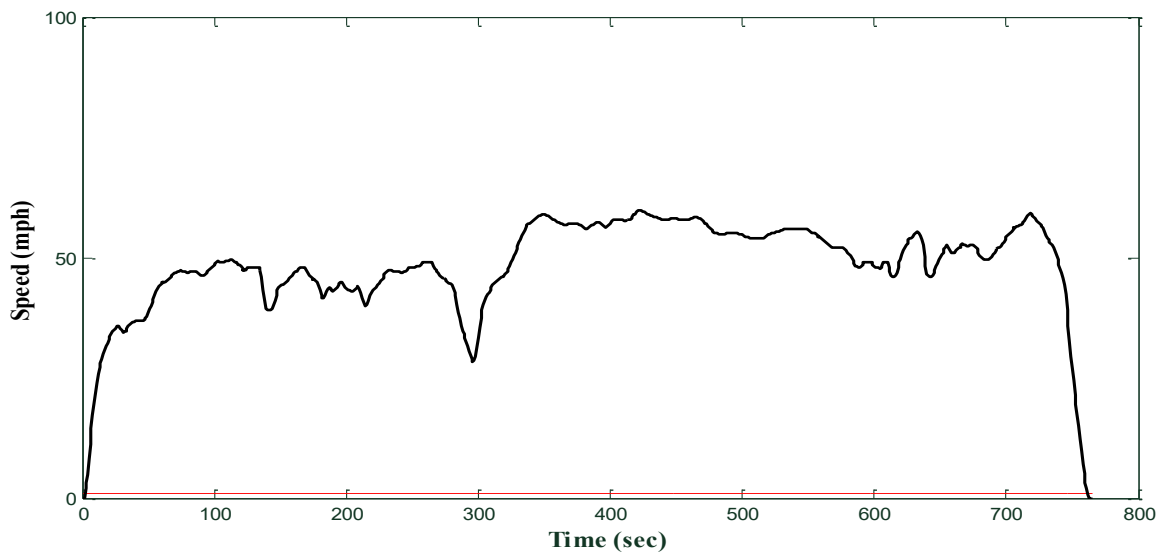
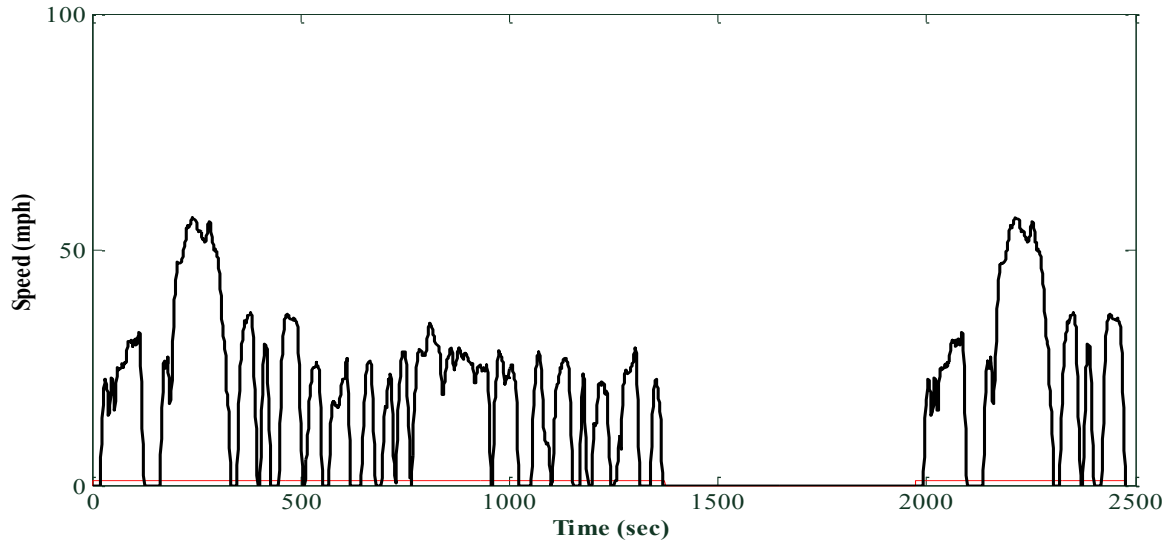
4.0 Hybridization Ratio

For the power rating of the electric motor used in hybrid electric vehicle, some new concepts have been emerged which are full hybrids, mils hybrids and micro hybrids. If the motor and ess used are fairly large then it is full hybrid. If electric motor considered has relatively smaller size then it is considered as micro hybrid. In full hybrid vehicle we can operate the vehicle with electric motor and battery but for micro hybrid the vehicle cannot be driven with electric motor only operation. For staring an stopping only the motor is used and thus the typical rating is less than 10 kw. The mild hybrid is a vehicle which range between full hybrid and micro hybrid[9]. The hybridization ratio is used to reflect the degree of hybridization for a hybrid electric vehicle. The ratio of electric power to total powertrain power is hybridization ratio. For ex- an electric motor with 50kw rating and engine with 75kw rating we can find the hybridization ratio as- $50/(50+75)=40\%$. We can say that the ice powered vehicle have 0 hybridization ratio and pure battery vehicle will have 100 % ratio.

5.0 Simulation Results

One half of the simulation is performed for the lower limit of SOC, and the other part is performed for the top limit of SOC. As too low or too high a value of SOC can harm the battery, it is necessary to maintain the practical limits of 20 to 80 percent. We form groups for the upper limit, or

the end point, run separate simulations, and attempt to determine which group's soc range is optimal. As it depends on the initial values of SOC, the two crucial aspects that are taken into consideration are the engines' operating procedure and overall fuel usage.



6.0 Conclusion

The HESS technique is quite intriguing and beneficial for both short- and long-term variations. Since the vehicle depends on energy storage systems, it is essential to choose the optimum ESS for the application. It has been demonstrated that traditional lead acid batteries are a highly efficient and reliable form of energy storage that requires little upkeep. The lithium-ion battery has a greater capacity for storage and a greater demand for horsepower. The state of charge parameter is used in this study to test the simulation results that are run in sequence for the four different drive cycles. When the need for electricity is low, energy storage devices are charged, and when the need for power is high, they are discharged. The ESS is the element that determines the electric range and

fuel efficiency. Currently, batteries and ultra-capacitors are the two most often used solutions for car ESSs. Batteries, which have high energy densities, are where the majority of onboard electric energy is kept in reserve. On the other hand, UCs feature high power densities, rapid charging and discharging, excellent efficiency, and long life cycles.

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