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Power Storage System Drive Cycle Control in Parallel Hybrid Electric Vehicle

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ABSTRACT

Environmental preservation and lowering gaseous emissions have become goals due to worries about the depletion of crude oil and the quick rise in urban economic growth. This has spurred long-term solution research, especially in the transportation industry where powertrain electrification is a major issue. Energy management systems (EMSs) have a direct impact on how fuel-efficient and emissions-efficient HEVs. The intricate design and little understood working cycles of hybrid electric vehicles make emergency medical services (EMS) a difficult issue to solve. Repetitive velocity profiles, or drive cycles, of four distinct curves—UDDS, ECE, FTP, and HWFET—are acquired in order to run the simulation. The system as a whole must be taken into account in order to maximize the operational efficacy of the various components. The forward-looking technique will be used to the control plan's implementation. Although this extra component is absent from other systems, this tactic optimizes fuel economy by optimizing operational efficiency. The driver demand, road slope, and battery State Of Charge (SOC) constraints are taken into account while determining the IC Engine's output torque through the use of adaptive fuzzy logic. In this study, elevation data from the real world is used to test, develop, and execute an adaptive fuzzy logic based method.

Keywords: *Electric Range; Velocity Profile; Control Strategy; Performance; Operating Efficiency.*

1.0 Introduction

Most commercially available HEVs include an all-battery ESS that is connected to a high-voltage dc bus via a bidirectional converter. The range of electric cars must be increased by increasing the battery pack's capacity to store adequate energy [1]. For electric vehicles, the energy storage system (ESS) must be able to manage the vehicle's whole power consumption. Several authors have developed topologies to hybridize ESSs for EVs, HEVs, FC hybrid vehicles (FCHVs), and PHEVs to increase mileage per gallon efficiency. The Ford Escape, Honda Insight, and Toyota Prius are the three commercially available hybrid electric cars (HEVs) with fuel efficiency of around 40 mpg. In order to increase fuel efficiency and reduce emissions, hybrid electric vehicles provide additional flexibility [2-3]. In order for the HEV to operate effectively, an electric motor is linked with the electrical energy storage. Due to the linkage of the bidirectional converter, a two-power path was made available, allowing the engine to be cut off during low power operation as well as the use of a smaller, more efficient engine for this kind of vehicle. This is possible while maintaining the average power carrying capacity of the vehicle [5]. By accepting the extra power generated by the engine's effective operation, the electrical energy in the battery or any other energy storage device is kept constant during this process.

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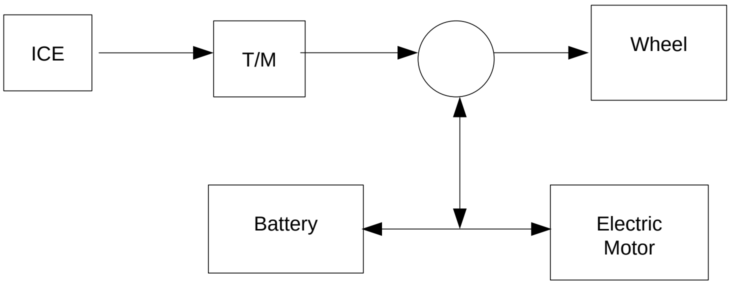
Regenerative braking, in which kinetic energy is converted into electrical energy and stored, also aids in recharging the energy storage system [6]. One of the ESS that is utilised the most is batteries. A battery-based ESS, however, has a variety of challenges, leading researchers to look for alternatives. The power density of the batteries used in battery-based ESSs must be sufficient to meet the peak power demand.

2.0 Parallel HEV Basic

A block schematic of the IC engine, transmission, and EM connections of a parallel hybrid car is presented in Figure 1. A few systems are impacted by the power flow: regenerative braking, which slows down the vehicle while using the EM as a generator; battery charging, which uses some of the ice power to power the EM as a generator and another portion to drive the wheels [7-8]. Using both the internal combustion engine and the electric motor at the same time, we can provide power using only ice and an electric motor.

Figure 1: Block Diagram of Parallel HEV

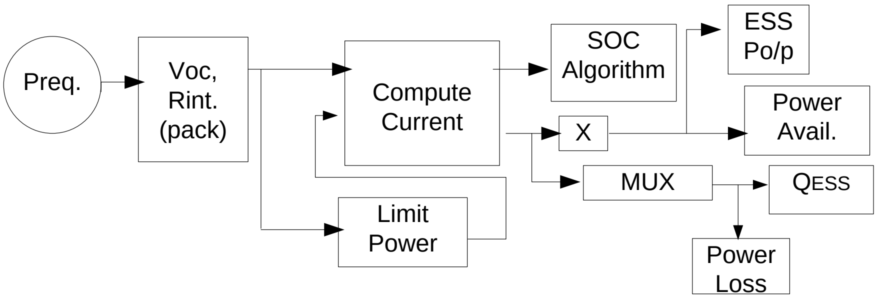


It suggests that a parallel HEV system's performance is significantly influenced by how this power split is managed. Simple rule-based or map-based heuristic control strategies seem to be falling behind controllers that are oriented on minimizing fuel consumption [9]. The latter, commonly known as optimal controllers, provides more generality and reduces the need for significant adjustment of the control parameters [10].

3.0 System Configuration

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[11].

Figure 2: Schematic Block Diagram of ESS Model



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 only amount that can be provided by the battery is the maximum amount of power that the equivalent circuit or controller can tolerate under the circumstances of the lowest voltage requirements[12].

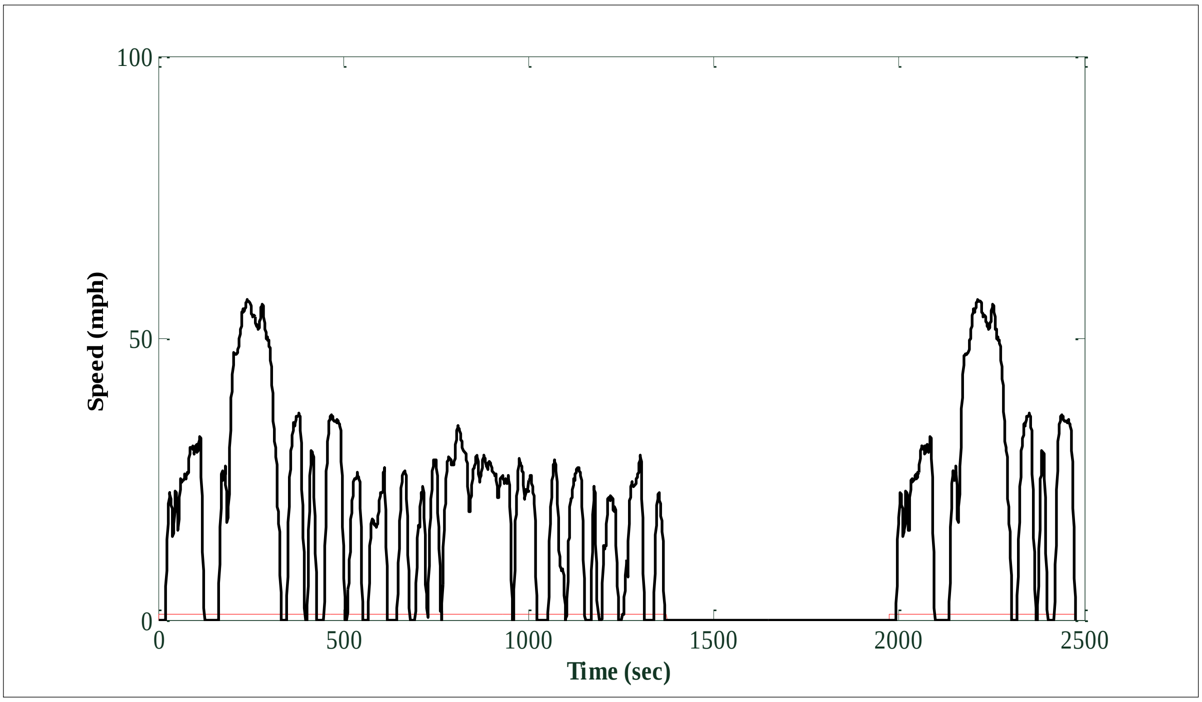
4.0 Simulation Results

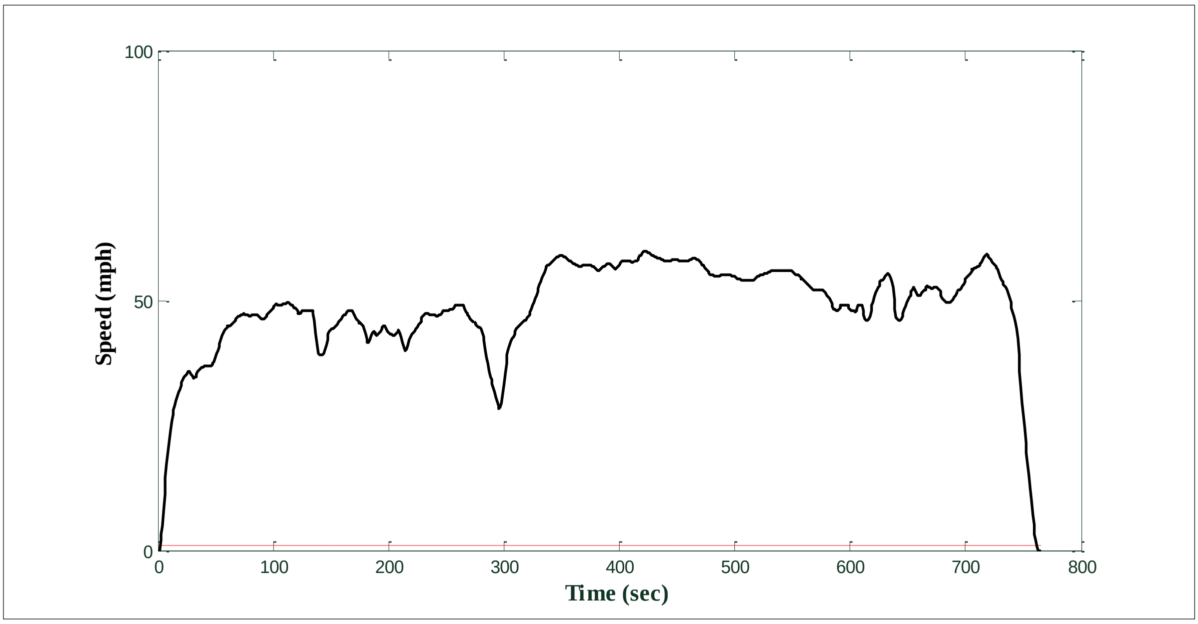
The vehicle is simulated with the following parameters given in the below table.

Table 1: Vehicle Parameters

Vehicle weight	15000 Kg
Motor ratings(power)	43 KW
Torque	200 nm
Engine ratings	120 hp
Battery pack	VRLA
Battery capacity	110 Ah
Terminal voltage	145 V

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.





5.0 Conclusion

In contrast to the traditional rule-based PEACS approach, there is a notable improvement in engine and motor efficiency. Consequently, the host computer-lower machine configuration may be used for an off-line real-time on-board control application thanks to the SDP approach. The host computer solves the problem and creates the transfer probability matrix. Additionally, the embedded system—also referred to as the slave computer—manages routine plan modifications and data collection. Using a model of a PTTR hybrid vehicle, the study examines the power transfer between the various parts. Adaptive fuzzy logic is used to compute the torque split between the ICE and motor while accounting for the grade of the road. The quantity of gasoline used is one of the measures that is used to compare the two approaches. The experiment's results show that adaptive fuzzy logic consumes less fuel.

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