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Self-Charging System for Electric Vehicles Using Neural Network

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Abstract *– An electric car's hybrid energy storage system (HESS), which is comprised of a battery and a supercapacitor, has excellent performance in terms of both power density and energy density when used in conjunction with the vehicle. With the help of neural networks and PI controllers, a hybrid electric vehicle (EV) is designed with an eye toward commercialization. An energy management strategy (EMS) for the EV is proposed, which takes into account the superiority achieved by each ESS as well as its protection from the other ESSes under different driving conditions. The specific energy and specific power of electrochemical batteries are, on average, substantially lower than those of conventional gasoline batteries. It is necessary to use a significant number of batteries in order to achieve the appropriate level of performance, which results in an increase in vehicle weight and expense, as well as a reduction in overall vehicle performance.*

Keywords*: Electric Vehicles, Hybrid Energy Storage System, Energy Management Strategy*

I. Introduction

The heuristic concept-based energy management system (EMS) has a tough time achieving the theoretically best outcomes in terms of energy transfer between the battery and the supercapacitor. As a result, for HESSs, the optimum control theory-based EMS is created later on. Engine/battery hybrid cars [12,13] are another application for this form of EMS, which employs either the global optimization theory, which includes Dynamic Programming (DP), or the instantaneous optimization theory, which includes Pontryagin's Minimum Principle (PMP). In research [9], an optimal EMS based on the PMP was proposed, with the goal of minimising the electricity consumption of the EV while at the same time maximising the battery lifetime. Simulation results showed that the proposed EMS saves electricity while also having the effect of extending the battery lifetime when compared to a rule-based EMS and the single ESS case. According to the findings of research [11], a DP algorithm-based energy management system (EMS) was developed that included a simplified battery ageing model in the formulation. Simulation results revealed that the root mean square value of the battery current is reduced by 10% when compared to a rule-based EMS, and the battery peak current value is also decreased by 45 percent when compared to the same rule-based EMS, which is beneficial for prolonging the battery lifetime. The optimal control theory based energy management system (EMS) ensures theoretically optimal results in energy management; however, it cannot be applied to real controllers in the global optimization theory case due to the excessively long calculation time, the backward calculation process, and the requirement for information about the entire driving cycle in advance. The difficulty in the instantaneous optimization theory situation is due to the large amount of computing required for real-time applications, as well as the need to determine the control parameters, which are dependent on the driving state.

Each of the types of EMS discussed above has its own set of advantages and disadvantages. In this regard, several researchers [14] have created novel EMSs for HESSs by combining the heuristic notion with optimum control theory, using techniques such as Simulated Annealing (SA), Particle Swarm Optimization (PSO), and Genetic Algorithms (GA) (GA). A recent study [14] offered a near-optimal EMS in which control rules were derived from DP findings, and shown that a well-tuned rule-based EMS outperforms the DP technique in terms of performance. [15] proposed a rule-based energy management system (EMS) in which SA was introduced to optimise the reference supercapacitor SOC and battery power, allowing the most appropriate mode of the multi-mode HESS to be selected and the HESS's global energy management optimization to be successfully realised.

According to the findings of the study, a fuzzy logic-based EMS in which GA was used to optimise the lower and higher bounds of membership functions in order to enhance the driving range and performance of the EV was provided.

II. Methodology

The use of generic mechanisms allows for the development of a broad knowledge of how people's personalities are defined by their neurological processes. The number of neurons in the human brain is estimated to be 100 billion, according to an approximate calculation. An affiliation stage is defined as the point at which a neuron's relationship with another neuron is between one thousand and one hundred thousand ten-thousandths of an inch (0.1 mm or 0.01 m) of the affiliation stage. In order to be utilised as reference materials, data is stored in individual brains, and it is therefore ready to be recovered by pulling out just one piece at a time, rather than by removing it sequentially.

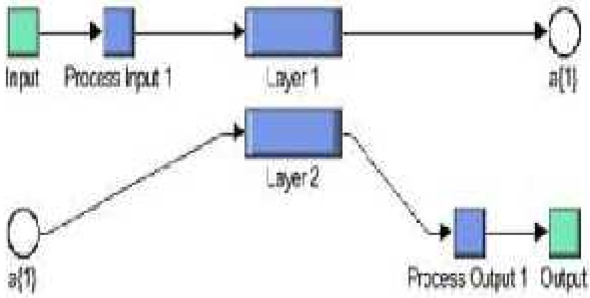

Figure 1: ANN Controller

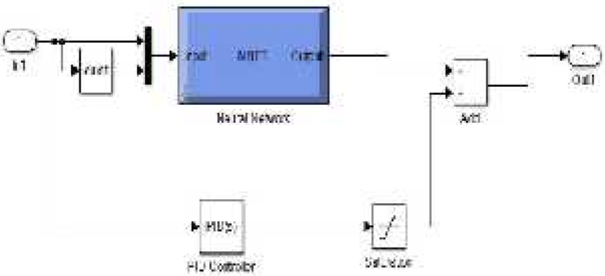

Figure 2: ANN -PI controller

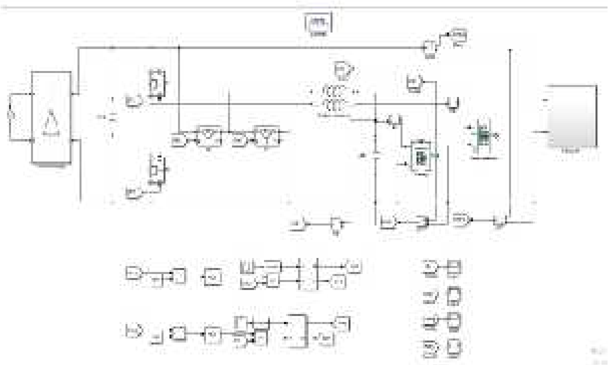

Figure 4.3: existing PI based Energy Storage System

The above screen shows the existing model for energy storage system implemented which is required to be improved.

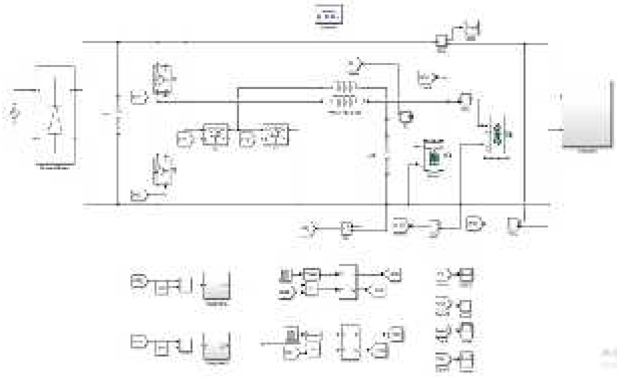

Figure 4: Proposed ANN-PI based Energy storage system

The above screen shows the proposed ANN PI based controller for energy storage system.

III. Result

The proposed work is implemented on MATLAB and simulation on simulink.

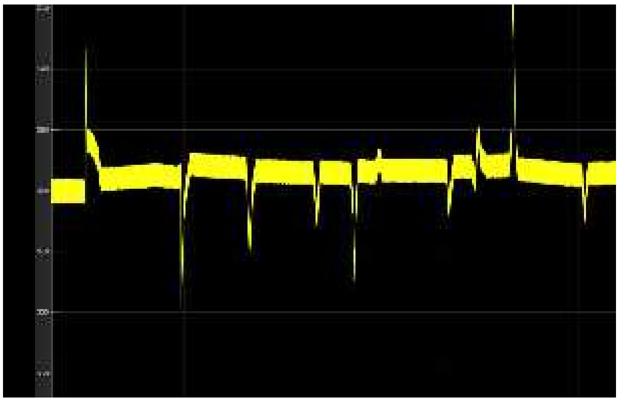

Figure 5: Output for VDC for PI based implementation

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Figure 6: Load Current

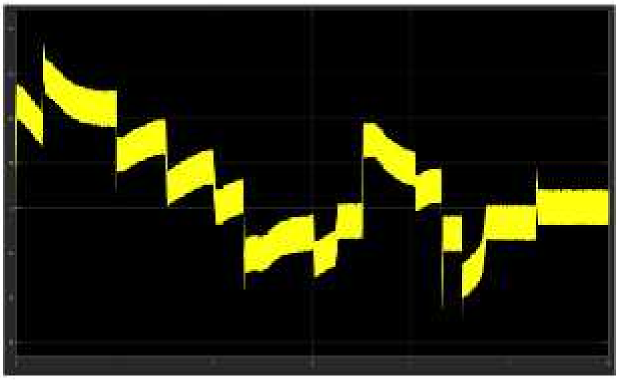

Figure 7: Current of Ultra capacitor

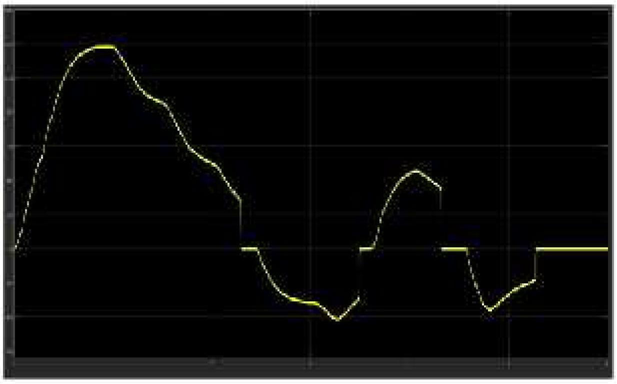

Figure 8: Battery current

Figure 9: Proposed Output for Vdc

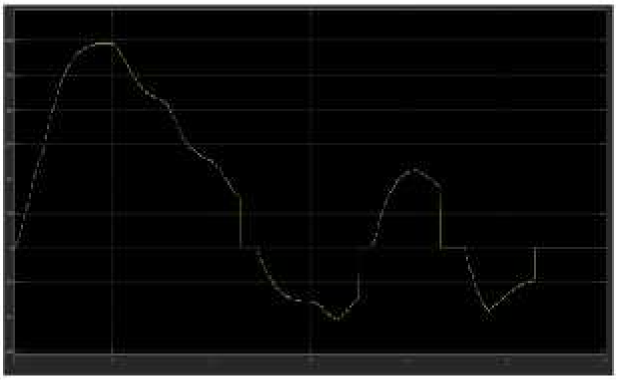

Figure 10: Battery Current for ANNPI

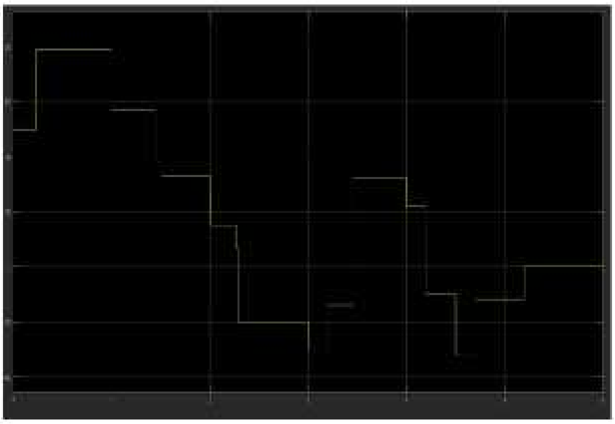

Figure 11: Load

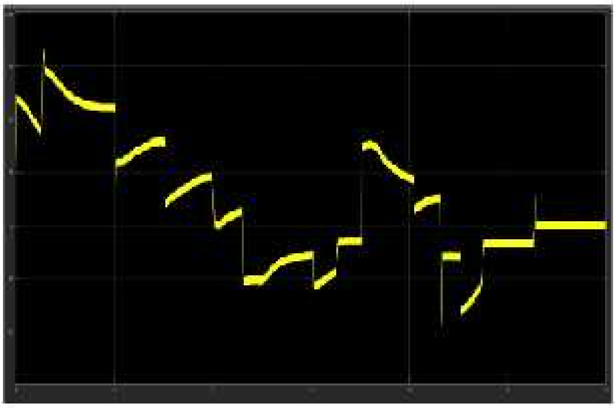

Figure 12: ANN-PI Output current for ultra-capacitor

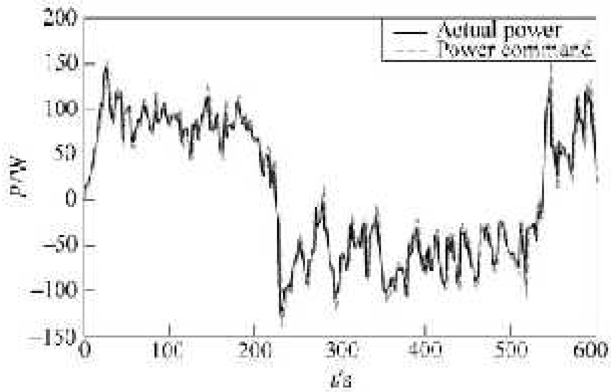

Figure 13 Power Command And Actual Power

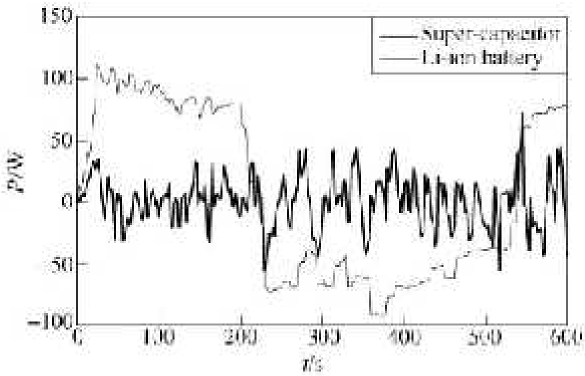

Figure 14 Power Of The Super Capacitor And Li-ion Battery

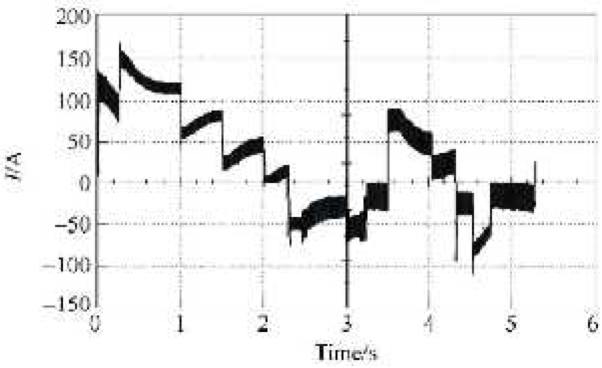

Figure 15 Supercapacitor Current

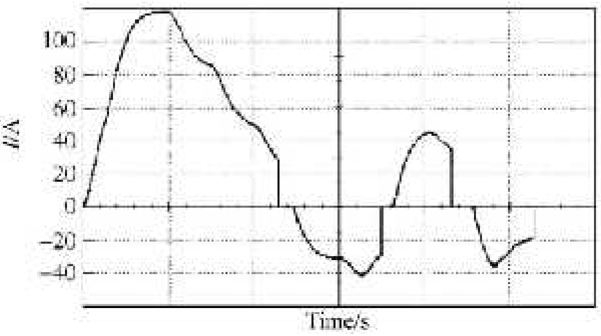

Figure 16 Battery Current

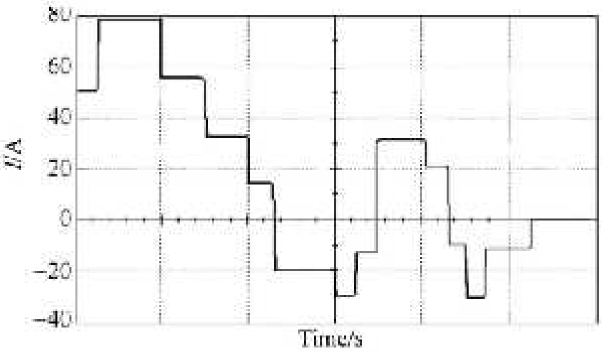

Figure 17 Load Current

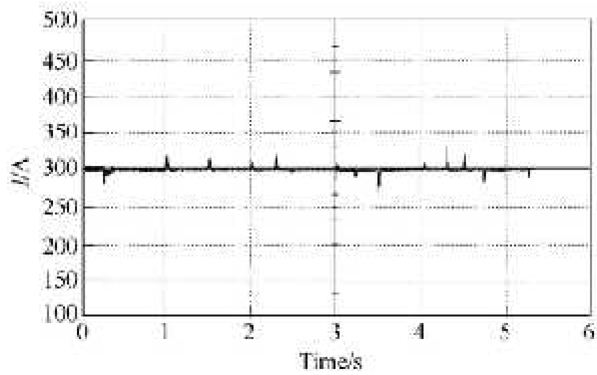

Figure 18 Load Voltage

IV. Conclusion

This research shows that the usage of an ANN-PI controller has enhanced the performance of an Advanced Energy Storage system and that distortions have been decreased, as shown by the findings. Because they release less carbon dioxide than internal combustion engine cars, electric vehicles (EVs) are considered a potential alternative to internal combustion engine vehicles. However, the precise nature of their effects is uncertain; however it is possible to improve the overall quality of energy in a number of ways. Utilizing a High-capacity Advanced Energy Storage device (HESS), which accepts enormous quantities of electricity instead of batteries' limited rate capacity; it is possible to reduce power loss during regenerative braking.

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