Modified neural network function for low-noise hybrid energystorage in electric vehicles

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ABSTRACT

A growing awareness of the need to preserve the environment and reduce energy use is driving innovation in the field of electric vehicles. Electricity is more than just a means to provide power to the car's motor. One of the biggest problems with current EV technology is that the EV needs its own energy storage system. Batteries are essential to the operation of electric vehicles (EVs). When compared to standard petrol batteries, electrochemical ones typically have far lower specific energy and specific power. To attain the desired level of performance, a large number of batteries must be used, which increases vehicle weight and cost while decreasing total vehicle performance. When used in conjunction with an electric vehicle, the battery and supercapacitor of a hybrid energy storage system (HESS) provide outstanding performance in terms of power density and energy density. Using neural networks and PI controllers, a marketable hybrid electric vehicle (EV) is created. An energy management strategy (EMS) is offered for the EV, taking into account the superiority achieved by one ESS and its protection from the other ESSs under various driving scenarios.

Keywords- HESS, EV, ANN, PI

INTRODUCTION

A hybrid energy storage system (HESS) is a collection of energy storage technologies designed to increase the performance, efficiency, and driving range of electric cars (EVs). An HESS is able to maximise the benefits offered by each storage system while mitigating the drawbacks that are often associated with these systems. Because of this, the HESS can control energy more efficiently across the board.

The lithium-ion (or Li-ion) battery is often recognised as one of the most important parts of a HESS. Due to its high energy density, greater power capabilities, and extended cycle life, lithium-ion batteries are often utilised in electric vehicles (EVs). Because of these qualities, lithium-ion batteries are highly recommended for use in EVs. They provide the bulk of the vehicle's power, supplying the constant energy needed to propel the vehicle. Li-ion batteries, on the other hand, can't always keep up with high-power demands like those seen during acceleration or regenerative braking. The reason for this is because the energy capacity of Li-ion batteries is lower.

Hybrid energy storage systems include extra energy storage technologies like supercapacitors to get around these constraints. A supercapacitor is a special kind of capacitor that can store and quickly release a large amount of energy. Ultracapacitor, electrochemical capacitor, and similar terms all refer to the same thing. These are all different ways of referring to the same object. They have a high power density because to their quick charging and discharging rates and their remarkable cycle capacity. In order to supplement the power provided by the lithium-ion battery during acceleration or regenerative braking, supercapacitors are increasingly being used because of their ability to effectively meet such high-power demands. These capacitors can store a lot of energy in a small package.

The flywheel is another kind of technology that is often integrated into HESS systems. Flywheels are used in energy storage systems because the energy is stored in the fast spinning rotor of the device. They feature a high power density, a long cycle life, and a high efficiency rating. Flywheels' capacity to store and release large quantities of energy rapidly makes them useful for limiting rapid power fluctuations and providing momentary surges of power. The aforementioned features make flywheels applicable in a wide variety of settings. A hybrid energy storage system (HESS) uses flywheels, Li-ion batteries, and supercapacitors to efficiently control power demands and make the most of available energy.

Hybrid energy storage systems, which are often employed in EVs, may include hydrogen-powered fuel cells as an alternative. In hydrogen fuel cells, hydrogen gas is electrochemically converted into useful energy. When compared to standard batteries, fuel cells provide more power, allow for greater range, and may be recharged more quickly. In addition, fuel cells need less time for refuelling. Fuel cell hybrid electric propulsion systems (HESS) allow electric cars to go farther between charges and use less infrastructure for charging. Fuel cells may act as a backup power source or provide extra energy to the HESS to boost the amount of power supplied by lithium-ion batteries and other storage technologies.

In order to improve the performance, efficiency, and driving range of electric vehicles, hybrid energy storage systems often combine several energy storage methods. This is done to lessen the financial burden of keeping the car on the road. A HESS may be able to overcome the constraints of individual storage technologies by merging several different kinds of energy storage technologies, such as Li-ion batteries, supercapacitors, flywheels, and maybe fuel cells. Because of this, electric cars may benefit from better power management, faster acceleration, more range, and greater economy.

A complex control and management system is needed for a hybrid energy storage system (HESS) for EVs in addition to the combination of several energy storage technologies. This is essential for the system's proper operation and for making the most use of the available storage options.

The control system of a HESS is crucial because it monitors and controls the flow of power between the different kinds of energy storage. It continuously assesses the vehicle's power requirements and determines the optimal combination of energy storage devices to meet those demands. For instance, the control system may elect to activate the supercapacitors and/or the flywheels in order to fast provide the required power when high-power demands are put on the system, such as during unexpected acceleration. When the system's power requirements are modest, the lithium-ion battery might provide practically all of the juice.

Charging and discharging operations for the different energy storage devices are also managed by the control system. It ensures that everything is charged to its maximum potential and that the system as a whole always has enough juice. This kind of control aids in maintaining the functionality of energy storage systems over time and so extends their useful lifetime.

One of the primary benefits of a HESS is its ability to capture and utilise energy that, in the absence of the system, would be wasted during regenerative braking. An electric vehicle's kinetic energy is recovered when the driver reduces speed or uses the brakes. An electric vehicle's Li-ion battery is where this power is typically stored for later use. However, the HESS might collect and store the regenerative braking energy efficiently if supercapacitors and flywheels were included into the system. When compared to the Li-ion battery alone, these accessories are superior at handling the high power requirements of charging and discharging. This stored energy may be used to enhance the vehicle's efficiency in the future, either during acceleration or to run auxiliary equipment.

When hydrogen fuel cells are part of a hydrogen energy storage system (HESS), electric vehicles gain more flexibility and a longer range. Hydrogen and oxygen may be chemically combined in fuel cells to produce energy, with the only byproduct being water vapor. HESSs may combine fuel cells with other energy storage technologies including Li-ion batteries, supercapacitors, and flywheels to take advantage of fuel cells' extended range and fast refueling. High-energy density fuel cells and other energy storage technologies may also contribute to the HESS's high power output. Because of this pairing, drivers don't have to worry as much about their vehicles' range, unlike with battery-only vehicles.

By integrating the best features of many energy storage technologies and using advanced management systems, a hybrid energy storage system boosts the effectiveness and efficiency of electric vehicles. This is achieved by using the best features of all relevant technologies. By efficiently managing power demands, capturing and utilizing regenerative energy, and providing range extension via the integration of hydrogen fuel cells, a HESS provides a comprehensive solution to optimize the operation and range of electric vehicles, making them more practical and appealing for everyday use. A hybrid energy storage system (HESS) is used to achieve this result.

IMPLEMENTATION

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.

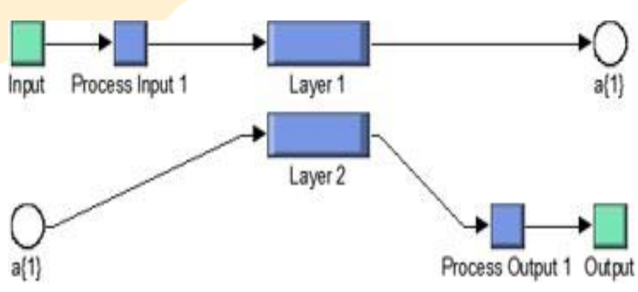


Fig. 1: ANN Controller

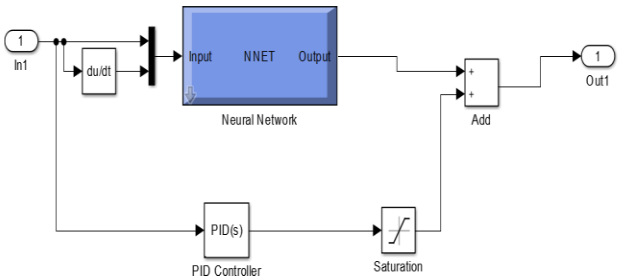


Fig. 2: ANN -PI controller

A virtual neural network (VNN) is a data-processing worldview whose behaviour is akin to that of biological sensory systems in terms of functioning. The innovative configuration of the data processing architecture of a counterfeit neural system is the most important characteristic of the system. This system is made up of a large number of intricately connected managementand registering pieces that work together to handle specific difficulties in a collaborative manner. False neural networks are being connected to an increasing number of true issues with significant unpredictability, according to recent research. They are addressing issues that are either prohibitively difficult for traditional developments or challenges for which there is no algorithmic solution available.

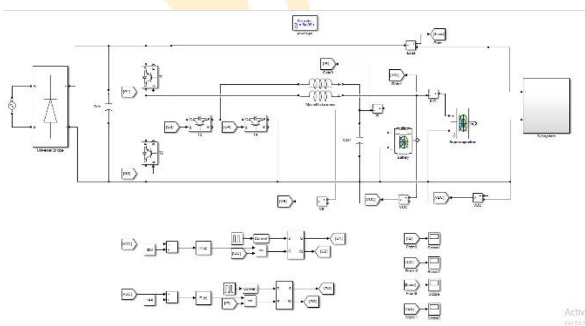


Fig. 3: existing PI based Energy Storage System

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

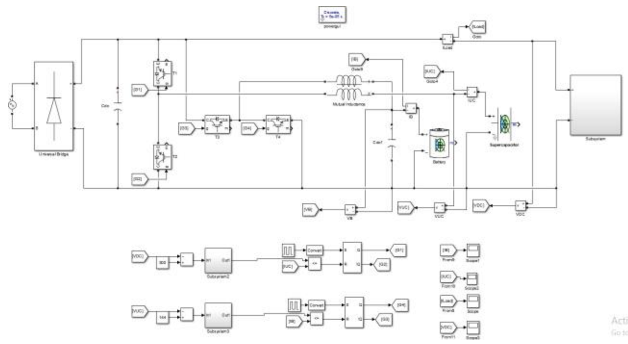


Fig. 4: Proposed ANN-PI based Energy storage system

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

RESULT:

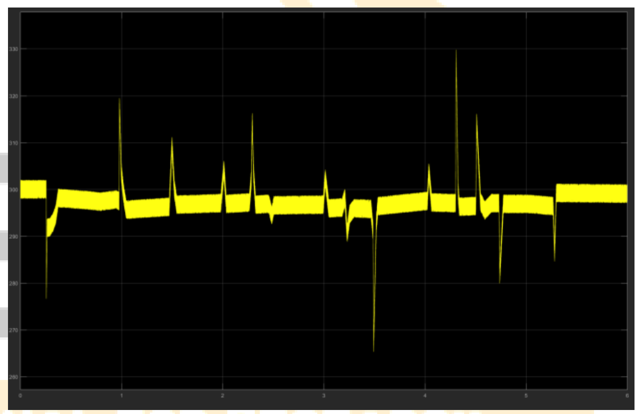
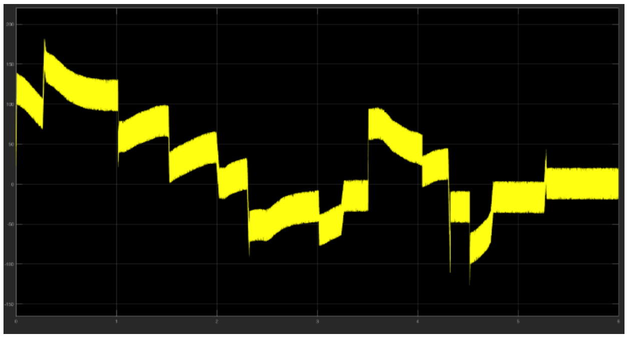


Fig. 5: Output for VDC for PI based implementation

PI based implementation shows high fluctuations.

Fig. 6: Load Current



Above figure shows the load given for various electric vehicle modes.

Fig. 7: Current of ultra capacitor

High noise is seen in ultra capacitor current output.

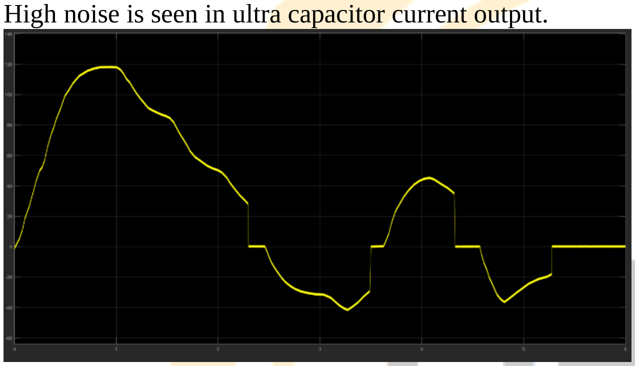


Fig. 8: Battery current

Battery current based on PI controller is shown above.

Fig. 9: Proposed Output for Vdc

ANN-PI shows less distortion output.

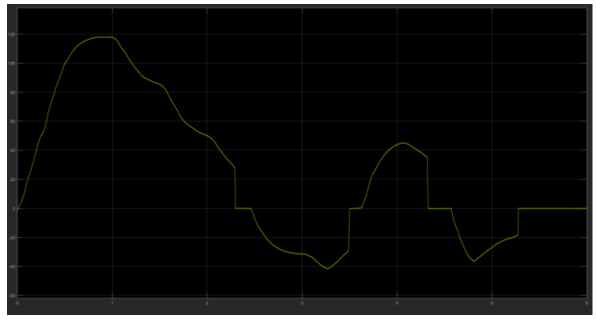


Fig. 10: Battery Current for ANNPI

ANNPI based shows better output for battery current.

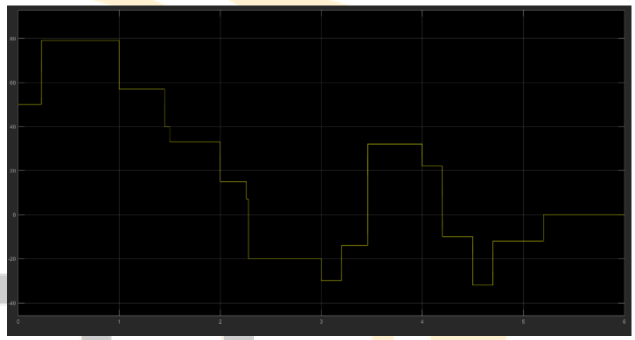


Fig. 11: Load

Load is similar but giving better output for ANNPI based implementation.

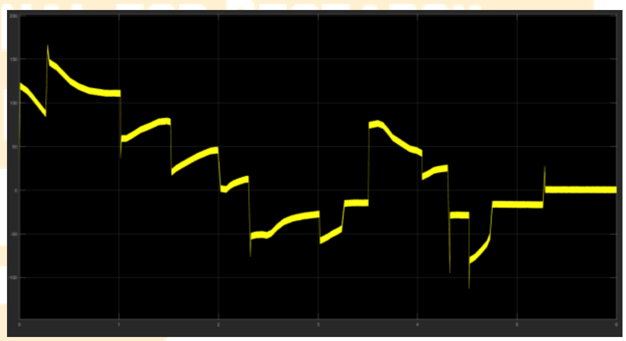


Fig. 12: ANN-PI Output current for ultra-capacitor

The above Fig. 12 is the graph diagram of ANN-PI Iuc

CONCLUSIONS:

The paper shows that an Advanced Energy Storage system's performance may be enhanced by using an ANN-PI controller. The introduction of this controller also seems to have minimised distortions, as seen by the data. Electric vehicles

(EVs) are being considered as a possible alternative to conventional automobiles powered by internal combustion engines. This is because electric vehicles produce less carbon dioxide emissions than conventional cars. While the precise effects of these factors remain a mystery, there are several potential approaches for enhancing energy's general standard of performance. The benefits of electric vehicles in terms of their impact on carbon pollution are greatly diminished when the vehicles are charged using energy that is supplied by power plants that run on petroleum due to power loss that occurs during the manufacturing, gearbox, transfer, and charging of electric vehicles. In its place, regenerative braking is one of the most important ways to maximise battery use in an electric vehicle. Energy is transferred directly from the wheel to the battery during regenerative braking. High-capacity advanced energy storage systems (HESS) may be used to reduce power loss during regenerative braking since they can store large amounts of energy as opposed to the limited rate capacity of batteries.

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