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COMPARATIVE STUDY OF SINGLE PHASE AND THREE PHASE REAL TIME SIMULATION OF EV BATTERY CHARGING SYSTEM

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ABSTRACT

It is necessary that alternating sources for oil reserves that are exhaustible in future need to be found. Due to combustion of oil, it will create environmental pollution problem. Most of the vehicles now a day are dependent on internal combustion engine for their operation which is cause of worry because they are responsible for air pollution so, vehicle manufacturer now a day are looking for alternative sources that can reduce pollution. Due to arising problem of pollution plug in hybrid electric vehicles are veryessential for the future. The Hybrid electric vehicle consists of two propulsion sources that are an electrical motor and internal combustion engine. Electrical road vehicle derives all part of their energy from on board battery. On-board chargers are mounted with in the vehicles and designed to operate only on the vehicles. The Plug in Hybrid Electric Vehicles are driven by the energy stored in the battery. Through conductive AC charging method, Electric vehicle supply equipment is connected to Electric vehicle for charging the battery. Apart from charging it can also help in creating trustworthy equipment ground track and exchange control data among Electric vehicle and Electric vehicle supply equipment. This project discusses electrical interface between Electric vehicle and Electric vehicle supply equipment to facilitate conductive charging and design of an on-board charger for fast charging of the hybrid electric vehicle. The aim of this project is to design interfacing system between Electric vehicle and Electric vehicle supply equipment as per automotive industry standard and to design of 3.45 kw on-board charger using Matlab software. By modeling the charger, charging of Li-ion battery can be done which is used for providing propulsion torque and through various stages of charger voltage and current level is controlled and make them desired for charging. This project shows how one can design conductive charging system as per automotive industry Standards.

INTRODUCTION

It is necessary that alternating sources for oil reserves that are exhaustible in future need to be found. Due to combustion of oil, it will create environmental pollution problem . Most of the vehicles now a day are dependent on internal combustion engine for their operation which is cause of worry because they are responsible for air pollution so, vehicle manufacturer now a day are looking for alternative sources that can reduce pollution. Due to arising problem of pollution plug in hybrid electric vehicles are very essential for the future . The Hybrid electric vehicle consists of two propulsion sources that are an electrical motor and internal combustion engine. Electrical road vehicle derives all part of their energy from on board battery . On-board chargers are mounted within the vehicles and designed to operate only on the vehicles. Road vehicle derives all part of their energy from on board battery According to automotive industry standard. IEC and ISO standards provide such protocols that are responsible for the start of charging of battery in the electrical vehicle. IEC protocols are applicable to the EVSE side and ISO protocols provide such feature that when charging plug connected to EV then it will automatically have interlinked with EVSE and it will inform the driver that vehicle is ready for charging and after charging is done it will automatically notify the driver for bill payment.]

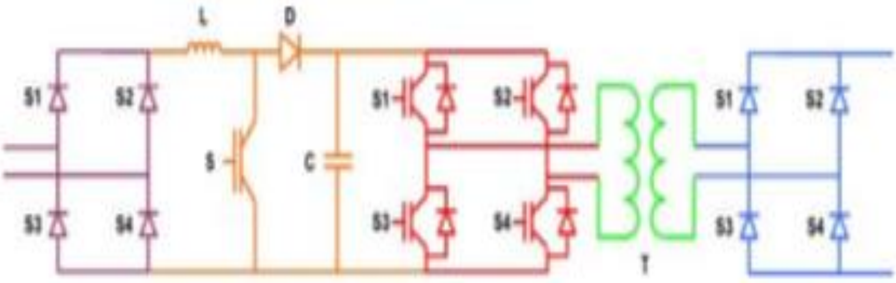

Fig.1. Circuit diagram of on-board charger

A method that permits an EV/PHEV to be coupled to the most common chastised electrical receptacles .The vehicle shall be tailored with an on-board charger accomplished of accepting energy from the prevailing single phase alternating current (AC) source network. A technique that uses devoted AC EV/PHEV supplyequipment in any private or public locations. The vehicle shall be fitted with an on-board charger accomplished of accommdating energy from the single phase alternating current (AC) electric vehicle supply equipment. These are the power converters that are used for charging the battery of the hybrid electric vehicle(HEV). There are two types of chargers that are basically used that are the on-board charger and off-board charger. These chargers are capable of accepting energy from the existing supply network.

A conductive device that is connected to vehicle inlet to establish an electrical connection to the electric vehicle for the purpose of transmitting energy and swapping information. This is part of the coupler. Control pilot circuit will ensure proper operation when EV is connected to EVSE. Control Pilot is the main regulator conductor and is coupled to the equipment ground over control circuitry on the vehicle and accomplishes the following functions : i) Authenticates that the vehicle is standing and connected. ii) Allow energization/de-energization of the supply. iii) Transfers supply equipment currents reading to the vehicle. iv) Observe the availability of the equipment ground. v) Create vehicle ventilation necessities.

Slow charging procedure basically require single phase supply and the desired current rating is approximately (14-15) A. IEC 60309 connector socket should be used during this process. Fast charging procedure basically require three phase supply and the desired current rating is approx. (63-64) A. Due to this IEC 62196 connector socket during this process. EVSE is considered as electrical grid that are used for supplying AC supply to Electric vehicle for charging. EVSE act as a charging station it consists of the conductor, plugs, electric vehicle connectors and appliances that are used for delivering power to electric vehicle .

The permission of charging of PHEV battery through EVSE is accomplished through electrical and mechanical parameters. The first process should be started with rectification process in which AC to DC conversion takes place. Again it should be necessary to control EVSE voltage to a level that provide desired charging rate according to battery charge level property e.g. voltage and other variable the above discussed part comes under electrical. Now under mechanical parameters consider physical connection between EV and EVSE which can be done by the user itself. Mechanical system which clutches a plug or connector in a place when it is in appropriate contact and avoids accidental dis-connection of the plug or connector. It is necessary to maintain surface temperature limits of EV and EVSE for fault free charging cycle. The surface temperature limits are different for different types of materials for example for metallic and non-metallic parts that are come in direct touch with the user have temperature limit of 45 degrees for metallic part and 56 degrees for nonmetallic. Part. For those parts that are not come in direct contact with the user have temperature limit of 65 degrees for metallic part and 80 degrees for non-metallic part.

ON-BOARD CHARGER

On-board chargers are mounted within the vehicles and designed to operate only on the vehicles. These chargers are used for charging the battery in EV by converting AC supply in DC. lithium-ion battery is used. Li-ion batteries are also called as a rechargeable batteries possesses great energy solidity and normally used in customer electronics. Li-ion battery commercially release in 1991. In security, power and energy solidities li-ion battery technologies are developing expressively. An anode, cathode, separator, electrolyte and two current collectors (positive and negative) are used to make li-ion battery. Anode and cathode accumulate the lithium. Usually li-ion batteries are expressively nimbler than further types of rechargeable batteries of related size. Energy solidity and power solidity are two most common notions analogous through batteries. Li-ion battery has less self-discharge than half of nickel-based systems and therefore this is applicable in fuel gauge. The mobile phones, tablets and digital cameras can directly power by nominal cell voltage of 3.60V which offers simplification and cost reduction over multi-cell designs 2. Description of separately excited dc motor is given in section II. Section III designated the suggested model of an isolated dc-dc converter. Simulation results of an isolated dc-dc converter are shown in section IV. Finally, section V shows the conclusion.

A DC motor is a rotatory electrical machines which converts direct current electrical energy into mechanical energy. A direct current (DC) motor is a legitimately modest electric motor, produces torque by using electricity and magnetic field, which rotate the rotor and provide mechanical work. In electric vehicles DC motors are widely used. DC installation is unpretentious and less exclusive. A distinctive motors are in the range of 20,000watt to 30,000watt. DC motors can overdrive for short periods of time. For a short period of time 20,000watt motor will accept 100,000watts and convey 5 times its rated horsepower. This is prodigious for small ruptures of acceleration. The separately excited DC motor is shown in Fig. 2. DC motor consists of two windings i.e. field winding and armature winding. Field winding is immovable and armature winding can revolve liberally.

When DC supply has given to the field winding, it produces magnetic field. When armature winding coupled with DC source, shaft connected to it and Lorentz force helps to rotate this shaft. Separately

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excited DC motor have separated field winding means supply to armature is different and supply to field is different. So there is no effect on field current (if) by change in armature current (ia). By reversing voltage, direction of motor rotation can be reverse. Separately excited DC motor can operate above base speed. Armature is the rotatory part and field winding is stationary part. Motor speed can be control by varying armature voltage or by varying field voltage control. Thus, separately excited DC motor gives good speed control

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An Isolated dc-dc converter consists of full-bridge inverter and full-bridge rectifier.shows an isolated dc-dc converter. Power conversion system consists of DC-DC converter. DC-DC converter generally operates either in buckmode or in boost-mode. Buck operation delivers smaller output voltage at receiving side and boost operation delivers higher output voltage at receiving side. Transformer is used to transmute power from lower side to higher side and vice versa. Transformer also provides the barrier between the two converters. Non-isolated dc-dc converter and isolated dc-dc converter are the two classification of DC-DC converter. Reduction in cost and improve the system efficiency is possible in non-isolated topology but it dispensation the safety issues of leakage current. Huge voltage dissimilarity between input side and output side produces the switching losses due to the capability of driving circuit which gives reduction in an efficiency of the converter. Therefore, isolated DC-DC converter is a main application for huge voltage dissimilarity.

During the nineteenth century, when power supply was dc, dc motors were used extensively to draw power direct from the dc source. The advent of thyristors capable of handling large current has revolutionized the field of electric power Control. DC motor drives are used for many speed and position control systems where their excellent performance, ease of control and high efficiency are desirable characteristics. DC motor are generally controlled by conventional Proportional – Integral – Derivative (PID) controllers, since they designed easily, have low cost, inexpensive maintenance and effectiveness.

It is necessary to know system's mathematical model or to make some experiments for tuning PID parameters. Due to its excellent speed control characteristics, the DC motor has been widely used in industry even though its maintenance costs are higher than the induction motor. As a result, position control of DC motor has attracted considerable research and several methods have evolved. Proportional-Integral Derivative (PID) controllers have been widely used for speed and position control of DC motor. Automation control, motion control and machine automation systems are used to improve manufacturing performance and flexibility. Engineering assistance with machine safety, energy efficiency, and breakthrough motion control and automation concepts. Reduce energy consumption. Improve worker safety. Make more effective use of new, integrated approaches to complex engineering challenges.

The DC motor can be controlled by controlling armature voltage and armature current. We know that speed control is possible by varying • Flux per pole (controlling of flux). • Resistance Ra of armature (By Rheostat Control). • Applied voltage. The above methods have some demerits like a large amount of power is dissipate in the controller resistance hence efficiency decreased. And also it requires very complicated and expensive arrangement for dissipations of heat produced in the controller resistance. It also gives very low speed below the normal speed. So by this we can conclude that these electrical and electromechanical methods are less economical, efficient and not of much use as these methods are having multiple drawbacks, so electronic methods and techniques are used for controlling of speed.

PROPOSED CIRCUIT SIMULATION RESULTS

Simulink is a software package for modeling, simulating, and analyzing dynamical systems. It supports linear and nonlinear systems, modeled in continuous time, sampled time, or a hybrid of the two. For modeling, Simulink provides a graphical user interface (GUI) for building models as block diagrams, using click and drag mouse operations. Models are hierarchical, so we can build models using both top – down and bottom – up approaches. We can view the system at a high level,then double-click on blocks to go down through the levels to see increasing levels of model detail. This approach provides insight into how a model is organized and how its parts interact. After we define a model, we can simulate it, using a choice of integration methods, either from the Simulink menus or by entering commands in MATLAB's command window. Using scopes and other display blocks, we can see the simulation results while the simulation is running. In addition, we can change parameters and immediately see what happens, for "what if" exploration.

The simulation results can be put in the MATLAB workspace for post processing and visualization. Simulink can be used to explore the behavior of a wide range of real-world dynamic systems, including electrical circuits, shock absorbers, braking systems, and many other electrical, mechanical, and thermodynamic systems.

Simulating a dynamic system is a two-step process with Simulink. First, we create a graphical model of the system to be simulated, using Simulink's model editor. The model depicts the time-dependent mathematical relationships among the system’s inputs, states, and outputs. Then, we use Simulink to simulate the behavior of the system over a specified time span. Simulink uses information that you entered into the model to perform the simulation.

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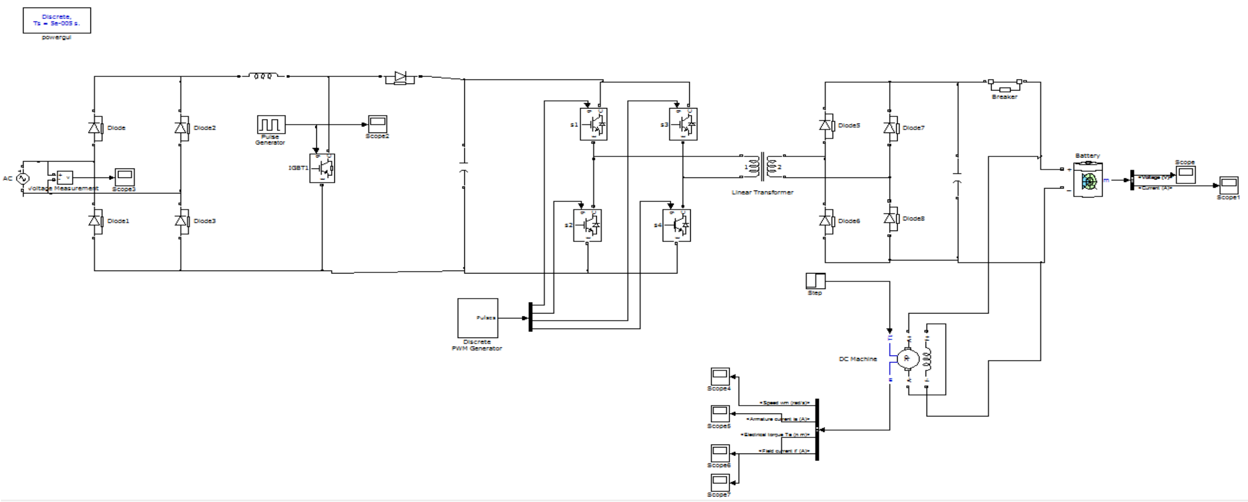
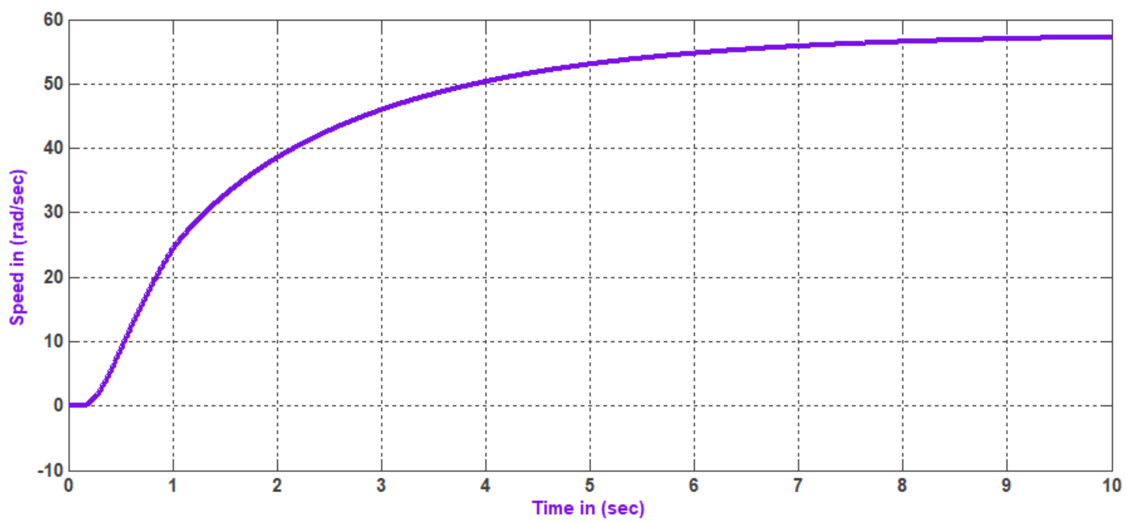


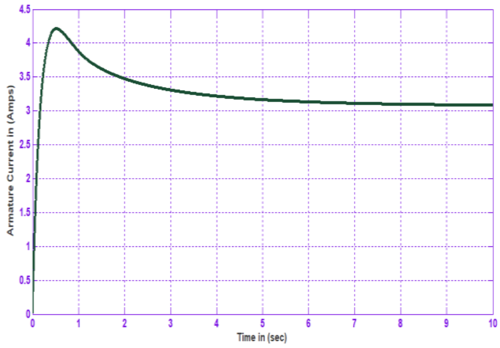
Proposed simulation circuit

The circuit representing Modelling of Hybrid Electric Vehicle Charger and Study the Simulation Results Shows Block diagram of the on-board charger which is used for charging the propulsion battery of electric vehicle. on- board charger consists of two stages that are power factor corrector(PFC) and DC-DC Converter. Power factor corrector consists of AC-DC rectifier and boost converter. The main purpose of PFC is to improve the power factor so that total harmonic distortion will be reduced and to make current wave form sinusoidal. This can also help in improving the efficiency of the on-board charger and reduces losses during operation of the on-board charger



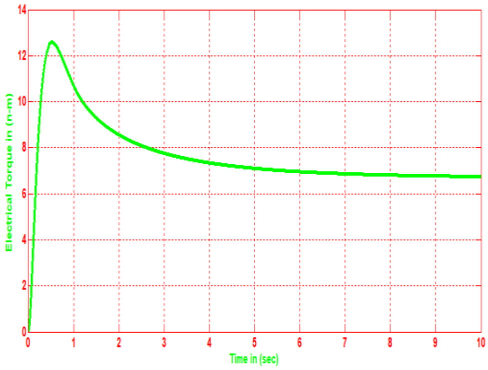
Simulation Result of Speed of electric vehicles

Fig representing Speed of electric vehicles vs time. DC machines, DC-DC converters, and control strategies. It discusses the corresponding design criteria, design example, and application examples for EV propulsion. For the series DC motor drive, the regenerative braking can be performed based on the same principle as that for the separately excited DC motor drive, but the field needs to be reversed with respect to the armature as compared with the connection for motoring.



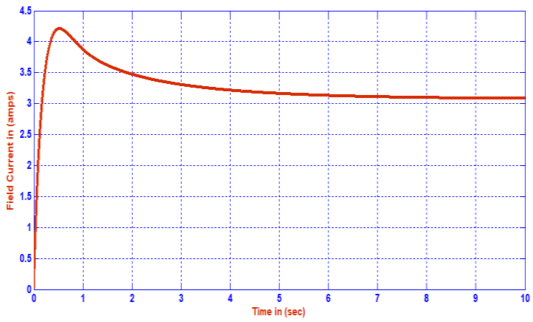
Simulation Result OfArmature current

Fig is representing armature current of electric vehicles vs time the peak value of the current is 4.3 ampand setling time is 6 sec for the proposed converter under simulated in MATLAB software



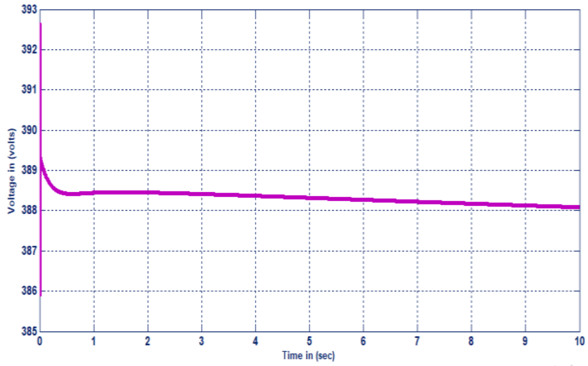
Simulation Result Of Electromagnetic torque

Fig is representing Electromagnetic torque vs time the peak value of the current is 12.2NM and settling time is 6 sec for the proposed converter under simulated in MATLAB software



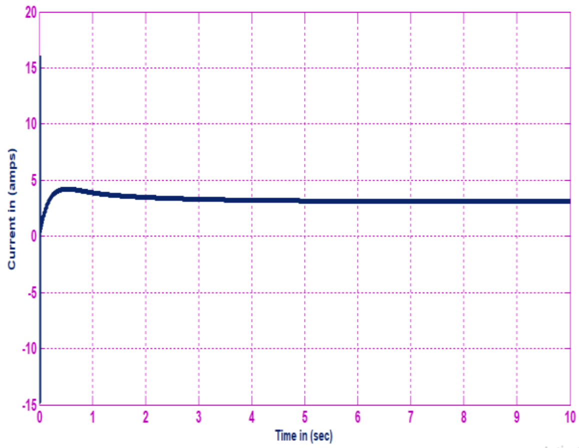
Simulation Result Of Filed current

Fig is representing Filed current of electric vehicle vs time the peak value of the current is 4.3 amp and setling time is 6 sec for the proposed converter under simulated in MATLAB software



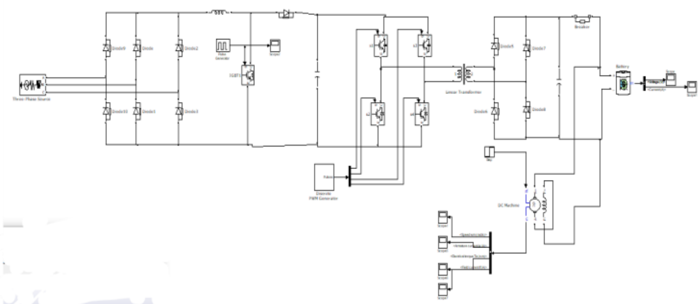
Simulation Result Of Battery Voltage

Fig is representingbattery voltage of electric vehicle vs time the peak value of the voltage is 389.5V amp and setling time is 0.2 sec for the proposed converter under simulated in MATLAB software



Simulation Result Of Battery current

Fig is representing battery current of electric vehicle vs time the peak value of the current is is 4.3 amp and setling time is 6 sec for the proposed converter under simulated in MATLAB software



Three Phase Simulation Circuit

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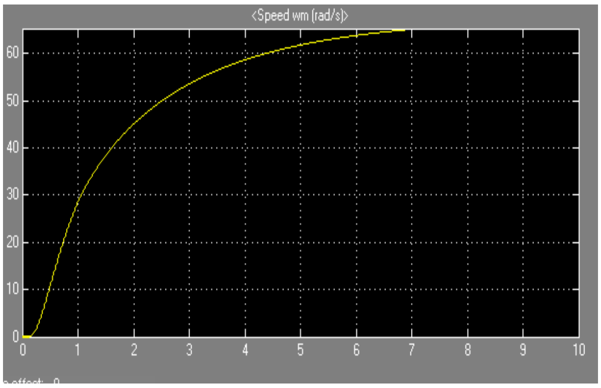
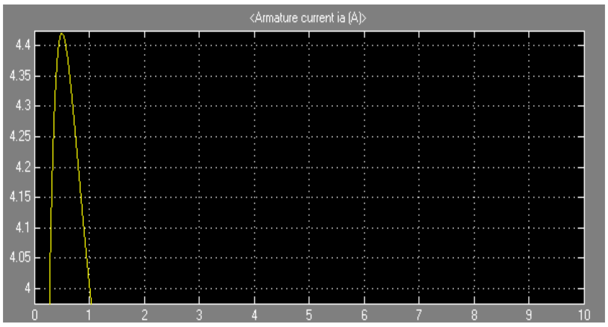
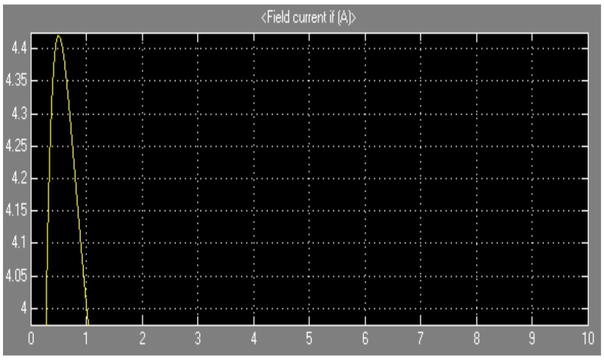


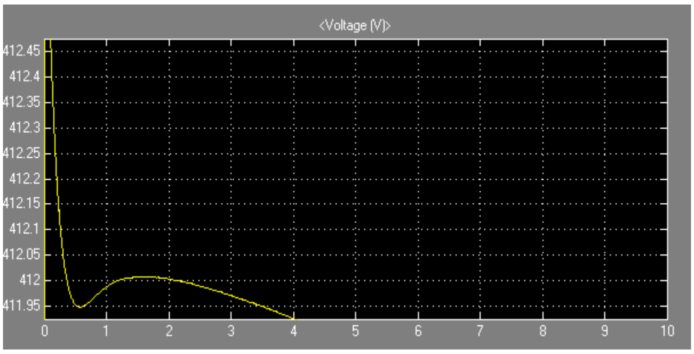
Simulation Result Of Speed Of Electric Vehicle



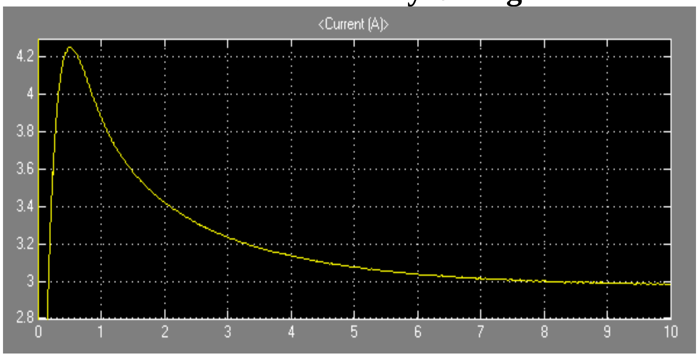
Simulation Result Of Armature Current



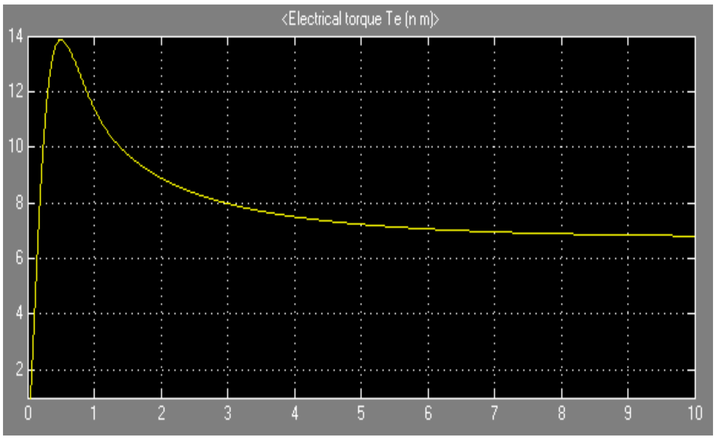
simulation result of field current



Simulation Result Of Battery Voltage



Simulation Result of Battery Current



Simulation Result Of Electromagnetic Torque

CONCLUSION

As the use of electrical vehicles are increasing day by day so their charging system must be robust and reliable so that one can use electric vehicles without any problem. This project presents conductive AC charging protocols for charging the plug in hybrid electric vehicles. In this project theory of conductive charging is investigated and complete analysis of the on-board charger is done due to which one should able to verify the valid states for the start of charging and the range of maximum current limit is determined by the duty cycle. This project shows how one can design conductive charging system as per automotive industry Standards.

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