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Dynamic Wireless Charging of Electric Vehicle

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Abstract: Dynamic Wireless Charging of Electric Vehicle approach revolutionizes the changes in Electric Vehicle Industry. Existing Electric Vehicle Batteries are designed to power the Drive for minimum hundred kilometers range. Beyond hundred kilometers range the Battery capacity must be increased which in turn increases the cost of electric vehicle and charging time. With Dynamic Wireless Charging the Battery size can be reduced for same travel range, Thereby reducing the cost of electric vehicle and charging time.
The Present work deals with the Development and Simulation of Dynamic Wireless Charging of Electric Vehicle (i.e. charging in motion). Dynamic Wireless Charging of Electric Vehicle system contains road embedded number of inductive coils. Selection of number of inductive coils depends on the track length. Each inductive coil acts as a Transmitter, for wireless power transfer the transmitter coil terminals are excited by high frequency resonant inverter. Solar panel along with Boost converter supplies dc power to resonant inverter which in turn converts dc input to high frequency AC output. Wireless charging using resonant inductive power transfer utilizes high frequency magnetic field to transfer power from primary to secondary over a large air gap. Receiver Coil is placed on Chassis of Electric Vehicle and connected to on board rectifier circuit. Rectifier with capacitor filter converts the bidirectional signal to unidirectional signal and provides regulated dc output with the help of regulator. The constant dc output is used to charge electric vehicle battery. In this paper power track is divided into five power line segments. Under Dynamic Wireless Charging mode the power is distributed to battery for its charging, and remaining power for traction motor to develop necessary torque. Wireless power transfer between the coils under dynamic condition is analyzed and simulated for alignment and for mis- alignment of coils.
Keywords: Resonant inductive wireless charging; dynamic charging; wireless power transfer.

I. INTRODUCTION

Resonant Inductive charging has many promising properties such as ease of use, cable-free charging of electric vehicles and charging on road during stops or during movement. This is a promising solution for charging and power transfer in many applications since it can easily be automated and standardized. The use of inductive power transfer in this project will include development and prototyping of an inductive charger for an electric vehicle. The vehicle has a small battery which needs to be charged more frequently than for a full-sized electric car. IPT is tested on a smaller vehicle to get a basic understanding of the technology since a smaller vehicle will use a smaller design.

Wireless charging of electric vehicles is possible using electromagnetic power transfer and electric static power transfer. In the electromagnetic power transfer the power is transferred from the primary to secondary through a large air gap using high frequency magnetic field. On the other hand, in electrostatic field, the power is transferred using electro static field. Wireless charging using inductive power transfer can be classified as a non-resonant IPT system and resonant IPT system. The basic difference between these two systems is the resonance phenomenon in the operation. Non-resonant IPT systems are best suited to very small air gap applications and found to be very efficient as seen in the GM EV1 Magne Charge. On the other hand, in RIPT systems, the primary transmitter and the secondary receiver coils resonate at the same frequency. The interaction of magnetic fields in both these cases is very different.

II. DYNAMIC WIRELESS CHARGING SYSTEM

Dynamic wireless charging system allows the vehicle to charge in real time while in motion, which also allows the reduction of the overall battery capacity in the vehicle. This provides the benefit of reducing overall vehicle cost and reduced charging times. Dynamic wireless charging systems are a part of wireless power transfer (WPT) technology, where power can be transferred from one circuit to another circuit without any physical contact or wiring. The power transmitter portion is composed of a power source and coil, where the power source is generated into an electromagnetic field as it enters through the coil. The power receiver portion, which consists of another coil, will convert the received electromagnetic field into usable energy that can power another source.

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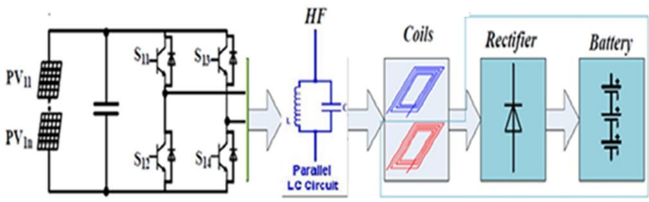
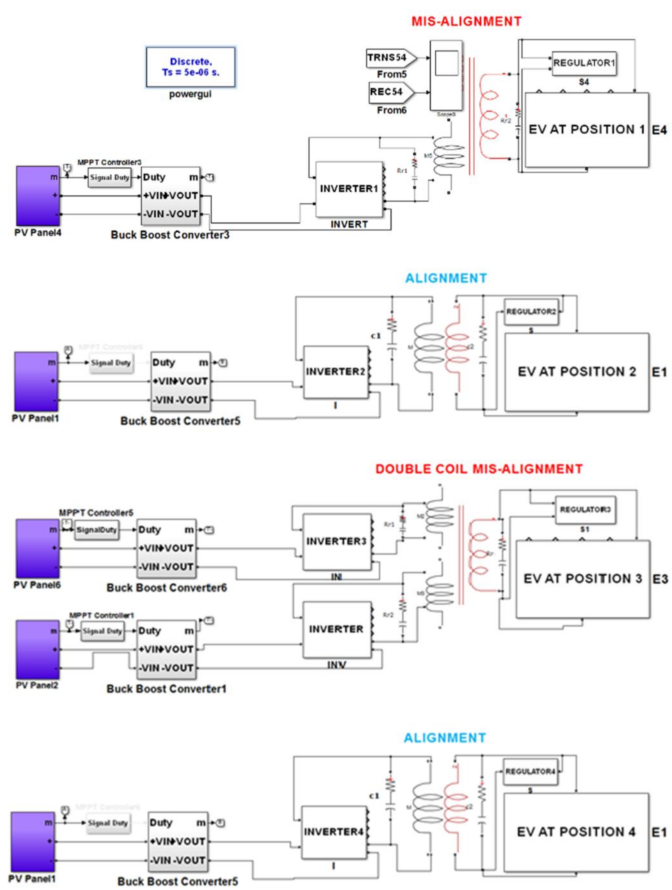


Fig 1 Dynamic Wireless Charging model.

A. Dynamic Wireless Charging System Control Logic

function [Load On, Charging On]= fcn (SOC)
%#codegen
LoadOn=1;
ChargingOn=0;
if (SOC >=80)
LoadOn=1;
ChargingOn=0;
end
if (SOC <20)
LoadOn=0;
ChargingOn=1;

End Dynamic wireless charging will be activated when the state of charge of electric vehicle battery is SOC<=20,when the SOC>=80 the electric vehicle battery supplies power to motor and operates under discharging mode.



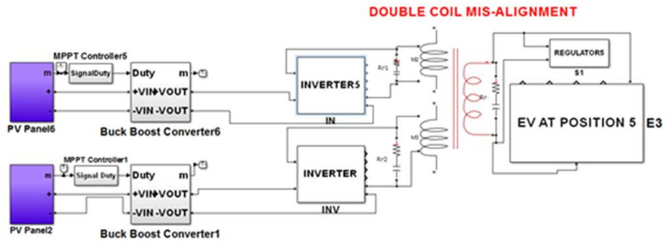
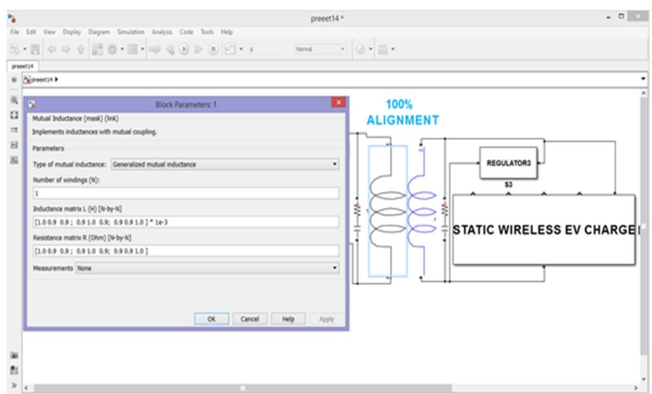


Fig 2 dynamic wireless charging simulink model

III. MODELLING OF DYNAMIC WIRELESS CHARGING SYSTEM

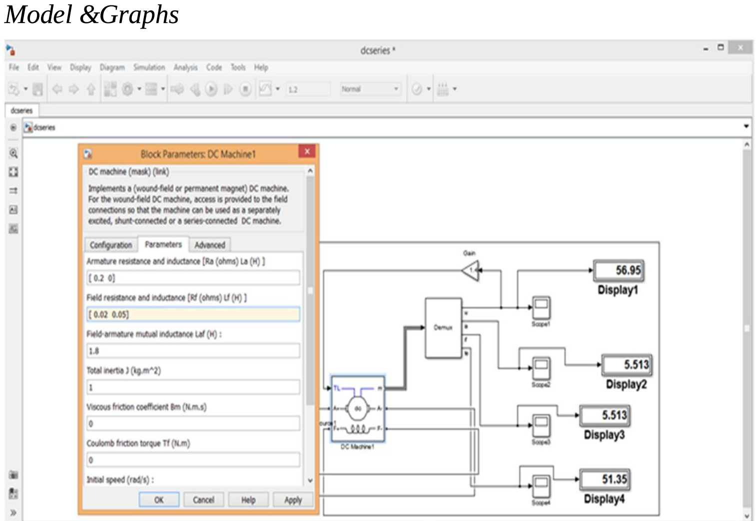
L1=1.1*e^-04;
L2=1.1*e^-04;
M=1.0*e^-04;
K=M/sqrt (L1*L2);
K=1.0*e^-04/sqrt(1.1*e^-04*1.1*e^-04);
K=0.9;
fr=1/2πsqrt(LC);
fr=1/2πsqrt(5*10^-3*9*10^-9);
fr=23khz; Wr=2πf=2π*23khz=46πrad/sec;

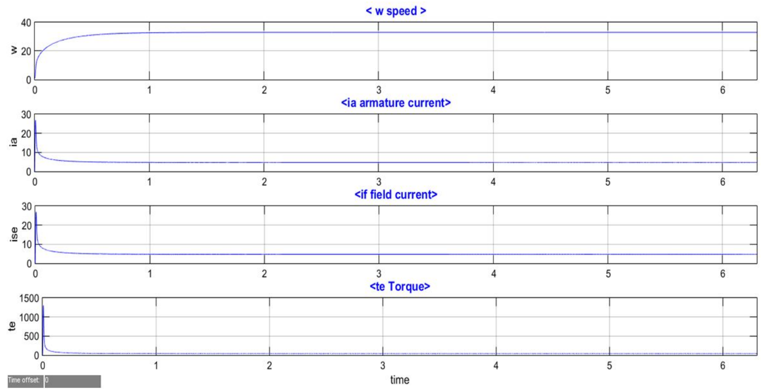
A. Simulink Model Of Wireless Coils



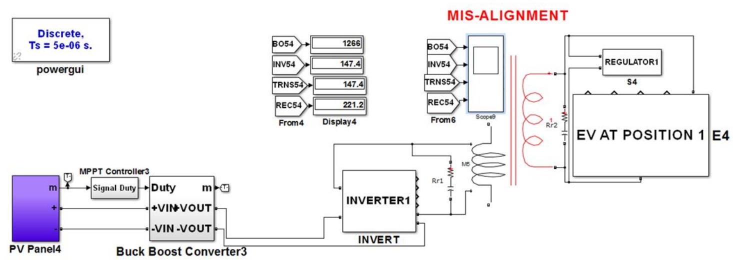
IV. DWC SYSTEM SIMULINK MODELS AND RESULTS

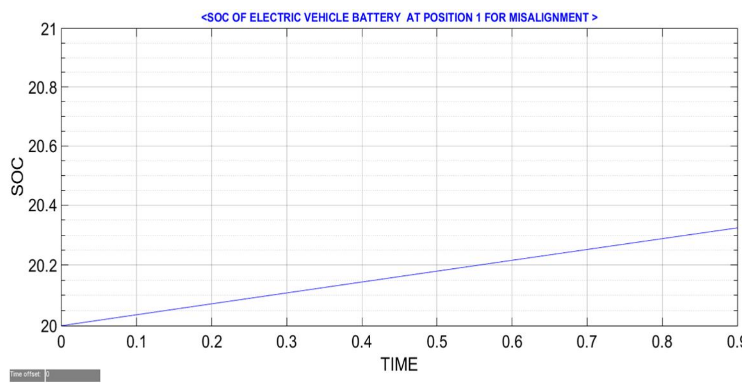
A. Dc Series Motor Simulink Model &Graphs





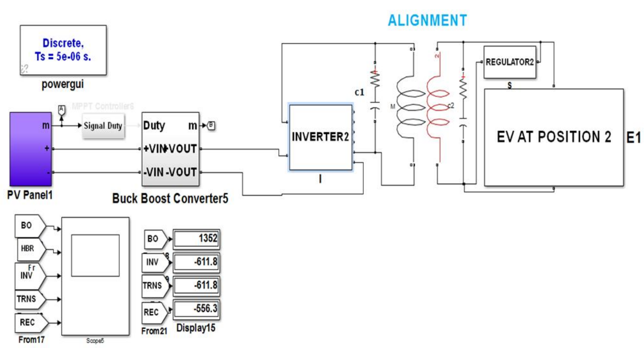
DWC of EV at position 1 from 0to1.9sec time range & SOC of battery at position1.





Simulated graph shown above shows the state of charge (SOC) OF EV Battery at position 1.Initial SOC of battery is 20%, under DWC system at position 1 for Mis Alignment condition of coils EV Battery charges from 20 to 20.32 within the time range 0 to 9seonds.

B. DWC of EV at position 2 from0.9 to 2sec time range & SOC of battery at position 2



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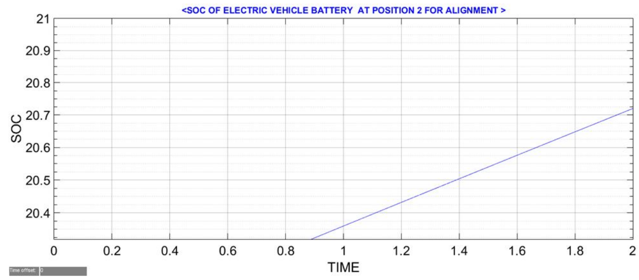
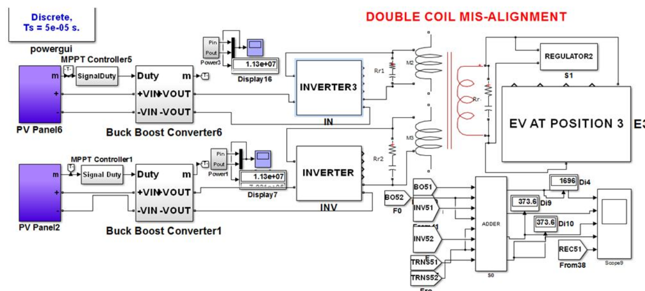
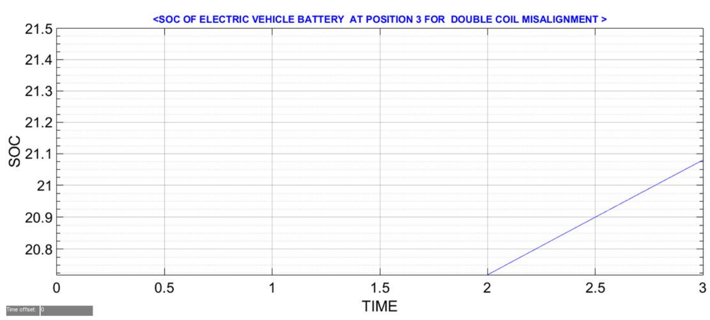


Simulated graph shown above shows the state of charge (SOC) OF EV Battery at position 2.Initial SOC of battery is 20.32%, under DWC system at position 2 for Alignment condition of coils EV Battery charges from 20.32 to 20.72 within the time range 0.9 to 2.0seconds.

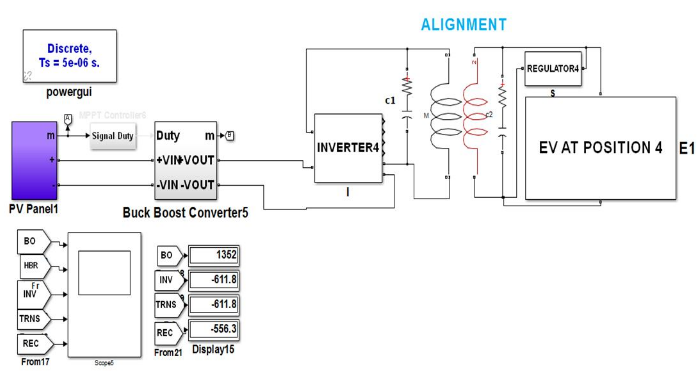
C. DWC of EV at position 3 from 2 to 3sec time range & SOC of battery at position 3

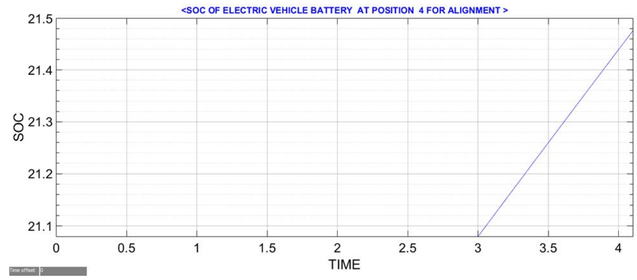




Simulated graph shown above shows the state of charge (SOC) OF EV Battery at position 3.Initial SOC of battery is 20.72%under DWC system at position 3 for Double Coil MisAlignment condition of coils EV Battery charges from 20.72 to 21.08within the time range 2.0 to 3.0seconds.

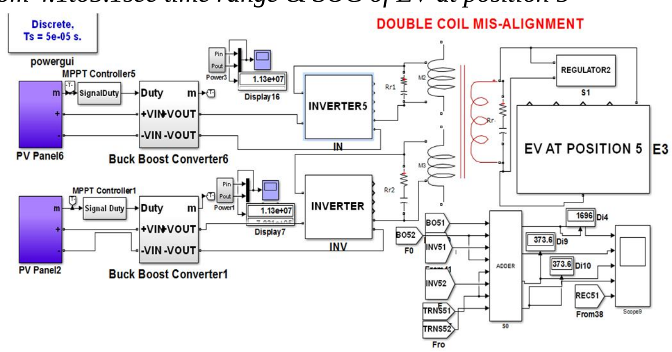
D. DWC of EV at position 4 from 3to4.1sec time range & SOC of EV at position 4.

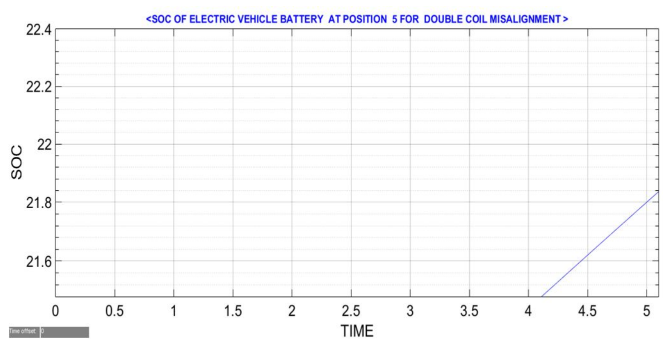




Simulated graph shown above shows the state of charge (SOC) OF EV Battery at position 4.Initial SOC of battery is 21.08%, under DWC system at position 4 for-Alignment condition of coils EV Battery charges from 21.08 to 21.48 within the time range 3.0 to 4.1seconds.

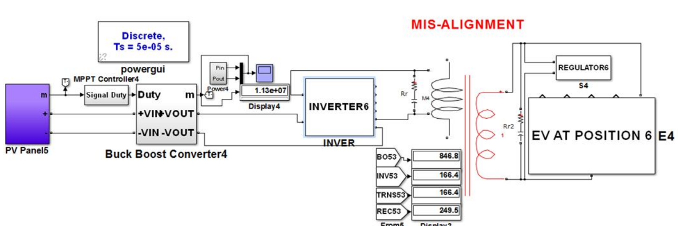
E. DWC of EV at position 5 from 4.1to5.1sec time range & SOC of EV at position 5

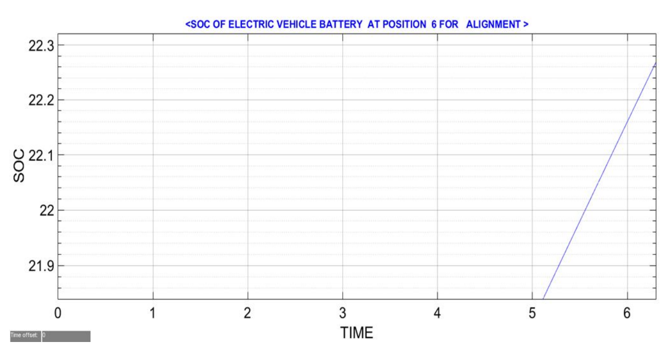




Simulated graph shown above shows the state of charge (SOC) OF EV Battery at position 5.Initial SOC of battery is 21.48%, under DWC system at position 5 for Double Coil MisAlignment condition of coils EV Battery charges from 21.48 to 21.84 within the time range 4.1 to 5.1seconds.

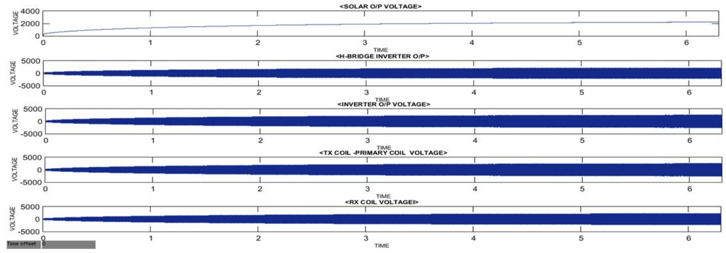
F. DWC of EV at position6 from 5.1to6.3sec time range & SOC of EV at position 6.





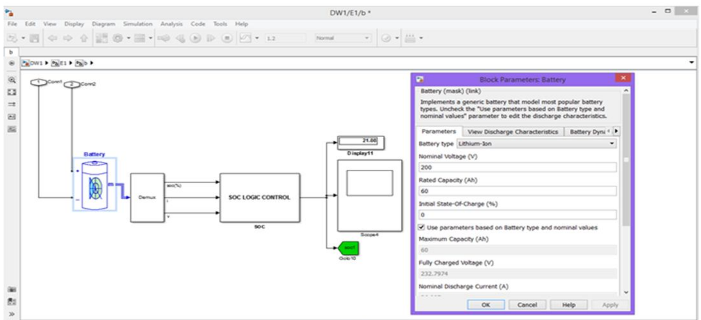
Simulated graph shown above shows the state of charge (SOC) OF EV Battery at position 6. Initial SOC of battery is 21.84%, under DWC system at position 6 for MisAlignment condition of coils EV Battery charges from 21.84 to 22.27 within the time range 5.1 to 6.3seconds

G. Dynamic Wireless Charging Results With High Frequency



DWC system is simulated for 6.3sec solar panel with Boost converter, H-bridge inverter, Resonant inverter, Transmitter **and** Receiver coils output voltages are shown above at 23 kHz frequency.

H. Simulink Model Of Battery



IV. CONCLUSION

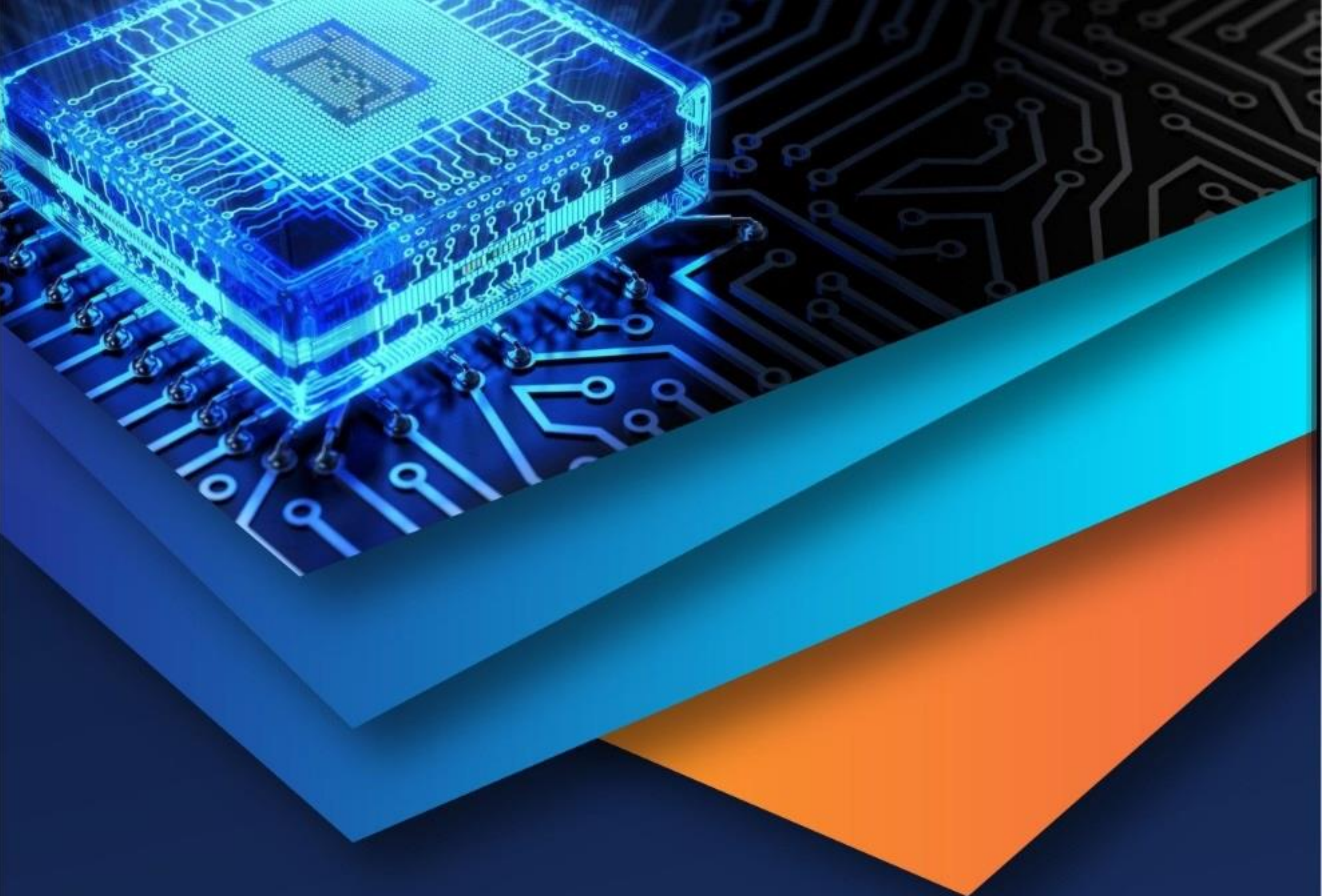
Dynamic Wireless Charging of Electric Vehicle approach revolutionizes the changes in Electric Vehicle Industry. Dynamic Wireless Charging of Electric Vehicle reduces the cost and size of the battery, thereby reducing the cost of electric vehicle. Simulation of Dynamic wireless charging system with transmitter and receiver coils at an air gap of 27cm at 23KHZ frequency with K=0.9 coefficient of coupling and efficiency of 93.4% have been achieved. Simulink models High frequency 23 kHz resonant inverter and solar panel with Boost converter are developed at transmitter end. Simulink models of rectifier with filter and traction motor have been developed at receiver coil end. Simulation results of state of charge (SOC) of electric vehicle battery at different alignment and mis-alignment positions of coils have been achieved. The Electric vehicle batteries which use to take 2-3hrs to charge up to the rated value will be charged with in 40min as their battery capacity is reduced. With reduced new battery capacity using dynamic wireless charging system electric vehicles can be charged under motion.

REFERENCES

[1] Georg Erdmann, Jürgen Kluge, Philipp Radtke and H. Wallentowitz,"DRIVE-The Future of Automotive Power," McKinsey & Company, Inc, 2006.
[2] Electrification Roadmap, Electrification Coalition, 2009
[3] I. S. Suh, "Application of SMFIR Technology to Future UrbanTransportation," In 21st CIRP Design Conference, Daejeon, Korea, 2011
[4] N. P. Suh, D. H. Cho and C. T. Rim, "Design of On-Line Electric Vehicle,"In Plenary Presentation at 20th CIRP Design Conference, Nantes, France, 201
[5] N. Tesla, "Art of transmitting electrical energy through natural medium," U.S Patent 1119732, 18 Apr. 1905
[6] N. Tesla, "Apparatus for transmitting electrical energy," U.S. Patent 1119732, 1 Dec. 1914
[7] Wireless Power: Current Status and Future Directions, Fuji-Keizai USA Inc., Oct. 2010
[8] Wireless Power Transfer Technology Workshop Proceedings, Korea Institute of Electrical Engineers, 2011
[9] Y. Hori and Y. Yokoi, Wireless Power Transfer and Infrastructure

HIGHLIGHTS

Dynamic wireless charging will be activated when the state of charge of electric vehicle battery is SOC<=20,when the SOC>=80 the electric vehicle battery supplies power to motor and operates under discharging mode.



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