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A STUDY ON NOVEL TECHNICAL APPROACH FOR ELECTRIC-DRIVE-RECONSTRUCTED ON BOARD CONVERTER (EDROC) BASED ON SWITCHING NETWORK

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Abstract
A proof-of-concept prototype has been built to verify the charging function and driving function of the proposed EDROC.The system can utilize the existing hardware of electric vehicles and does not need extra equipment. Compared with traditional EDROC, the proposed novel EDROC has advantages in cost and volume. Proposed EDROC can realize the unity power factor in the charging mode and discharges to drive the motor in the driving mode.

Keywords:EDROC, VEHICLES.

Introduction: Charging system is an important part of the electric drive, which contains two stages bi-directional converters. Usually, Plug-In Electric Vehicles(PEV) consists of charging system and drive system, independently. The system has large size and high cost. ***New Electric-Drive-Reconstructed Onboard Converter (EDROC) has been proposed to reduce the size and increase the power density by integrating the drive system and charging system and is reconstructed by a switching network.*** Converter can operate in drive mode or charging mode, independently. Meanwhile, EDROC can be classified as three types based on the number of converters: the composite converter system, double-stage converter system, and the single-stage converter system.

EDROC has been proposed with a split-winding AC motor. In the charging mode, motor winding and 3 H-bridge inverters are reconfigured as two 3-phase boost converters sharing a DC bus. The AC power supply connected to the middle point of the stator winding. In the driving mode, the motor work as a three-phase motor; In the charging mode, the motor work as a transformer.

Literature Survey
Jang-Mok, K. and Seung-Ki, S. in 1997, proposed a novel flux-weakening scheme for an Interior Permanent Magnet Synchronous Motor (IPMSM). It was implemented based on the output of the synchronous PI current regulator reference voltage to PWM inverter. The on-set of flux weakening and the level of the flux were adjusted inherently by the outer voltage regulation loop to prevent the saturation of the current regulator. Attractive features of this flux weakening scheme included no dependency on the machine parameters, the guarantee of current regulation at any operating condition, and smooth and fast transition into and out of the flux weakening mode.

Bose, B. K., in 2001 , presented different types of synchronous motors and compared them to induction motors. The modeling of PM motor was derived from the model of salient pole synchronous motor. All the equations were derived in synchronously rotating reference frame and was presented in the matrix form. The equivalent circuit was presented with damper windings and the permanent magnet was represented as a constant current source. Some discussions on vector control using voltage fed inverter were given.

Ong, C in 1998, explained the need for powerful computation tools to solve complex models of motor drives. Among the different simulation tools available for dynamic simulation he had chosen MATLAB/SIMULINK® as the platform for his book because of the short learning curve required to start using it, its wide distribution, and its general-purpose nature.

G.Venkataraman had developed a simulation for permanent magnet motors using MATLAB/Simulink. The motor was a 5 hp PM synchronous line start type. Its model included the damper windings required to start the motor and the mathematical model was derived in rotor reference frame.

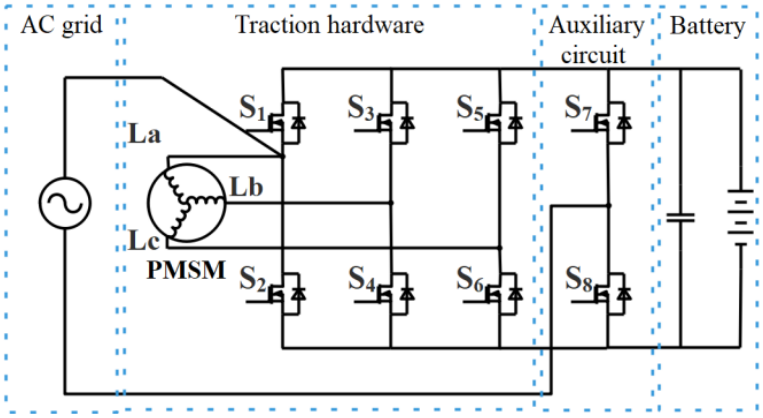
Objectives

1) To know the utilization of Conventional Motor of Plug-in Electric Vehicles(PEV) on Switching Network Board.
2) To offer suggestions for reconstruction by Switching Network board

Discussions and Results

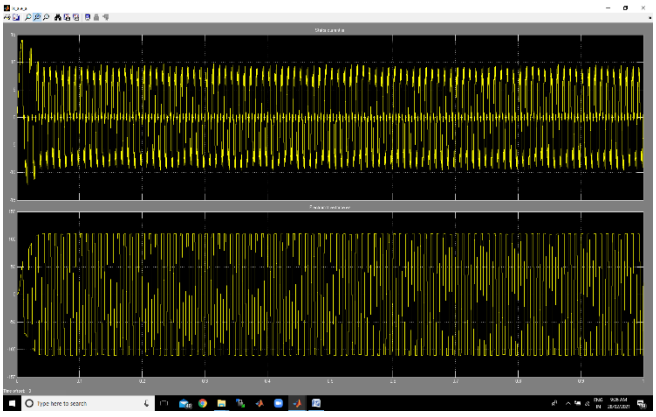
Proposed EDROC is realized by connecting an auxiliary circuit between battery and traction hardware Auxiliary circuit and inverter of traction hardware forms a switching network Proposed control method is applicable for any traction hardware with three-phase inverter No need of specially designed motor Uses a single-phase power supply without additional equipment.

Circuit



Topology of electric-drive-reconstructed converter

Simulation Results



From the simulation results, the max ratio of input current is σmax=1.6% and the THD is 3.86% for the proposed EDROC. The proposed EDROC has a good suppression effect on the ripple of the input current. Under the same conditions, the input current ripple of the proposed EDROC is equivalent to the scheme using a specially designed motor. Meanwhile, the proposed EDROC simplifies the structure of the existing EDROC.

Conclusion

A novel and simple electric-drive reconstructed onboard converter is proposed. The proposed converter utilizes the conventional motor of PEV and is reconstructed by a switching network. The proposed converter can directly utilize the socket power outlet at the office or home. The system can utilize the existing drive system without specially designed, and it has the advantages of simple structure and low cost. The performance of the propose EDROC is verified through simulation and experimental results.

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