Analysis of Electric Vehicle Performance in SRM Drives Using Fuzzy Logic

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Abstract: The electrical drive system is crucial to the drive performance and safety of electric vehicles (EVs). In contrast to the traditional two-wheeler driven EVs, the sensor less low-cost current controller in SRM drives for an electric vehicle application, can steer the vehicle by controlling the whole data speed of each wheel independently, yielding a very simple distributed derivation with high efficiency and reliability. Due to the lack of reducers, the direct-drive SRM needs to face more complex working conditions and design constraints. During the implementation, the requirements of the motor are taken through the practical EV driving cycles which are collected from the campus. Based on these requirements, two models are proposed as the preliminary designs for the SRM drives. The finite-element model and thermal network model are employed to verify the performance of the optimized SRM drives. An optimal design scheme is selected by comparing the comprehensive performance of the two optimized motors. In addition to that a duty-cycle model predictive current control is adopted to the drive motor. Finally, prototype has been developed and tested for their works.

Keywords: Switched Reluctance Motor, Pic, Convertor, Sensor less, Electric Vehicles, Drives, Fuzzy Logic.

I.INTRODUCTION

This chapter provides an overview of Switched Reluctance Motor (SRM) in EV, outlining its main advantages and drawbacks using Fuzzy Logic. The optimization method for a sensor less low-cost current controller method in an electric vehicle application for a campus patrol EV based on a practical driving cycle. An efficient multi-objective optimization method is employed to the motor to improve its performance considering different operational conditions. The aim of the first sensor less method is to detect the rotor position electronically in a simple way in order to minimize the implementation cost, while keeping reasonable performance of the drive itself. In other words, the method is able to estimate the rotor position in applications that do not require high "dynamic" performance. The second sensor less method detects the rotor position based on either current on flux linkage using an observer machine model. The aim of the method is to achieve high resolution of rotor position in order to maximize the performance of the drive regardless of cost, which means that robustness and high dynamic performance are of high priority. The principle of the switched reluctance motor was introduced many years ago, however, the boom in its development started around 25 years ago with the rapid growth of power electronics devices and microcontroller technologies. The SRM drive, as other motor technologies, has benefited enormously from advances over the years in solid-state switching devices, such as diodes and transistors. This has opened the window to control the SRM drive electronically and more efficiently. The development of SRM drive technology has seen significant progress over the past few decades, particularly with advancements in power electronic devices and microcontroller technologies. These advancements have facilitated electronic control of SRM drives, leading to improved efficiency and performance.

II.LITERATURE SURVEY

The Author says that the analysis of the quality of different adjustments in DC thyristor electric drives can made using 12- pulse convertors with parallel connection of valves [1]. By reducing the usage of fossil fuels, the electric vehicles will be the future of transportation to manage the increasing demand. To fulfil the high mileage demand and to reduce time fast charging is needed [2]. Power electronics technology is essential in this evolution and such that are quite mature and the systems designed should have high reliability which could be quite complicated in electrical perspective [3]. By the usage of vehicle and road operation the characteristics and the proportion of electric mileage vary [4]. Electric Vehicles connect with power grid analyses the structure of charging equipment and measures two aspects such that power grid side charging safety and equipment side charging safety [5]. This paper deals with the existing variants of propulsion systems on the market in order to find out relevant information about the characteristics of the electric vehicle [6]. This paper deals with the thermal characteristics of the electric vehicle to know the capability of the vehicle up to which it can withstand [7]. This paper notifies the sufficient torque for the motor to run efficiently without much losses [8]. This paper says the demand prediction model driven by driving track in rural areas and provides Particle Swarm Algorithm to find the optimal charging plan [9]. This paper deals with the sensor less control strategy of a fast EV battery charger based on the Voltage-type PWM [10]. Hence it is necessary to consider the ratings of the SRM motor, electrical drives, charging capacity of the battery and torque required.

III.PROPOSED CONCEPT

The existing system has many sensors to operate and monitor the vehicle which make the vehicle more complicated and thus increase the cost. To overcome these issues, a sensor less position control of 8/6 Switched Reluctance Machine used in drivetrain of an electric vehicle. The developed observer could be an excellent alternative to replace the analog position sensor, in case of high maintenance cost, limit lifecycle and safety-driving with a sensor default. The software position sensor based on Sliding Mode Observer consists of estimating the rotor position, the velocity and the torque of the SRM drive with a known and an unknown load torque. The main advantage of the developed observer is to estimate online the variables over all the velocity operation range using only the current and voltage measurements of each phase. However, the proposed observer is implemented in a simulator, where results confirm the reliability and the accuracy of the developed observer comparing to the real rotor position, velocity and machine torque. a new position sensor less control method for SRM is proposed. The new method is a combination of direct calculation method and flux observer method. Rotor position is firstly calculated by numerical method through the relationship among position, phase current and flux linkage. Then the motion of the SRM including acceleration is modelled and a phase locked loop (PLL) based on this model is designed to estimate the rotor according to the numerically calculated results. The dynamic response of this method is improved through the motion model and the impact of measurement noise and residual error could be reduced through parameter selection of the PLL. The Fuzzy Logic function is implemented in the PIC controller by coding. Here the triangular membership function is used for the three parameters such as current, torque and flux. The performance of the vehicle is improved by maintaining the current within a particular range. Thus, the vehicle can operate even with low battery.

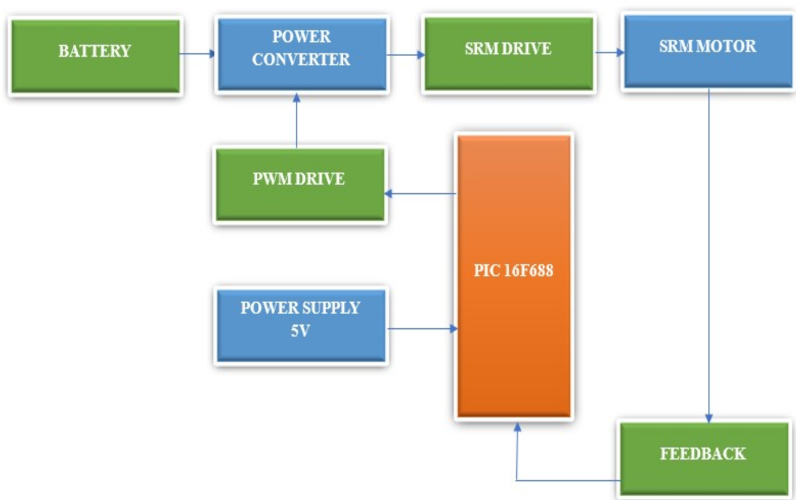

Figure 1. Block Diagram

IV.HARDWARE COMPONENT DESCRIPTION

SRM Motor

Switched Reluctance Motor transmits mechanical power from one place to another. It is here used to provide power the wheel of our electric vehicle, specifically the two wheelers. The output is obtained by rotating the chain which is used to lift or drag objects. By attaching shafts or hubs to the gear a second gear can be placed. We can also place more than two gears to move around places.

PIC Microcontroller

PIC Microcontroller is a Harvard architecture family originally from PIC1650. RAM, flash memory, Timers/Counters, EEPROM, I/O Ports, USART, CCP, SSP, Comparator, ADC, PSP, LCD are the main features of the PIC microcontroller. Here we implement the fuzzy logic technique in the pic controller in which the conditions are written.

MOSFET

Here we use the N channel MOSFET. This has been specifically designed to minimize capacitance and gate charge which is the series realized with ST Microelectronics. It is used as the primary switch in advanced high efficiency, high frequency isolated DC-DC converters. It is for applications with low gate drive requirements.

Battery

In every electric vehicle the battery is required for charging application. We use deep cycle batteries because they have larger plates and variety of chemistry to reduce the corrosive effect to intake the full capacity. The rated capacity of the battery is ampere-hour. The lead-acid battery will function at 80-90% efficiency if they maintained properly.

Figure 2. Analysis of Electric Vehicle performance in SRM drives using Fuzzy Logic

V.RESULT AND DISCUSSION

The expected results of implementing electric vehicle performance in SRM drives using fuzzy logic technique include improved efficiency about 20%, enhanced dynamic response, and better adaptability to varying operating conditions. It also increased the drive range about 5 cycles. Fuzzy logic control can lead to optimized torque management, reduced energy consumption, and potentially smoother acceleration, contributing to an overall enhanced performance of electric vehicles powered by SRM drives. Here the current, speed lies constant and there will be a good start of the vehicle as the SRM provides high initial torque. Additional potential outcomes of the project may include increased energy efficiency, reduced electromagnetic interference, and improved reliability in the electric vehicle system. Fuzzy logic control can also contribute to minimizing torque ripple, enhancing the overall driving experience, and addressing challenges associated with SRM drives, such as nonlinearities. The success of the project would be reflected in achieving these performance improvements while considering real-world factors and practical constraints. The output shows voltage and current, battery level needed for the vehicle to run.

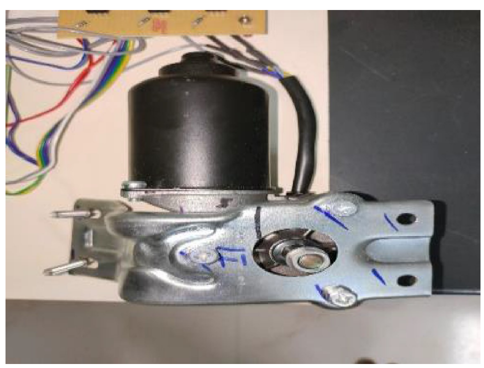

Figure 3. Snapshot of output (The motor is running)

S.NO	PARAMETER	EXISTING SYSTEM	PROPOSED SYSTEM
1	POWER SUPPLY	24V	12/5V
2	EFFICIENCY	80%	90%

VII.CONCLUSION

The design and implementation of electric vehicle performance in SRM drives using fuzzy logic technique hold promise for substantial advancements in efficiency, adaptability, and overall system performance. The utilization of fuzzy logic control can lead to optimized torque management, reduced energy consumption, improved reliability, and enhanced driving experience. The successful implementation of this project in anticipated to contribute positively to the ongoing evolution of electric vehicles, addressing challenges associated with SRM drives and fostering a more efficient and sustainable transportation paradigm. The anticipated outcomes include improved adaptability to varying conditions, reduced torque ripple, and enhanced driving experience. While success is contingent on thorough implementation and testing, the potential benefits could significantly contribute to advancing electric vehicle technology, making them more competitive, efficient, and environmentally sustainable in the rapidly evolving automotive landscape.

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