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Multilevel Inverter With Hybrid Source To Control Pmsm Motor For E Vehicle Application

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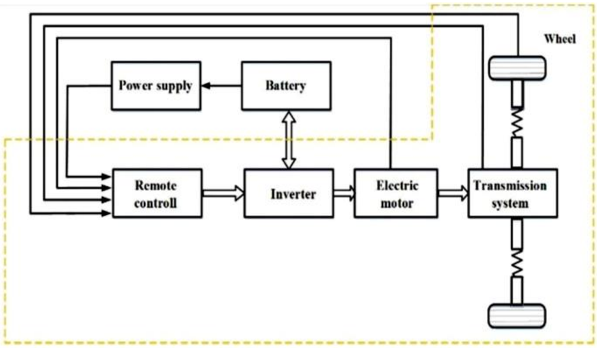
Abstract.
The Electric vehicles have been around for long time, but their use has grown enormously over the last few years. This paper presents the drive control of Permanent Magnet Synchronous Motor (PMSM) motor by using multilevel converter with hybrid sources for electric vehicle applications. In particular the torque mobilization of PMSM engine has been selected for the electric drive of electric vehicles. In addition to this our proposed technology we are used the H bridge multilevel converter for harmonic reduction and improve the quality of electric vehicle performance. The performance of permanent Magnet Synchronous motor will be analyzed and its characteristics have been analyzed with different conditions. The space vector modulation technique (SVMT) has been used the Hybrid Bridge (H bridge) multilevel converter to reduction of harmonics (THD) and improvement the efficiency of the PMSM motor. Finally, the results of simulation prove the correctness of the theoretical research.

Keywords: Electric Vehicle, Multi Level Inverter, Permanent Magnet Synchronous Motor, Space Vector Modulation Technique, Hybrid Bridge, Total Harmonics Distortion.

Introduction

Many pieces of industrial power equipment throughout the previous few years. High voltage and megawatt power levels are becoming more and more necessary for many medium voltage motor drives and utility applications. There are difficulties when connecting a single power semiconductor switch directly to a medium voltage grid. Therefore, one alternative for high power and medium voltage situations is the implementation of a multilayer power converter system. In addition to achieving high power ratings, a multilayer converter makes it possible to use renewable energy sources. For high power applications, a multilayer converter system can be easily interfaced with renewable energy sources including solar, wind, and fuel cells.

Multilayer converters are a notion that dates back to 1975. The three-level converter is where the term "multilevel" first appeared. There are a lot of different multilayer converter topologies available right now. Nonetheless, the basic idea behind a multilayer converter is to create a voltage waveform that looks like a staircase by mixing numerous power semiconductor switches with multiple lower voltage dc sources. Batteries, capacitors, and sustainable energy sources are a few examples of the various dc voltage sources. The rating of the DC



voltage sources that the power semiconductor switches are connected to determines their rated voltage in the only way. These several dc sources are combined by the power switches' commutation to produce a large voltage at the output.

Literature Review

Pham ThiGiang & Vo Thanh Ha in the journal of Engineering, Technology & Applied Science Research in 2022. The primary benefits of this work are the reduction of total harmonic distortion in permanent magnet synchronous machines and the application of SVM-based modulation approaches. This study used an electric automobile with a three-level T type inverter powered by a PMSM motor to improve torque response fast and precisely. The machine's efficiency was raised, and its qualities were assessed.

V. Naga Bhaskar Reddy and M. YerriVeeresh in the Engineering, Technology & Applied Science Research journal in 2022. A mathematical model is created and its simulation results are assessed for a vector controlled PMSM drive with PI and PID controllers used as an electric vehicle's propulsion system. The findings show that compared to the PID controller, the PI controller produces a more reliable tracking response to the command speed with reduced steady state error.

Existing System Block Diagram:

First off, electric motors are very controllable. This means that sophisticated control techniques can be used to regulate the motor, which enhances the car's kinematics. Therefore, a lot of scientists and automakers have always given thought to the problem of choosing the engine that is most suited for an electric vehicle gearbox.

Second, to power the motor, the inverter transforms the battery's DC voltage into an AC voltage. As a virtual device, the inverter helps to guarantee the necessary parameters by enhancing the gearbox quality. When it comes to lowering Total Harmonic Distortion (THD), a multi-level inverter outperforms a two-level inverter. The 2-level inverters have a THD of 11.39%, whereas the 3-phase current has a regular sinusoidal shape with a THD of 7.53%. A DC voltage source, semiconductor valves, and wavelengths as the output voltage are further components of the multi-level inverter. Therefore, the output voltage of a multi-level inverter can be made sinusoidal with low THD by adding more voltage levels. This study used an electric automobile with a three-level T type inverter powered by a PMSM motor to improve torque response fast and precisely.

Advancedb Locks Diagram
Modulationtechniques

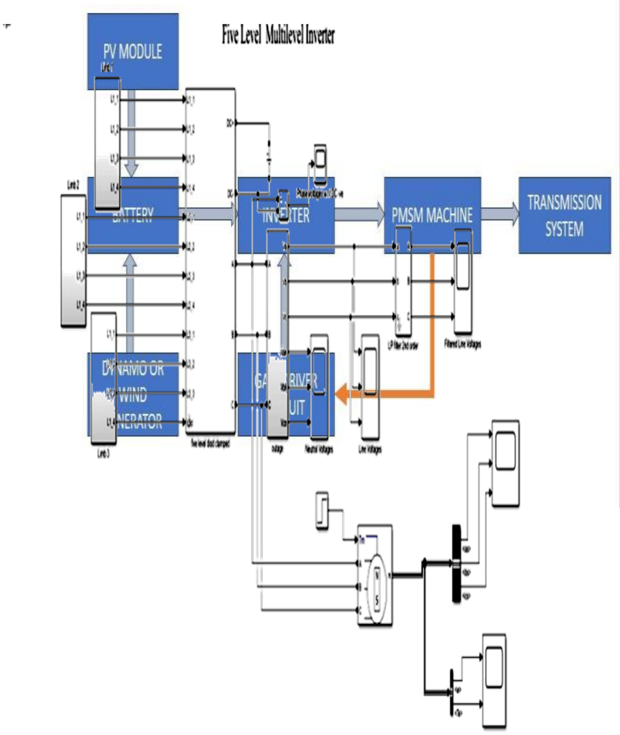
The basic techniques of pulse-width modulation (PWM) are covered in this chapter. The voltage-source and current-regulated approaches are the two categories into which the methodologies are separated. Since directed currents are nearly always created by higher-level controls (vector control, reactive power control, active rectifier, etc.), one advantage of current-regulated technologies is that they require direct current control. Nevertheless, current controllers are usually reliant on event scheduling because they are analogue implementations that are frequently only dependable at a specific power level. Although several discrete current-regulated techniques are included here, voltage-source techniques provide better harmonic performance owing to their inherent characteristics. Moreover, using a programmable logic device (PLD) or digital signal processor (DSP) makes using voltage-source techniques easier.

Redundant Stateselection

It was mentioned in earlier chapters that some inverter switching states are redundant since the same output voltages may be obtained in several combinations. As a result, there is no unique inverter switching, and this redundancy may be used to accomplish specific objectives. Possible objectives for redundant state selection (RSS) include

• Voltage balancing of capacitors
• Sharing of reactor current
• Control of DC source current
• Turning off frequency decrease

It's also critical to note that there are two different kinds of redundancy. Changing the



common-mode voltage, or raising or lowering the voltage level of all three phases, is what joint phase RSS entails. This was shown during the voltage vector discussion in the first part. The voltage vector graphic, which shows voltage vectors produced from numerous permutations of switching states, makes the combined phase RSS easily evident. For each set of switching states, (3.10) yields the number of redundant states that make advantage of joint-phase redundancy. Certain inverter topologies with redundant switching states within each phase are referred described as having per-phase redundancy. The flying capacitor architecture, in which many transistor switching configurations result in the same line-to-ground voltage, is an illustration of this.

Results And Discussion:

Simulation Diagram:

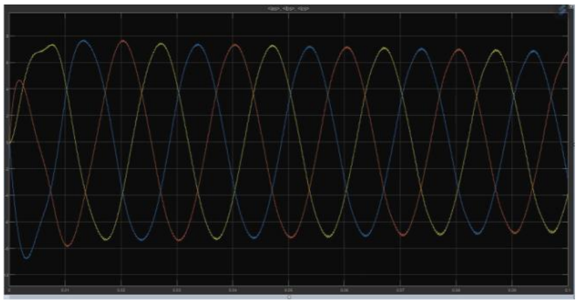


Fig: Faulted PMSM

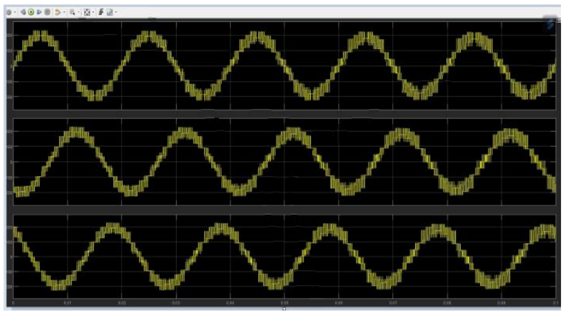


Fig: Single-Phase PMSM Control (Speed and torque) and monitoring the motor speed and torque during numerous power friction

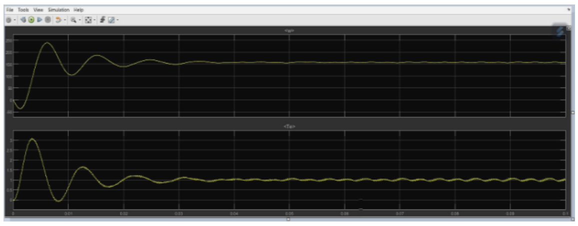


Fig: Single-Phase PMSM Control (Speed torque and current) monitoring the motor speed and torque during numerous power friction during transmission

Future Scope

The adoption of Permanent Magnet Synchronous Motors (PMSMs) in Electric Vehicles (EVs) has marked a significant turning point in the development of automotive propulsion systems. Applications for PMSM-based EVs are numerous in the domains of economics, technology, and the environment. This article investigates the several aspects of this technology, looking at its promise for the future as well as its present state. When it comes to efficiency, PMSMs outperform conventional electric motors. Lower energy losses occur during power conversion because of the direct connection between the rotor and permanent magnets. Better performance results from this increased efficiency, giving electric cars more range and acceleration.

Complex power electronics systems and PMSMs are frequently coupled. Improvements in power electronics technology, such as gallium nitride (GaN) and silicon carbide (SiC), increase the electric powertrain's overall efficiency. This integration increases performance and prolongs the motor's life.

PMSMs are critical to meeting the power needs of numerous sensors and processing systems that are necessary for autonomous operation as autonomous driving technology advances. Because of their accuracy and dependability, PMSMs are a good option for the developing field of autonomous electric cars.

PMSM-based EVs fit into the larger pattern of linked and intelligent mobility. Sensors, communication technology, and sophisticated control systems may all be easily combined with these motors. Features like remote software upgrades, real-time monitoring, and predictive maintenance are made possible by this interaction.

Range anxiety is one of the main obstacles to the adoption of EVs. PMSMs optimise energy use, which helps to solve this problem. The goal of ongoing research and development is to improve these motors' energy density so that they can operate for longer periods of time without requiring a corresponding increase in battery size.

PMSM technology supports the worldwide movement towards environmentally friendly transportation. Developments in materials science and the use of permanent magnets help to create environmentally friendly propulsion systems. The environmental issues with old magnet technologies are addressed by the newer designs' decreased need on rare-earth elements.

The economic impact of PMSM-based EVs being widely used is significant. Innovation is encouraged, leading to the creation of jobs in R&D, production, and maintenance. Energy security and independence are further enhanced by the decrease in reliance on fossil fuels.

Conclusion

The three-level H-type Cascaded bridge inverter used in this work has a three-phase voltage and stator current response with minimal harmonic distortion thanks to the implementation and modeling of the SVM spatial voltage vector modulation. Additionally, active damping and torque controllers were developed. The actuator damping controller has been pushed using the same torque response form as the stator current. The actual torque follows closely behind the designed torque, which includes the oscillation. But since these controllers use a PI controller, over-throttling still affects the torque, stator current, and speed responses, and the timing set is slow. Future work will thus concentrate on enhancing the aforementioned responses in accordance with the specifications by integrating state variable observers like tyres and road surfaces and using nonlinear control techniques.

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