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# THREE PHASE SWITCHED RELUCTANCE MOTOR DRIVE WITH IMPROVEMENT IN TORQUE RIPPLE

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## I. INTRODUCTION

This paper presents the operation of a 6/4-pole configuration switched Reluctance Motor (SRM) drive with fixed turn-off angle control scheme. Dwell angle acting an important role in developing electromagnetic torque in SRM and responsible variable operation of the drive. However, this study judge the effect of decreased decay time for current waveby inserting resistance in Single phase drive circuit, so that give us a flexibility to tuning Dwell angle without developing negative torque, finally lead to reduction in the torque ripple. The following method is used to reduction torque ripple as shown below. Torque ripple are severe for many high performance applications. This method is very simple, inexpensive and effective control torque ripple control scheme are emphasized. To verify the proposed method simulations with MATLAB/Semolina have been performed.

Switched reluctance motor advantages over induction motors:

1. High efficiency - 80% efficiency.
2. Salient rotor and stator poles and rotor windings are absent.
3. Reduced operation and material costs
4. Fault tolerant operation

## II. CAUSES OF TORQUE RIPPLE PRODUCTON

The negative characteristics of SRM motors include it is difficult to control and it causes high torque ripple and higher noise level. The phase current commutation is responsible for the torque ripple**.**

Because SRM has salient poles, the torque ripple is more severe.

1. The negative characteristics of SRM motors include it is difficult to control and shaft is required the position sensors and it causes high torque ripple and higher noise level.
2. The phase current commutation is the main cause of the torque ripple.

## III. SRM SPECIFICATION

This paper presents simulation for 60-kW 6/4 SRM. Table, gives the specifications of Motor used for MATLAB simulation

| Parameter | Specification |
|---|---|
| Number of rotor poles | 4 |
| Number of Stator poles | 6 |
| Aligned Inductance | 24.6e-3 H |
| Unaligned Inductance | 0.68e-3 H |
| Maximum Current | 450 A |

**Table: Srm Specifications**

## IV. OBJECTIVES

In a three-phase switched reluctance motor (SRM) drive, voltage source DC is generally supplied by a circuit consisting of a bridge rectifier and capacitor connected to circuit as filter. The charging time of the capacitor is less from the ac source as capacity increases. The bridge rectifier produces variable current from the supply, which results in a torque ripple production. Theproposed method gives us flexibility to adjusting the overlap angle without producing negative torque;result in reduction in torque ripple.

## V. ADVANTAGES OF METHOD

1. SRM drive maintain high efficiency over wide speed and high load range because as there is no winding present on rotor. So Cu loss reduces.
2. Torque ripple production in SRM is disadvantage of this motor, but in this paper, torque ripple reduction technique used, which can solve this problem.

## VI. METHODOLOGY ADOPTED AND SYSTEM IMPLEMENTATION

To improve the Torque ripple reduction of SRM, some current overlap techniques have been presented. The proposed drive circuit adding resistance in the return path of asymmetric half bridge converter reduces variation in current wave, so that give us a flexibility to adjusting the overlap angle (dwell angle) without producing negative torque, finally lead to minimization in torque ripple.

Asymmetric Half Bridge Converter:

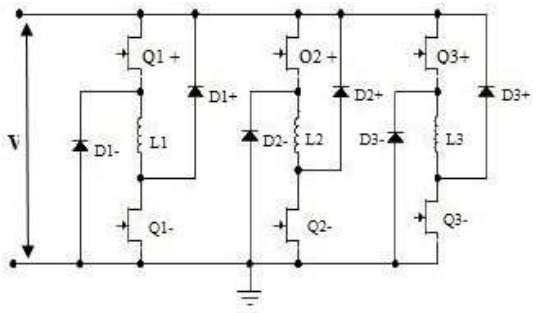


**Fig.1: Asymmetric Half Bridge Converter**

Fig.1 shows the Asymmetric Half Bridge Converter. Inthe asymmetric half bridge converter each phase of machine is connected to two power switches and two diodes.

By selecting from three possible states Phase current in asymmetrical half bridge converter is controlled:

1. Both switches$Q_{1+}$&$Q_{2-}$ in a phase are on, and phase is energized from power supply (magnetizing stage).
2. Both switches$Q_{1+}$&$Q_{2-}$ in a phase are off. Phase current commutates to the diodes and decays rapidly (demagnetizing stage).
3. When one switch in phase is off. Winding voltage is near zero and phase current decays slowly (freewheeling).

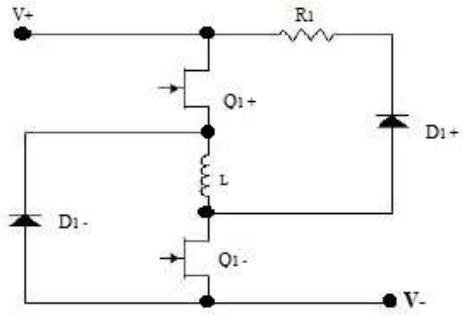


**Fig.2: Single Phase Drive Circuit**

In Fig.2 Asymmetric converter for SRM with freewheeling diode and adding control resistance regeneration capability.

Importance of asymmetric bridge converter is as follows:

1. Ideal for high performance current.
2. Allows greater smoothing in controlling machine current.
3. Good for Positive, Negative, and zero voltage output.

## VII. SIMULATION RESULT

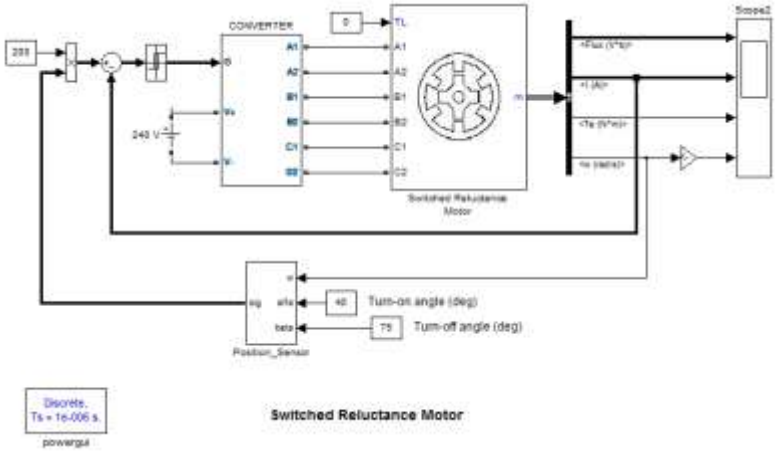


**Fig.3: Matlab Simulation Model**

MATLAB Simulated Result in SCOPE

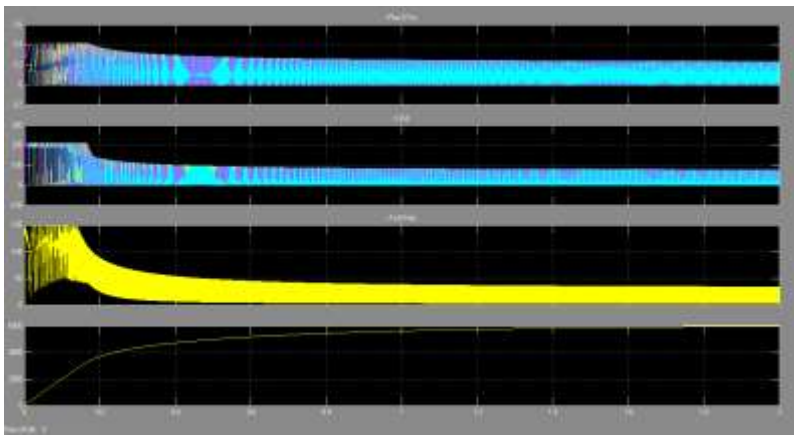

**Fig.4: Scope Result for 2 Sec**

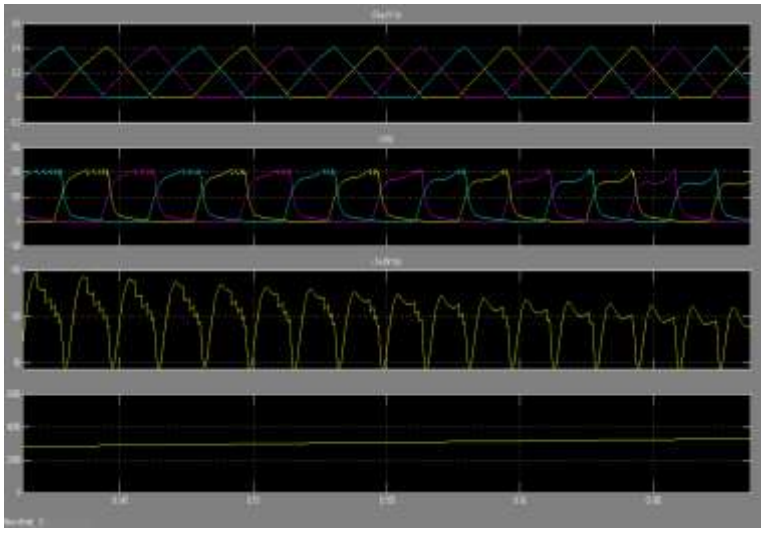

**Fig.5: Reduction in Torque Ripple**

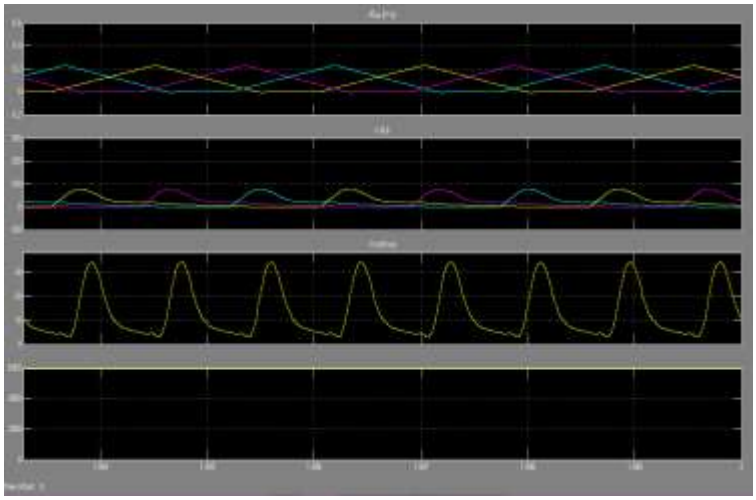

**Fig.6: Torque Ripple Reduces**

## VIII. MATHEMATICAL RESULT

By using maximum torque ripple formula,

$$\%TR = \frac{T_{peakmax} - T_{peakmin}}{T_{avg}}$$

| Method | Reference torque N.m | | |
|---|---|---|---|
| | Average | ΔT | Torque ripple% |
| Conventional | 30.20 | 68 | 2.25 |
| With additional resistor in driver | 30.33 | 68 | 2.24 |
| With resistor and change the on angle | 58 | 54 | 1.08 |

**Table VI.1: Simulation Result of Torque Ripple %**

## IX. CONCLUSION

Inthissynopsis As we see the motor will be in the steady state after (2 sec), in this simulation we can also control the firing angle as advance (in or off) for separately phase which they influence the all operation.

From equations and this simulation we can emphasis that the torque ripple in this motor depend upon more than one parameter (angle of firing ,form of current and flux) and these parameter internally depends upon each other's. From above method we conclude that our suggestion to improving torque ripple is effective easy and inexpensive and convenient at no-load and full-load. In many applications, it is highly desirable to have highest torque/ampere ratio and lower torque ripple.

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