Research Paper Engineering

Energy Efficient Converter for Switched Reluctance Motor

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ABSTRACT

Energy saving method is very important for manufacturing of motor industries. Since 65% of electrical energy is consumed by electrical motors. Hence in this present work describes a new methodology to increase the efficiency of Switched Reluctance Motor (SRM). A new control circuit has been designed to improve the performance and efficiency of SRM. Modified controller is used to explain the energy savings of SRM. This proposed method is better than existing method. This method is also used to reduce the switching losses of SRM. Hence the cost of the drive system is reduced. Stored energy in off-going phase winding is once again used. Hence consumption of electrical energy of motor is reduced

Keywords : SRM, Controller, Converter Energy saving.

1 Introduction

Selection of switched reluctance motor (SRM) is very important because it is a high speed home appliance motor like washing machine etc. Construction of SRM is simple and no winding in rotor [1]. The main disadvantages of an SRM is summarized as follows

- SRM is a salient pole rotor and hence wind age losses are high compare to other same diameter of smooth cylindrical rotor motor. [2]
- Switching losses are higher than other conventional motor.

Main aim of this work can be described below.

- To reduce the losses in core during demagnetization.
- To increase the efficiency of the SRM by reusing the energy in off-going phase winding.

2. SRM Converter

Switched reluctance motor (SRM) is not self operating motor. It is shown in Figure 1. It is operated with any one type of converter Selection of converter is very important for energy efficient operation. A main component for the converter is operating switches. Each and every winding is having separate switches at existing system. Many converters is described by several authors. It has been published [3]-[10]. Radial and axial air gap machine designs are explained in [5]. Barnes and Pollock introduced [11] asymmetric half bridge converter with voltage boosting circuit in selection of converter. M. Barnes and C Pollock [12] proposed the different types of converters. Design of converter is described by Chan [13]. Similarly numbers of converters are introduced for SRM. Analysis of C-dump converter is described by Souvik Ganguli [14]. Disadvantages of above converter is as follows

- Switching losses are high.
- Cost of the control circuit. is very high.

In this work is used to reduce the switching losses for increasing the efficiency of SRM.

3. Proposed Converter:

In this proposed method single pulse operation is takes place by single switch. It is shown in Figure 1. The operation of switch is depending upon the rotor position of the SRM. The components for the proposed converter method are D1, D2, D3, D4 diodes and dumped capacitors like Cd.

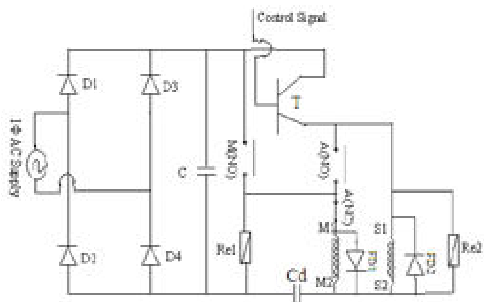

Figure 1 proposed converter circuit for SRM.

The stored energy in off-going phase winding is dumped into Cd. Hence the suppressing voltage present in off-going phase winding is once again reused in the system.

4. Mode of operation:

There are four kinds of modules may proposed for our new controller.

Module: 1

In this module the rotor position is aligned with stator winding. At this condition control signal is used to turn on Transistor T. As a result of this winding S1 S2 and relay coil 2 are energized. Hence the auxiliary contact of relay 2 is closed (Normally open to normally closed.) when relay coil is 1 is energized.

Module: 2

SRM rotor position is varied due to energized winding S1 and S2.ie, unaligned position to aligned position. From the movement of rotor position the switch T goes to OFF position. The first phase (S1, S2) winding is deenergized with relay 2. The stored energy in off-going phase winding (S1, S2) is transfer into Cd. The Second phase winding (M1, M2) is energized with auxiliary conductors of relay coils 1 and 2. The suppressing voltage in dumped capacitor is used to increase the supply voltage. Hence the speed of the switched reluctance motor is also maintained.

Module: 3
SRM rotor position is once again rotated due to energize winding S1, S2 .ie, and aligned position to unaligned position. From the movement of rotor position the transistor T is once again going to ON position. The same procedure is (Same as Module: 1) repeated. Once again the speed of the SRM is also maintained.

Module: 4
SRM rotor position is once again rotated to second position. The same procedure is repeated (same as Module: 2)

The Freewheeling Diodes FD1 and FD2 are connected in parallel with each winding at reverse direction. These diodes are helped to provide a smooth current to the load and also eliminate the negative voltage across the load.

5. Experimental Setup and Results:
The experimental results are obtained and tabulated in table 1. The efficiency of SRM for various turn-on and turn-off are tested. The results are shown in figure 2.

Table: 1 Torque-Efficiency Analysis of SRM

S.No	Torque in N-m	Efficiency in %
1.	0	0
2.	0.2	58
3.	0.4	56
4.	0.6	66
5.	0.8	70
6.	1.0	74
7.	1.2	78
8.	1.4	82
9.	1.6	80

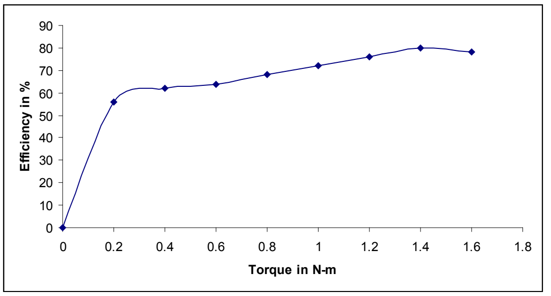

Figure: 2 Torque- Efficiency characteristics of SRM.

6. Conclusion:
A new proposed converter with single transistor is implemented for SRM. This proposed work is validated with experimental work. The existing work is having (n+1) switches for SRM operation. But in this method is having only one switch for operating the rotor of SRM. This proposed system is helps to reduce the losses. Hence the efficiency of the SRM is also improved with low cost.

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