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Speed control of switched reluctance motor using PI controller

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Abstract: SRM (Switched Reluctance Motor), now a day's take more attention. It is an electric motor which runs by reluctance torque. It is simple in construction and it is a double salient machine. Winding is wound only stator & there is no winding or no magnet in rotor. The motor is low in cost, reliable, high speed. This paper presents modelling, simulation and analysis of 6/4 switched reluctance motor & also presents open loop and closed loop simulation using MATLAB/SIMULATION toolbox.

Keyword: SRM, converter topology, pi controller Matlab/Simulink

I. Introduction

Switched reluctance motor [6,4] is one of the oldest electric motor. It is used in industrial application, the srm track in 1800's but the reinvention has been possible due to advent of inexpensive. High power switching devices. The srm is double salient motor. There is no winding & no magnet in rotor.srm have also drawback like generating torque and acoustic noise. When supply is apply to the stator than stator behave like electromagnets that's attracts the nearest rotor poles. The switched reluctance motor is basically a steeper motor and has had many applications as both rotary and linear stepper. Power transistors, GTO, IGBTs and MOSFETs have been developed in the power ranges for srm control.srm eliminate permanent magnets (PMs), brushes and commutators. The stator consists of steel laminations forming salient poles, a series of coil windings, independently connected in phase pairs, envelops the stator poles. With no rotor winding the rotor is basically a piece of steel shaped to form salient poles.

Switches	Characteristics	Applications
SCR	Has low switching speed.	Very high power application(>5 MW)
GTO	Switching speed is not very high.	High power application up to some MW
MOSFET	Low current rating up to some hundreds amperes.	Low to medium power application up to some KW
IGBT	High current rating up to 1 KA	Medium power

Where,

SCR- Silicon controlled rectifier.
GTO- Gate Turnoff Thyristor.
MOSFET- Metal Oxide Semiconductor Field Effect Transistor.
IGBT- Insulated Gate Bipolar Transistor

Here,
Switched reluctance motor [6] has used for high speed applications. it leads to high current flow in to the power converter thus they requires high current rating switches to control the current flow through the converter. From the above table. IGBT is more suitable for the SRM drive.

II. Operation of switched reluctance motor

In the figure, consider [1,2] that the rotor poles r1 and r1' and stator poles c and c' are aligned. Apply a current to phase a

with current direction. A flux is established through stator poles a and a' and rotor poles r2 and r2' which tends to pull the rotor poles. When they are aligned the stator current of phase a is turned off. now the stator winding b is excited pulling r1 and r1' toward b and b' and then winding c is exited.

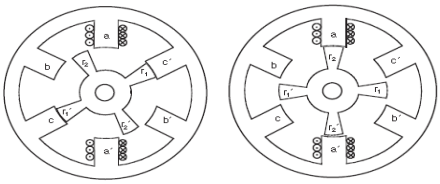


Figure1: Operation of switched reluctance motor

III. Asymmetric bridge converter

Asymmetric bridge converter [5] is most popular and gives best performance each phase branch consists of two discrete switching components and to freewheeling diode.

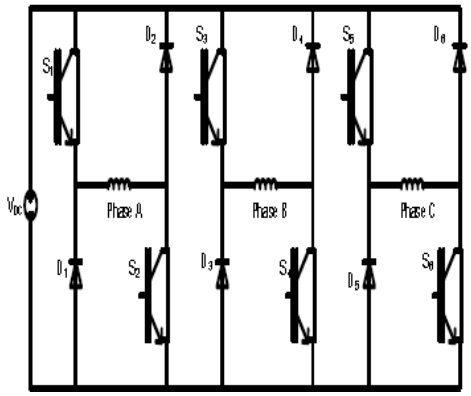


Figure2: Asymmetric bridge converter for 6/4 SRM

When fault is occur in one phase that is generally effects only that phase. The other phase can continue to operate indecently.

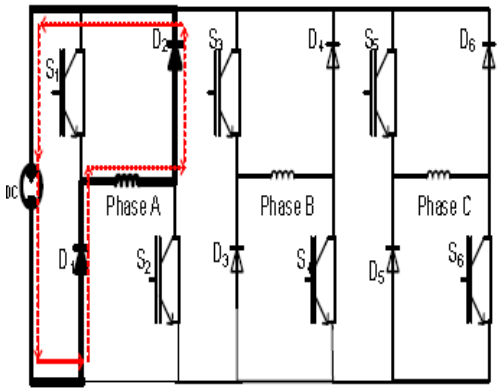


Figure3: Current flow when Phase A is Energized

When switches S1 and s2 are turned on the phase a is energized.

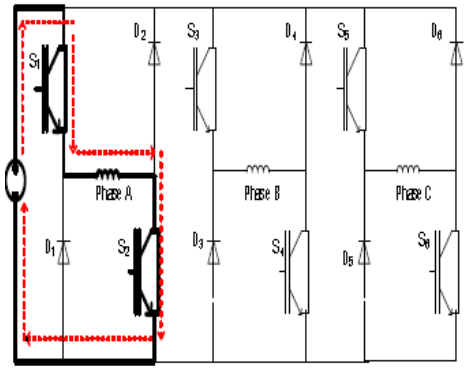


Figure4: Current flow when Phase a is denergized

When switches S1 and S2 are turned off, the diode d1 and d2 are forward biased & phase a is denergized.

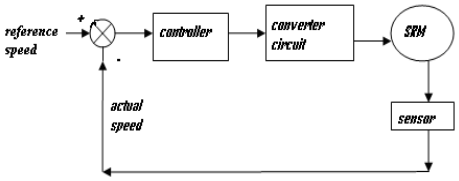


Figure.5: Block diagram of SRM speed control

IV. MATLAB/SIMULINK OF OPEN AND CLOSED LOOP

1) Open loop of srm drive

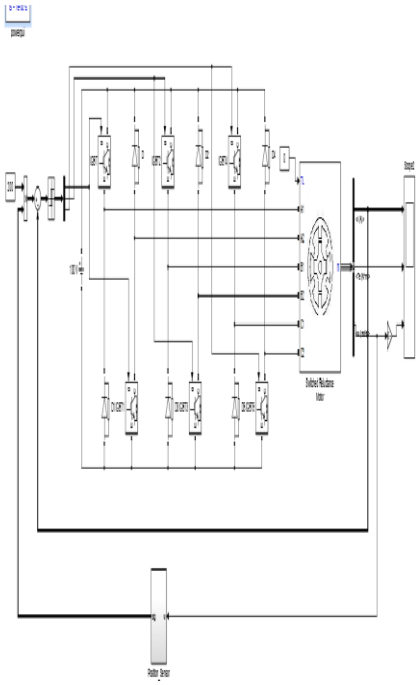


Figure 6:Matlab/Simulink of Open loop Simulation of srm drive system

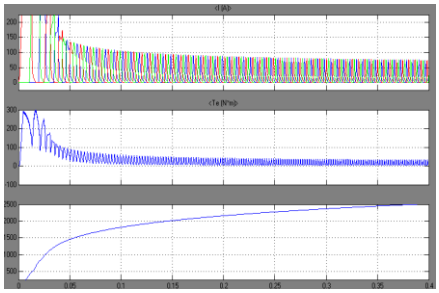
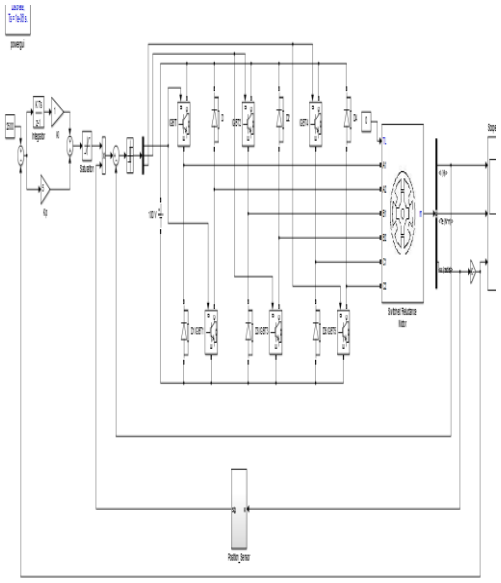


Figure7: current, torque and speed of srm drive system

2) Closed loop of srm drive



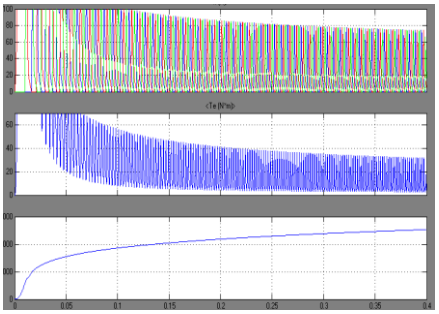


Figure8: current, torque and speed of srm drive system

Figure 8:Matlab/Simulink of closed loop Simulation of srm drive system

When,kp=5 and ki=1

When,Kp=0.8 and ki=0.4

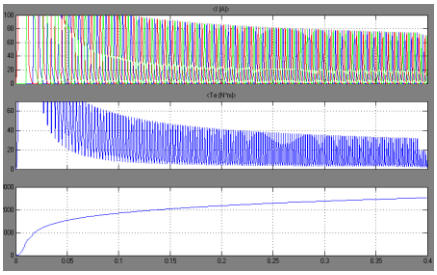


Figure9: current, torque and speed of srm drive system

TABLE FOR RISE TIME AND ERROR

	Kp=5 Ki=1	Kp=0.8 K i=0..4
Rise time tr	***0.34***	***0.33***
Delay time td	***0.03***	***0.03***
%error	***1.04%***	***0.72%***

From the above table, pi controller kp=0.8and ki=0.4 reach steady state compare to other value.

V. Conclusion

6/4 switched reluctance motor is drive by asymmetric bridge converter. And using trial and error method in closed loop PI controller is using with different value. .pi give better performance and eliminated error. it increased the speed using matlab/simulink tool.

VI. References

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