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Analysis of Inter-turn Fault in Stator Winding of PMSM Motor

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ABSTRACT: Permanent magnet synchronous motor are basically used where high speed speed is required. If we observe the last two last two the last two last two decades we find that this Motors are mostly used with the collaboration of Electronics components for a very different kind of applications, the applications are such as electric traction propulsion and electromechanical system. Here we do analysis of fault and this of fault and this diagnosis of fault can eventually improve system performance and its reliability. This paper mainly refers with the short circuit fault in the stator winding of permanent magnet synchronous motor. In this paper both that where the fault occurs that is its location and the impact of the impact of the fault that is fault severity are seen or diagnosed. here we see that by observing the different parameters of motor we simulate the motor performance under normal condition as well as faulty condition also while doing this we can also do analysis of the inter turn fault of stator winding.

KEYWORDS: Permanent Magnet Synchronous Motor (PMSM) , Stator winding short circuit fault, Fault Analysis

I. INTRODUCTION

PMSM is more reliable in applications with wide speed range because they are highly efficient and has wide constant power speed range. The PMSM based drives find great applications nowadays. The most common and frequent fault that occur in PMSM motor is the stator winding fault .On one hand there is stator winding short circuit fault and on the other hand there is open phase fault that occurs normally. Here the open circuit or phase fault occur because of stator winding short circuit so the major cause of fault is short circuit fault and it should be detected as soon as possible. The stator fault in three phase electrical machine may cause heavy inrush in three phase electrical machine may cause heavy inrush phase electrical machine may cause heavy inrush of current flow as it generates large amount of heat in the shorted turn or where the fault is occurred. Now the heat that created is relative to the square of circulating current so if this is not Limited the fault may result in complete motor failure. However in the worst case scenario the stator in turn fault affects fault affects safety and serious accident may occur which may involve loss of human life also resulting in abrupt shutdown of motor. The main purpose of this work is to detect the fault that is inter turn short circuit fault and know the severity of fault and it's diagnosis. Fig. 1 shows the layout of PMSM under inter turn fault.

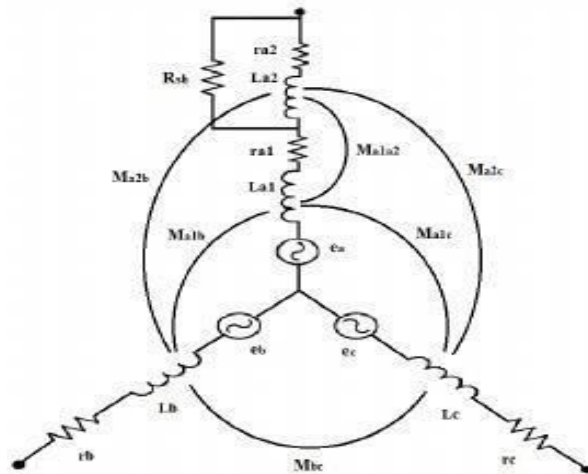


Fig. 1 PMSM under SC fault

II. LITERATURE REVIEW

The stator winding fault are one of the frequently occurring fault on interior permanent magnet motor. These damages results in the deterioration of stator winding and phase and also isolation of windings. Thus, fault will cause rise in the torque ripple of the motor this leads in deterioration of performance of the machine. However such stator turn fault can lead to rapid increase in circulating current inside the shorted path which causes tremendous heat and in worst situation of heat it causes faster degradation and eventually it will break the insulation of the winding in the phases of motor. Here the torque control approach for PMSM drive under the stator fault is Analyzed.

In this operation of the system carries without any degradation specially when we apply fault for a fraction of seconds. The torque control approach shows the ability of detecting and locating the fault.

III. OVERVIEW OF PMSM

The construction of PMSM is robust. It has high power density and inertia of the rotor is less. These are the Significance of PMSM motor. Usually the construction of PMSM's is such that they have embedded magnets on the rotor. Thus this location of these magnets have an effect on electrical and mechanical characteristics of the motor especially they have effect on motor inductances.

IV. SIMULATION OF PMSM BEFORE AND AFTER FAULT

Simulation of PMSM motor under actual inter turn fault condition is near about impossible because inter turn fault means the wire or copper wire inside the Immanuel coating gets in contact with each other. This kind of fault occurrence may lead to dangerous results. On the other hand the fault detection of synchronous motor and its diagnosis is very important owing to this severe fault effects. The first and foremost step in designing the fault detection system is to design a good, reliable and precise model which can simulate the machine behaviour in a complete manner. As we cannot create direct inter turn fault so here what we are doing is we are creating an artificial fault for a microsecond by applying a external high voltage by which we can determine the system behaviour under the faulty condition completely. So when the fault is created the system performance and the changes speed, torque waveforms are observed which is shown in fig. Before the fault creation and after fault both the waveforms are observed and the system response to the fault is calculated. In This we have done is, we have made two different models to know better operation of PMSM motor without fault and with short circuit fault. The following Fig.2 and Fig 3 shows the model before and after short circuit fault.

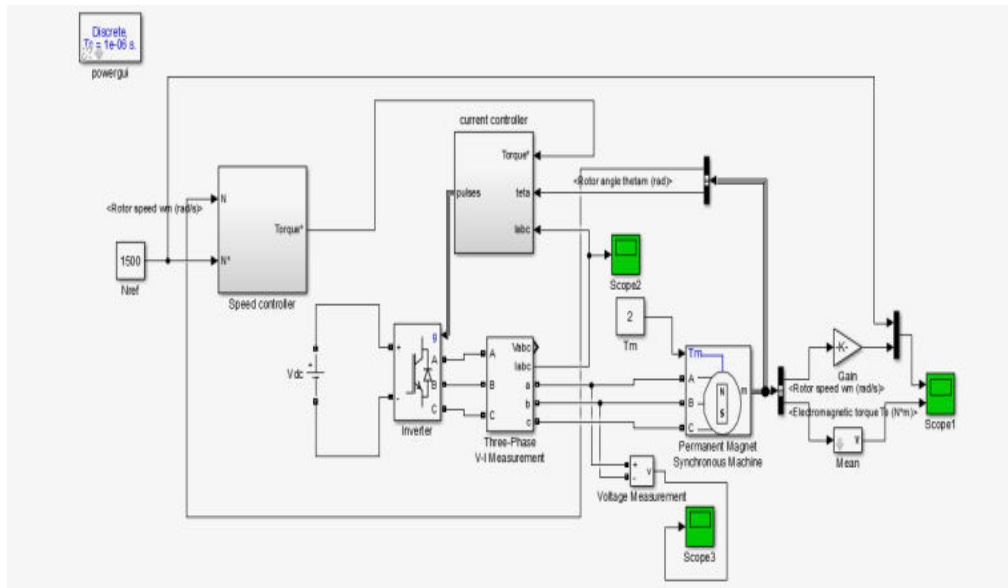


Fig. 2 Simulated model of PMSM before fault

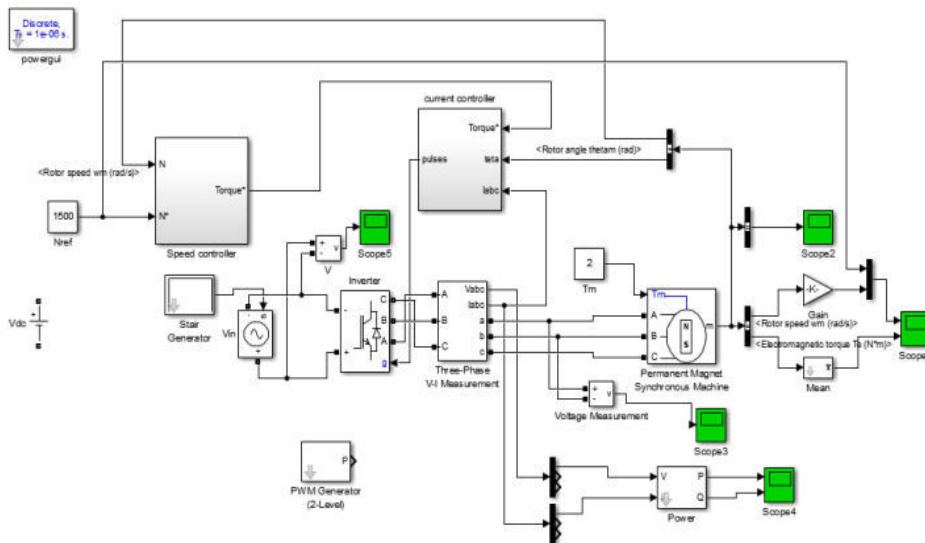


Fig. 3 Simulation model of PMSM after fault

V. ACTIVE AND REACTIVE POWER

In matlab by using active and reactive power calculator we can calculate active and reactive power The figure shows the simulink model of active and reactive power calculation. Fig. 4 shows the simu link diagram to calculate active and reactive power and Fig.5 shows its waveforms.

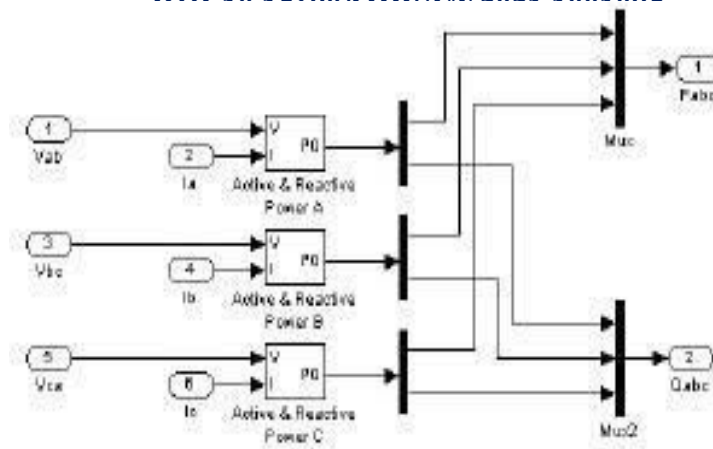


Fig. 4 Active and Reactive power calculation simulink model.

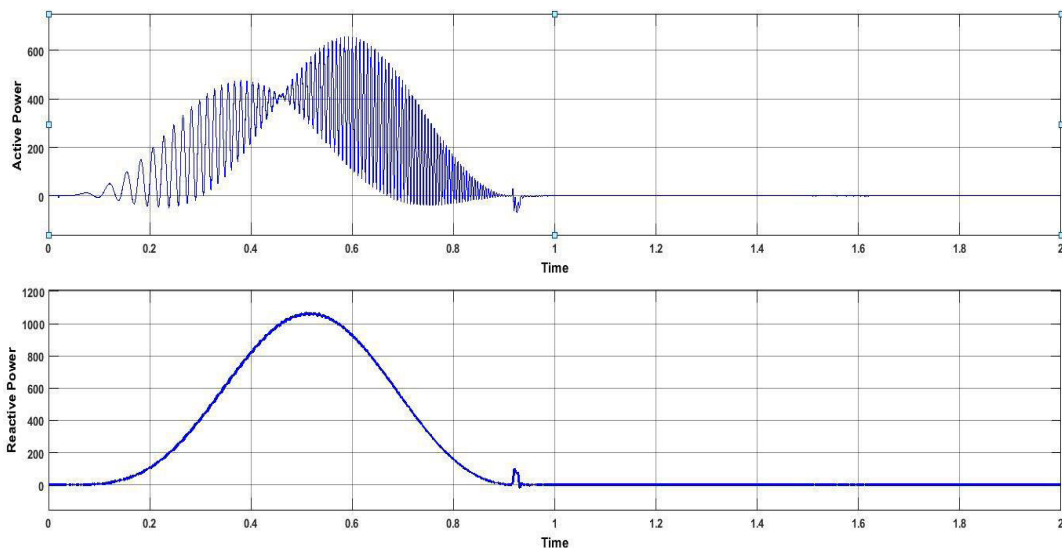


Fig. 5 Waveforms of Active and Reactive power.

VI. RESULT

So as a result in order to simulate the internet and stator winding fault of PMSM motor we have prepared a simulink model as shown in Fig.2 and Fig.3 by which we can create a fault for a microsecond or a second a second or a second and we can do the analysis on the basis of fault that we have created by applying the external high voltage to the motor. So after the simulation following results have been obtained as shown in Fig. 6 and Fig. 7 Where we can clearly see the system response under faulty condition. Now, here as we can see the results are before and after faulty condition. It is clearly seen that the fault which we have created for point one second has an major impact on stator winding currents also the simulink model for both the results are different. Fig.8 shows the torque speed characteristics. Fig. 9 shows the FFT analysis of our model in which total harmonic distortion is within limits which is below 10%.

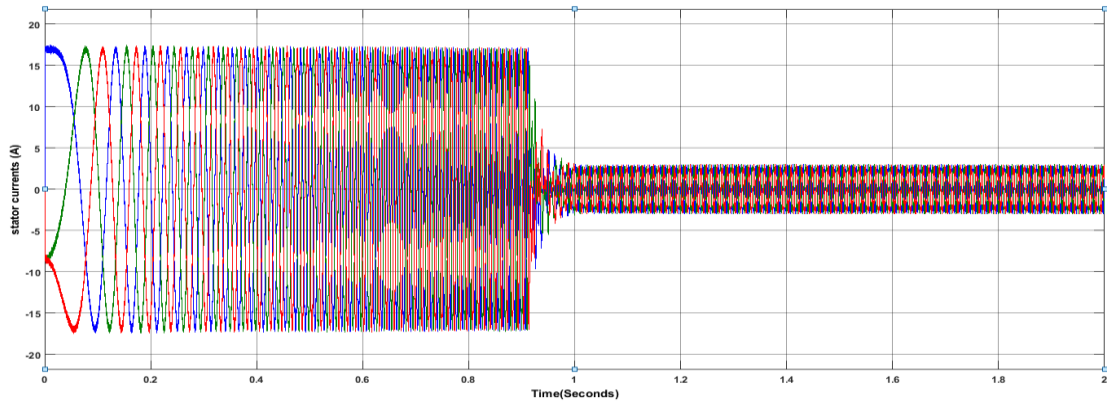


Fig. 6 Results of waveform before fault.

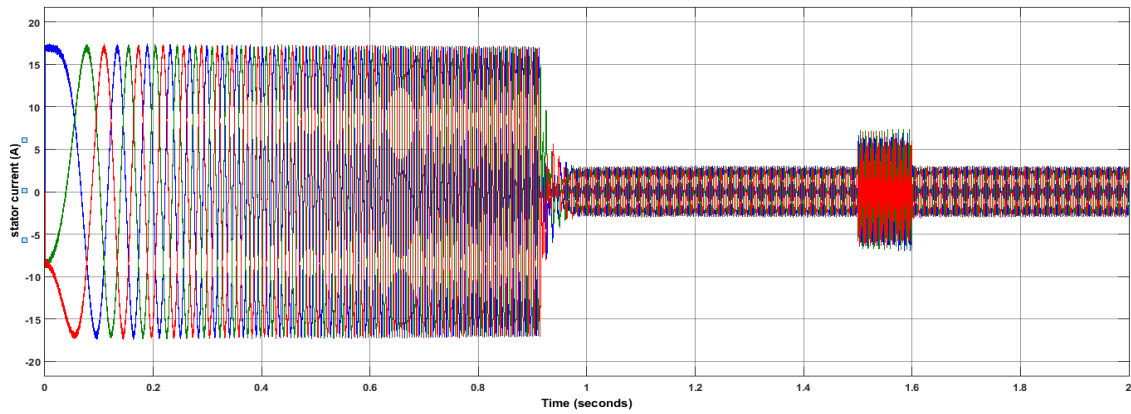


Fig. 7 Results of waveform after fault.

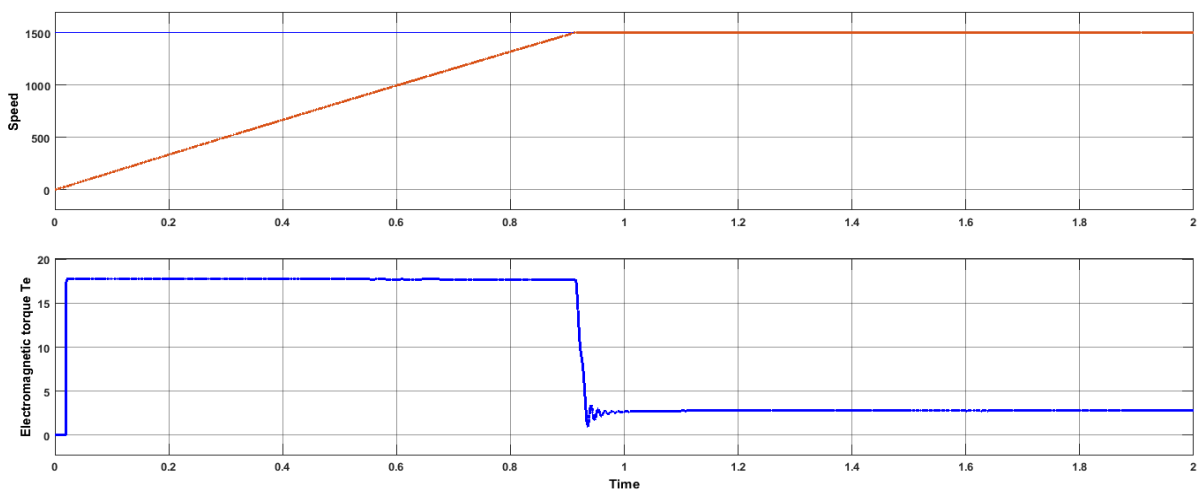


Fig. 8 Torque Speed characteristics.

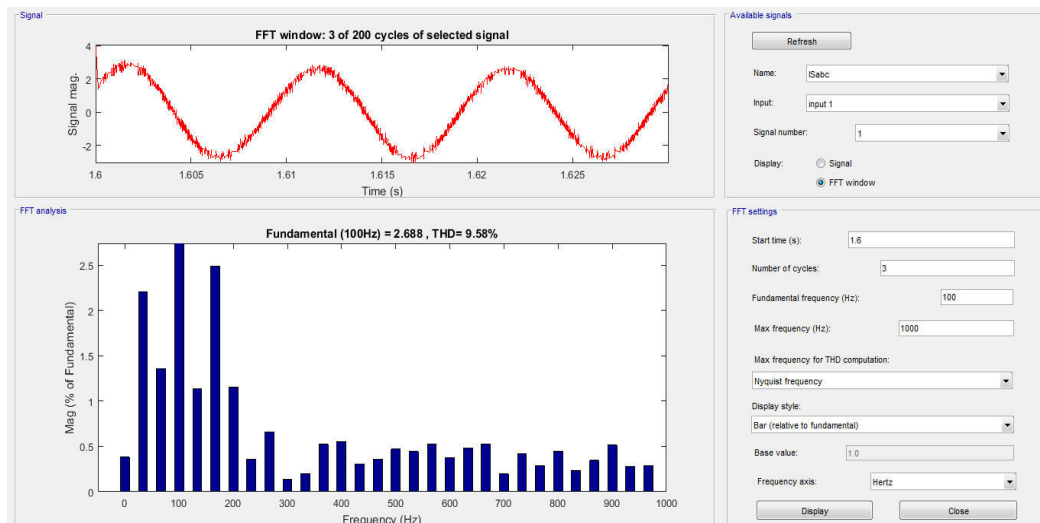


Fig. 9 FFT Analysis.

VII. CONCLUSION

In this paper the fault which occur very frequently on the stator winding of PMSM motor and also which is most severe i.e. Inter turn stator winding fault is diagnosed and the behaviour of this fault is seen by using simulink model both before fault condition and after fault condition. By using FFT analysis the behaviour of the whole system has been analysed.

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