Modeling, Simulation and a Comparative study between a Single-phase Switched Reluctance Machine (6x6) and a Three-phase Switched Reluctance Machine

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Abstract. The comparative study of electric machines has been in vogue due to the growing demand for electromechanical converters with maximum possible efficiency. In this scene, the switched reluctance machines have proven to be competitive. Comparative studies between these machines and the already established induction machines can be easily found in the scientific literature, but studies on various configurations of the switched reluctance machines are not as widespread. This paper shows the modeling, simulation and presents a comparative study of two Switched Reluctance Machines to a single phase (6x6) and three phase (6x4). Aspects of construction, drive and efficiency are discussed in order to find advantages and disadvantages to each of these machines.

Key words

Single phase Switched Reluctance Machine, Three phase Switched Reluctance Machine, comparison of efficiency.

1. Introduction

The interest in Switched Reluctance Machines (SRM) has getting a competitive market space. The industries are still in majority, induction machines; some synchronous machines that require a more rigorous maintenance due to the presence of brushes and rings; and fewer appear permanent magnet machines, losing competitiveness because of the high cost of magnets.

Several years ago, the obstacle to the interest in SRM was the high cost of power electronics, nowadays is not a problem due to the decrease in cost of microprocessors and semiconductor switches [1].

Because there are no windings, brushes and magnets on the rotor, the MRV in addition to having a simple structure and be more robust, have lower cost of manufacturing compared to other existing machines[1].Windings concentrated only in the stator, phases considered magnetically independent of one another, high torque per amp, high power density and high effiency are other advantages of this machines.

These advantages are leading more and more researchers to study on their application as electric motor cars, small domestic appliances, pumps, fans and others [2] [3] [4]. But there are also unfavorable characteristics for use as vibration and acoustic noise, yet several studies are already being taken to reduce these problems [5].

One study, not very rencent,[7] compares SRM with the indcuction machines.

The objective proposed in this paper is the comparasion of two SRM: a Single Phase Reluctance Motor (SPSRW) and a Three Phase Reluctance Motor (TPSRW). The comparative study was carried out through simulations and experimental results.

2. Structure of the machines

A Switched Reluctance Machine (SRM) is composed of a laminated structure of double salience, simple, in which the coils are restricted only to the stator teeth. Moreover, in the case of this work, each coil of a pair of teeth opposite of the stator are a phase, as shown in Fig.1

This figure shows a 6x4 SRW, in other words, a SRM with six stator poles and four poles in the rotor. Because each pair of poles in the stator form only one phase, this is a Three-Phase Switched Reluctance Machine to (TPSRM).

It also can be seen in Fig.1 the connection in series of coils of each pair of teeth opposite to form of mentioned phase. Thus, the current that runs through these coils is the same. Fig.1 shows the coils of only one phase, phase A, but this configuration is repeated for the other two phases. In this case, phase A is in its position of complete alignment, this position was chosen to be the reference in this work, ie, everytime the rotor is aligned with the stator at a certain phase, it is said that the rotor is in zero degree of that phase.

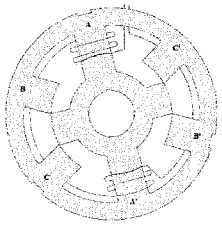

Fig.1 – Cross Section of a TPSRM, showing the winding of the phase A.

The Fig.2 shows a 6x6 SRM. As can be seen, what distinguishes the two machines studied is only the number of teeth on the rotor and its drives. Again, each pair of teeth opposite in the stator was connected in series, but the energization of all coils will be held at the same time, no delay between pulses, hence this configuration of SRM , where the number of teeth rotor is equal to the number of stator teeth, is called a Single-phase Switched Reluctance Machine (SPSRM). The polarity of the windings of the other teeth are also represented in Fig.2.