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Modelling, Simulation and Comparative Study between Switched Reluctance Generator 8x6 and Switched Reluctance Generator 12x8

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Abstract. This paper presents the modelling, simulation and comparative study between switched reluctance generator 8x6 and switched reluctance generator 12x8. During work, the structural properties of the rotor and stator laminates of these machines are exposed. This information was used to perform mathematical modelling for both topologies. Based on this modelling, a computer simulation model was developed in the Simulink/Matlab® environment where several tests were carried out. To ensure comparability between machines, the output power in both topologies was set to 735,5 VA. After analyzing the results obtained during the simulations, it was found that the topology of the switched reluctance generator 8x6 is more efficient than 12x8.

Keywords. Three-phase switched reluctance machine (12x8), Four phases switched reluctance (8x6), machine, simulation, comparative study.

1. Introduction

The Switched Reluctance Machine (SRM) is possibly the simplest. This is because it does not use brushes and permanent magnets, and it also requires less ferromagnetic materials and copper [1] [2]. In addition, it is a robust machine with better performance at a variable speed [3]. Switched reluctance machines are also versatile, due to the fact that they can be driven as a motor or as a generator with simple drive modifications.

With increasing concern about the conscious consumption of energy resources, there is a growing scientific research using SRM in electrical cars [4] [5] and wind turbines [6] [7]. The aim of this work is to perform a comparative study between the switched reluctance generator 8x6 (SRG 8x6) and switched reluctance generator 12x8 (SRG 12x8) through computer simulations. An important focus on one specific application of these machines, by having a variable speed regime, is the field of wind energy [8].

2. The Structure of a Switched Reluctance Machine

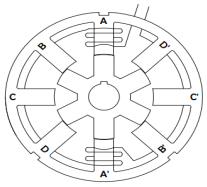

Fig. 1 Design of Switched Reluctance Generator 8x6

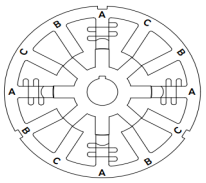

Fig. 2 Design of Switched Reluctance Generator 12x8

3. Mathematical Model

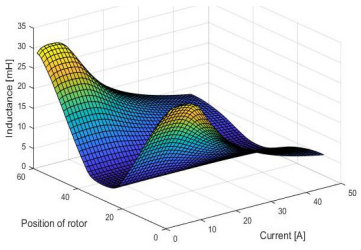

Fig. 3. The surface of a Self Inductance SRM 8x6

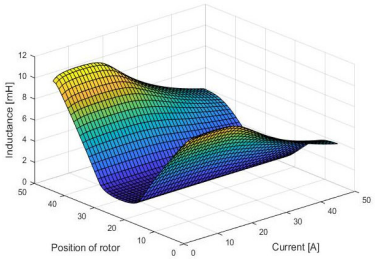

Fig. 4. The surface of a Self Inductance SRM 12/8

4. Simulations Results

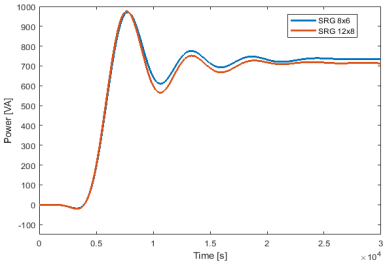

Fig. 5 Output power

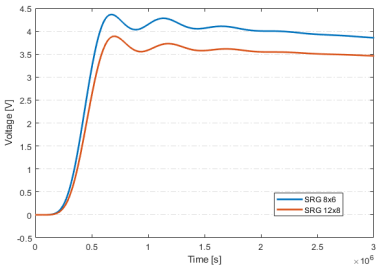

Fig. 6 Average voltage in phase A

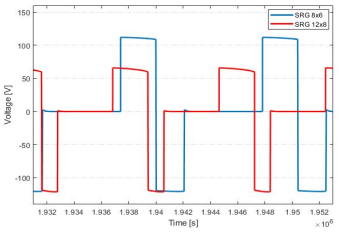

Fig. 7 Voltage in phase A

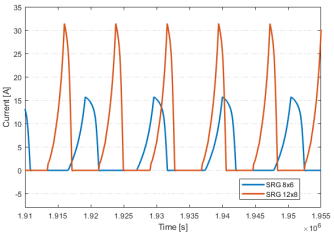

Fig 8. Current in phase A

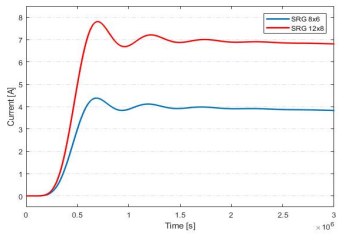

Fig. 9 Average current in phase A

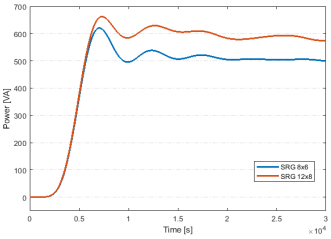

Fig. 10 Power in the source

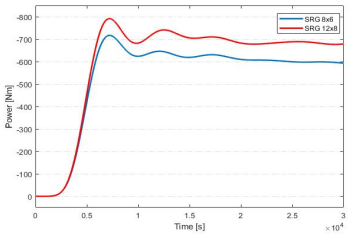

Fig. 11 Mechanical Power

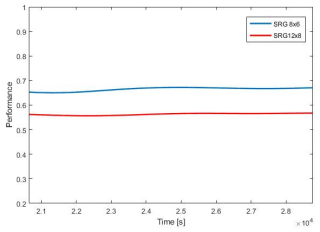

Fig 12. Performance

5. Conclusions

The experiments were conducted with several analyzes, such as the phase voltages and current in the coil, the power at the source and power at the load.

By the assessment of the results obtained with the simulations, it was found that the switched reluctance generator 12x8 needs more input power (source) and also more mechanical power to produce the same output power as the switched reluctance generator of 8x6.

It can be concluded that the switched reluctance generator 8x6 is more efficient with the same output power than the other topology (SRG 12x8). However, to drive this machine (SRG 8x6), it is necessary a converter with one more branch than in the SRG 12x8. Therefore, more IGBT and electronic components will be used.

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