University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Applied Science

of

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BE (College of Engineering Guindy, Anna University, 2012)

"Estimating the Magnetic Characteristics of A Salient Pole Synchronous Machine Using Ampere Turns Distribution Method"

Department of Electrical and Computer Engineering

Tuesday, July 28, 2015
2:30PM
Engineering Office Wing
Room 430

Supervisory Committee:
Dr. Subhasis Nandi, Department of Electrical and Computer Engineering, University of Victoria (Supervisor)
Dr. Nikitas J. Dimopoulos, Department of Electrical and Computer Engineering, UVic (Member)

External Examiner:
Dr. Andrew Rowe, Department of Mechanical Engineering, UVic

Chair of Oral Examination:
Dr. Hao Zhang, Peter B. Gustavson School of Business, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Modeling plays a very important role in a variety of applications such as performance analysis, characterization, fault diagnosis, condition monitoring and stress analysis of electrical machines. With the importance for the modeling of electrical machines increasing day by day, researchers are striving for better methods to solve the problem. One of the widely used techniques for modeling electrical machine is the finite element method. As the computational power continues to be less and less expensive, the finite element method is becoming a widely used technique for modeling of electrical machines because of its advantages in terms of accuracy and efficiency. Many commercial finite element software packages are now available for this purpose. One such software, the Ansys Maxwell is used extensively for the modeling of electrical machines. It is a top of the line finite element package used by many motor manufacturers for industrial motor design and performance analysis. Ansys Maxwell has features specifically such as field calculator and RMxprt which facilitates the modeling of electrical machines. One of the important parameter while modeling electrical machine is the magnetic characteristics of the core material. This plays a huge role in the performance characteristics and analysis of the electrical machines. This research work takes up this problem and comes with a simple yet effective solution to determine the average magnetic characteristics of a salient pole synchronous machine which uses a material for the rotor with unknown magnetic characteristics. Existing techniques available to determine the magnetic characteristics of a material are mainly Epstein and single sheet tester. These two tests require a separate sheet of material and they are destructive. Therefore a non-invasive and non-destructive technique had to be designed to solve this problem as the manufacturers could not provide the data for the magnetic material used in the rotor.

In this work, a FE model of the salient pole synchronous machine was developed to closely emulate the characteristics of the experimental machine. This FE model was first subjected to magnetostatic simulation under different field currents using a known magnetic material. By comparing the result with the experimental machine and by performing a technique named as ampere turn distribution technique, a new magnetic material characteristic was developed to follow the average characteristics of the rotor and the stator. Following the determination of the new material, this material was used in the simulation of the salient pole synchronous machine running as a motor and a generator under varying load condition and field currents. Then these results were compared with the real machine to determine the effectiveness of the developed scheme.