IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
Research Paper Journal Volume 10, Iss 08, 2021

EVALUATING AND RATING THE PERFORMANCE OF DSWIM USING ANSYS MAXWELL

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ABSTRACT: Induction motors are popular in the industrial and agricultural sectors due to their durable design, low cost of ownership, efficient operation, low maintenance requirements, and consistent performance under a variety of loading conditions. As a result, the researcher has a strong desire to improve performance to a higher extent. This idea suggests the use of two separate stator windings, each with a different number of poles, on a standard induction motor's shared cage rotor. The Finite Element Method (FEM) is used in this study to provide a thorough assessment of the Dual Stator Winding Induction Machine (DSWIM). ANSYS Maxwell and RMxprt are the software packages used for the design and analysis of DSWIM (Direct-Driven Synchronous Windings Induction Machine).The output of RMxprt is a complete design sheet that includes the machine's important parameters and performance indicators. The ANSYS Maxwell program can be used to evaluate electromagnetic properties such as flux charts and to generate three-dimensional and two-dimensional models. This design and simulation aid in correcting any inadequacies in the building or operation of the equipment prior to the probable occurrence of any negative impacts.

Index Terms: Dual stator winding Induction machine, DSWIM, FEM, ANSYS Maxwell, RMxprt, Flux plots, skew.

1. INTRODUCTION

The current study provides a thorough analysis and inspection of a dual stator winding induction machine. The machine's structure is identical to that of a standard cage rotor induction machine, with the exception of the presence of two stator windings within a single magnetic circuit. As a result, the system generates two distinct torques, which may then be modified to control the ultimate velocity. As a result, there is a greater degree of freedom in manipulating the torque-speed characteristics. There are two approaches to analyze the machine: one considers it to be two separate induction machines joined by a common shaft, while the other considers the DSIM motor to be a six-phase induction motor. The multi-speed machine is widely used and abused. The Maxwell 2D program is used to simulate the dual stator induction motor, while the RMxprt software is used to model the traditional induction machine, taking each stator winding into consideration.

2. DUAL STATOR INDUCTION MACHINE DRIVE

The recommended induction machine drive comprises of a die-cast cage rotor made of aluminum and a stator with two electrically isolated windings. Based on reference [1,] it has been demonstrated that winding stator windings in a pole ratio of 1:3 can effectively alleviate local saturation, decrease additional stator losses, and maximize magnetic material consumption. When the supply frequency varies, the two stator windings receive separate power inputs from two distinct variable frequency drives. Furthermore, in the case of a 50 Hz supply, these windings are linked to two independent auto transformers. The torque is created by combining the fluxes produced by the rotor, which is a typical die-cast squirrel cage rotor, and the stator windings.

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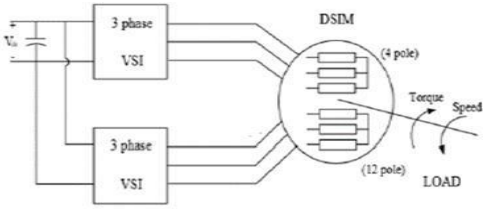

Fig.1 The user's response included the abbreviation "IDWIM."

The decoupling effect caused by the use of two stator windings wound for different numbers of poles enables the Dual Stator Winding Induction Machine (DSWIM) to operate as two separate conventional induction machines physically linked by a shaft. Several assumptions were made throughout the DSWIM study.The magnitude of the inter-bar rotor current is quite low. The stator windings are electrically separated and distributed sinusoidally. A consistent air gap surrounds the rotor. However, the saturation level is far too low.

3. RMXPRT AND MAXWELL 2D

When using the finite element method, one is confronted with an infinite number of Integro differential equations that must be solved. However, due to the non-linear properties inherent in their geometry, the use of finite element analysis (FEA) for the design and study of electrical machines becomes computationally complex. The use of sophisticated architecture and composite materials can be ascribed to the complex electromagnetic behavior observed in electrical equipment. As a result, the corresponding partial differential equations can be solved using digital computer programming or traditional manual procedures. In this case, the Finite Element Method (FEM) is thought to be more advantageous. ANSYS Maxwell 2D/3D, FLUX 2D, Infolytica Motors Solve, SPEED, Comsol Multiphysics, Quick_eld, JMag Designer, and more finite element analysis software are available on the market. The capacity of ANSYS to use multi-physics simulations is its primary advantage. The setup of a full ANSYS environment is rather simple. ANSYS offers a full electromagnetics workflow that includes tools such as Optimetrics for optimization, as well as RMxprt, PExprt, Maxwell 2D, Maxwell 3D, and Twin builder (Simplorer). This software can precisely duplicate and model electric and magnetic fields in two and three dimensions. Temporal, frequency, and static studies are all covered by finite element method (FEM) solvers. In addition, a 3D modeler is included. This study addresses the many high performance computing (HPC) factors that contribute to the acceleration of simulation calculations. Each product has various advantages; nevertheless, listing them all in this context would be difficult and time-consuming.

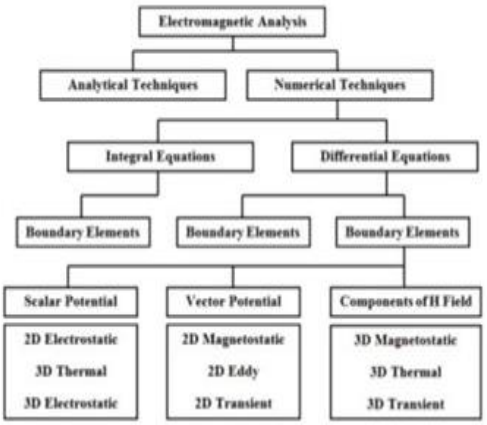

Fig.2 The electromagnetic solution sequence is the methodical approach used to address problems involving electromagnetic phenomena.

ANSYS is a popular software package in the engineering and simulation fields. Maxwell is a great resource for machine design specialists, allowing them to do extensive evaluations of electromagnetic and electromechanical components.Finite Element study (FEA) substantially simplifies the identification and study of electric, magnetostatic, eddy current, and transient problems. The use of Maxwell 2D is one example of a practical use of Maxwell's equations.

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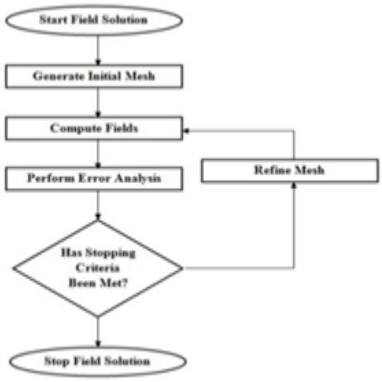
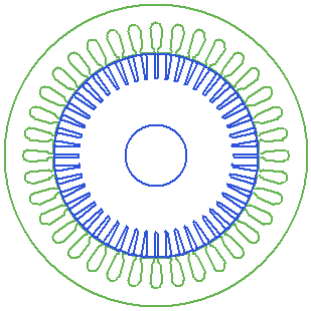


Fig.3 The stages involved in using Finite Element Method (FEM) software are as follows:

The RMxprt software application is a template-based design tool that aids electrical machine designers in their work. The combination of Maxwell 2D and RMxprt allows for the creation of specialized machine designs that meet specific objectives such as increased efficiency, cost-effectiveness, and a favorable power factor. When done manually, initial sizing estimations and machine performance calculations can be completed in minutes rather than days. MAXWELL can import the RMxprt design, including its geometry, materials, and boundary conditions.

4. RMXPRT DESIGN

The design and analysis of a 1.2kW squirrel cage induction motor with three stages is now complete. The die-casting process is used to create the rotor, which is made of aluminum.



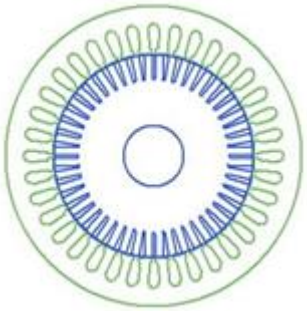


Fig.4 4- A pole stator-rotor configuration is a type of layout utilized in electric machines such as motors and generators. A stator is used in this design.

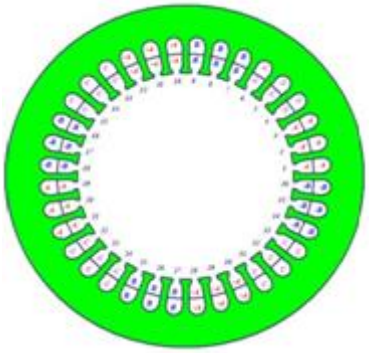


Fig.5 4- Coiling or winding a flexible material, such as wire or string, around a cylindrical object, also known as a pole.

The next section shows the findings of the RMxprt analysis for a four-pole winding.

Rated speed	1486.56 rpm
Torque	11.8661
Totallosses	401.074
Power factor	0.871537
Efficiency	81.7785
Output power	1.2kW

Similarly, RMxprt's 12-pole design demonstrates the same characteristics:

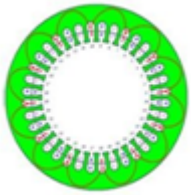


Fig.6 12- The wrapping or coiling of a flexible material around a cylindrical object.

The findings of an examination of a 12-pole setup using RMxprt are shown in the next section.

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Rated speed	465.06rpm
Torque	36.9618
Totallosses	1398.44
Power factor	0.613243
Efficiency	56.2784
Output power	0.7kW

5.DSWIM DESIGN USING MAXWELL 2D

As a result, the RMxprt design may now be instantly transferred to MAXWELL 2D.

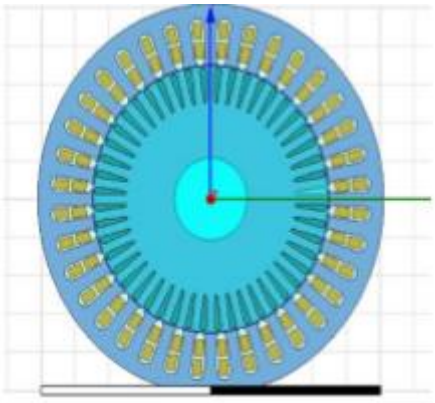


Fig.7 DSIM GEOMETRY

The graphic below depicts the dispersion of magnetic flux density.

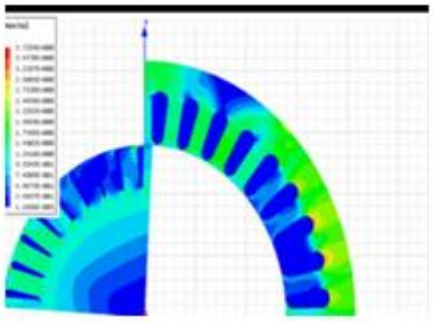
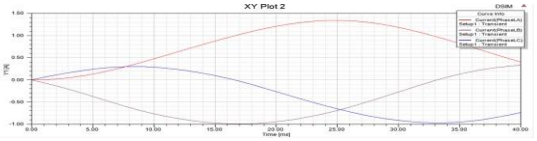
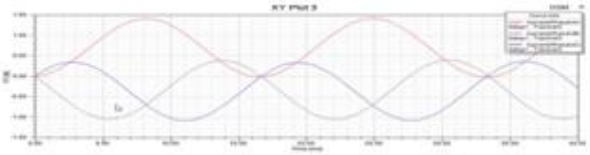


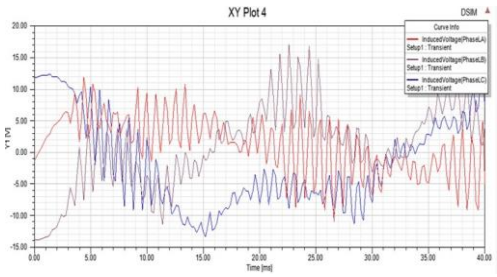
Fig.8 The magnetic flux density is the number of magnetic field lines per unit area.

6.PERFORMANCE CHARACTERISTICS

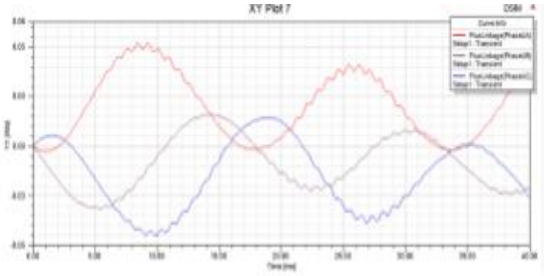
The following graphs are used to visually depict the machine's performance.







Induced voltage



Flux Linkage

7.CONCLUSION

The interaction between two or more variables that are interrelated or interdependent is referred to as a flux connection. It is a fundamental idea.This research analyzes the importance of using machine finite element modeling and provides a complete review of numerous finite element analysis-based software tools. The created machine's finite element model is shown in Maxwell 2D. The comparison of field testing results on manufactured machinery and simulation results shows a high degree of congruence. Based on the results of Maxwell 2D simulations, the current work covers an investigation of various DSWIM supply conditions. Despite the fact that there are currently no proven applications for twin stator winding induction machines, the findings presented in this study are sufficiently promising to warrant additional investigation in future research attempts.

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