## **Expression of the Magnetic Flux Distribution in Squirrel Caged Induction Motors By Means of Simulation Program**

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*Abstract:* The developments in computer field are in parallel with the developments in the education field. For this reason, the computer aided education suggests a new education model that changes all the philosophy and content of education different from the education technologies. If this model is used correct and in place, it may solve some problems of education. Various computer software are used in many branches of the electric education. Today, it is possible to give the theoretical courses to the students more successfully by getting use of the technological infrastructure. The computer programs are very important in supporting of the theoretical expression, especially in education branches that require laboratory like electrical education. To use the simulation programs in theory of electric machines course, that is the basic of the Electric Technology Education, will increase the output of the course, improve the student quality and so help in understanding of the scope.

In this study, the expression of magnetic field distribution of induction motors for the electric machines course is realized by means of various simulation programs and a sample application is made.

*Keyword:* Computer aided education, induction motor education, induction machine simulation, multi-media education, Flux Distribution

## **1** Introduction

In development of a scientific scope, two approaches are used; induction and deduction. By using the induction approach, the observations of some basic experiences are examined and the related laws and theorems are produced from them, and then the historical development of the scope is traced. On the other hand, the deduction approach accepts the new basic relations for a ideal model as real. The accepted relations are axioms and laws and theorems can be produced from them. The validity of models and axioms are verified with the estimation property of the results that are controlled with empirical observations. In the induction machines course, the deduction approach is preferred. Because, this provides expression of shorter and more substantial electromagnetic scopes to the students in a more regular manner.

## 2. APPLICATION OF THE EDUCATION

When a sinusoidal voltage with  $120^{\circ}$  phase difference is applied to the stator winding of a 4-pole squirrel caged induction motor (Fig.1), poling that occurs on magnetic body because of the current passing from the stator winding at any "t" moment is given.



Fig. 1 Stator winding structure

In order to demonstrate the magnetic flux line passing from the rotor and stator during this polling process, the stator and rotor drawing in Fig. 2 is analyzed in simulation program and the analysis results in Fig. 3 are obtained.



Fig. 2. Squirrel caged induction motor drawing to be analyzed

After the drawing is completed, if the program is run for the analysis, the analysis results in Fig. 3 are obtained.





As it can be seen on the analysis display, the simulation programs also show the magnetic flux distribution curves that can't be manually calculated. This has a reinforcing effect in understanding of the scope by the students. Besides, as it can be seen from figure 4, all the numeric values on the magnetic circuit that can be manually calculated may also obtained. Fig. 4 gives the magnetic data on coordinates (126,162.8) on magnetic circuit.



Fig.4. an analysis value on (126,162.8) coordinates

The flux distribution on each point of induction motor can be shown to the students and the values on desired points can be calculated. For instance, in Fig.5, changing of the magnetic flux change through a line defined in the air space between stator and rotor is given. As it can be understood from figure 5, the student can better understand the useful and leakage flux concepts by means of simulation.



Fig.5. Induction changing in the air space of induction motor

In Fig. 5, the magnetic induction change through a line defined under a pole couple in the air space of induction motor is given. It is observed that the flux is dense at the beginning of the pole and its density decreases towards to middle sections. The changing flux in time creates a wave from similar to sinus form in the air space.

## **3.**Conclusion

Recently, the computer aided applications are widely used in educational institutions. Such well developed analysis programs of which validity has been proved decreases the education costs and besides, they positively contribute to the quality of education. In this study, the computer software and hardware are used to make visual the theoretical education of induction motor by means of simulations. In this way, all the tests and analysis can be applied easily. In this application, the analysis is made by means of FEM program and flux changing in magnetic field distribution of induction machine is given. This is a very important element in well expression of magnetic flux distribution of induction motor to the students.

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