EXTERNAL MAGNETIC FIELD ANALYSIS OF INDUCTION MOTOR

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ABSTRACT

This article describes analysis of magnetic leakage field of induction motor. Information about external field of motor is derived from these sources. The first one is a 2D computer motor model and the second one consists in measurement of external magnetic field of real motor. Machine is monitored in a different working condition. Acquired results are evaluated and create a conception of magnetic field character round machines.

1 INTRODUCTION

Electromagnetic field problems round the electric appliances are known mainly as electromagnetic compatibility problems. Electromagnetic fields round electric machines are usually low intensity and low frequency. The danger of electromagnetic disturbance of other appliances is only in proximity of machine. Otherwise the external magnetic field relates to processes inside the machine. Information about the field could be used for determination of working conditions and machine faults. Possibilities of utilization are examined presently.

2 ANALYZE OF INDUCTION MOTOR

Technical data of 3-phase induction motor produced by EMP Slavkov u Brna company.

Rated power:	1.5 kW
Rated voltage:	Y/Δ 400 / 230 V
Rated current:	Y/Δ 3.4 / 5.9 A
Rated speed:	1420 rpm
Number of poles:	4

2.1 COMPUTER MOTOR MODEL

A computer motor model is generated upon geometrical machine dimensions, properties of used material and circuit values (see fig.1). Self-computation is performed on Finite Element Method by the help of computer programme FEMM, which is specialized for solving static and low frequency problems in magnetic. Because of impossibility of model creation with reference to all properties of real motor is necessary to accept some simplification.

Accepted simplifications:

- Model is only two dimensional. Influences of grey iron flange, end turn, rotor slots shift are neglected.
- Hysteresis loop of used material isn't included in model.
- Rotor revolving is modelled by frequency of stator current, which is equal to rotor slip frequency.

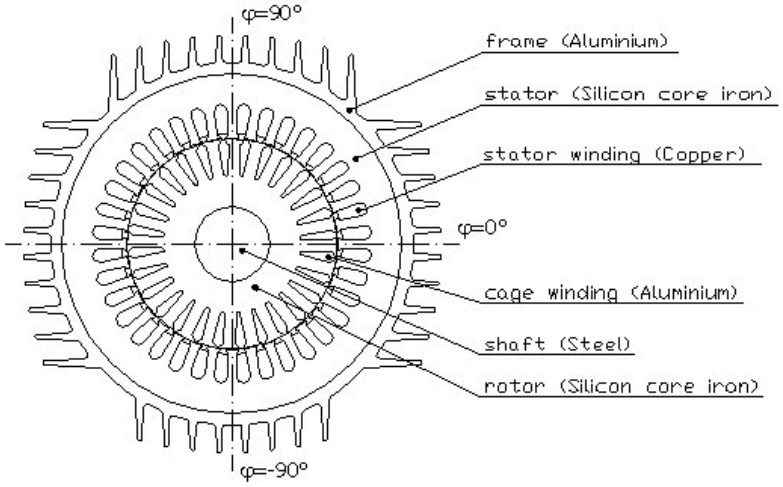

Fig. 1: *2D induction motor model*

2.2 OBTAINED RESULTS

The model of induction motor supplied by direct current is presented on figure 2. The magnetic field is only excited by stator current and it has four pole shape. Voltage induced to rotor is zero. In case of 3-phase A.C. supply the magnetic field revolves and creates a circular rotating field. The value of magnetic flux density in motor iron is out of range of grey scale. The magnetic field is displayed by the magnetic flux lines in this area.

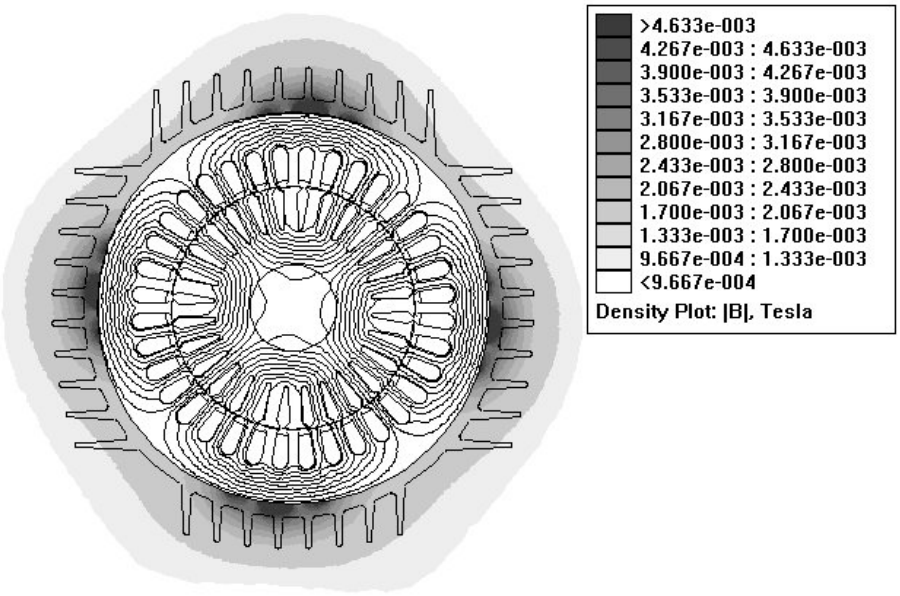

Fig. 2: *Static analysis of induction motor leakage field*

The model of no loaded induction motor supplied by 3-phase power supply is presented on figure 3. The density plot shows the distribution of effective value of magnetic flux density. The magnetic field round the motor is not strictly circular because of stator surface asperity. The current is induced to the rotor cage and it excites the magnetic field counteractive the stator rotated field.

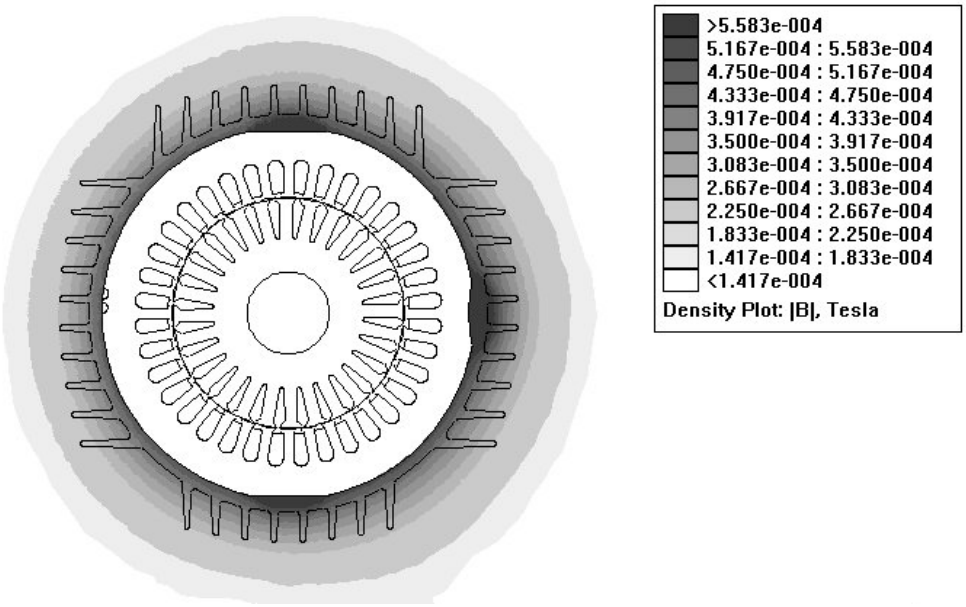

Fig. 3: *Low frequency analysis of no loaded induction motor leakage field*

2.3 INDUCTION MOTOR MEASUREMENT

The external magnetic field measurement of real motor is necessary for model precision determination, because a simplification in model generation can evoke errors. The magnetic flux density is measured in suitable points for comparison of measured and calculated values. Points are located in distance of 5mm above the motor frame surface along circular arc (see figure 1). Curves of acquired values of |B| for motor supplied by D.C. are shown in figure 4.

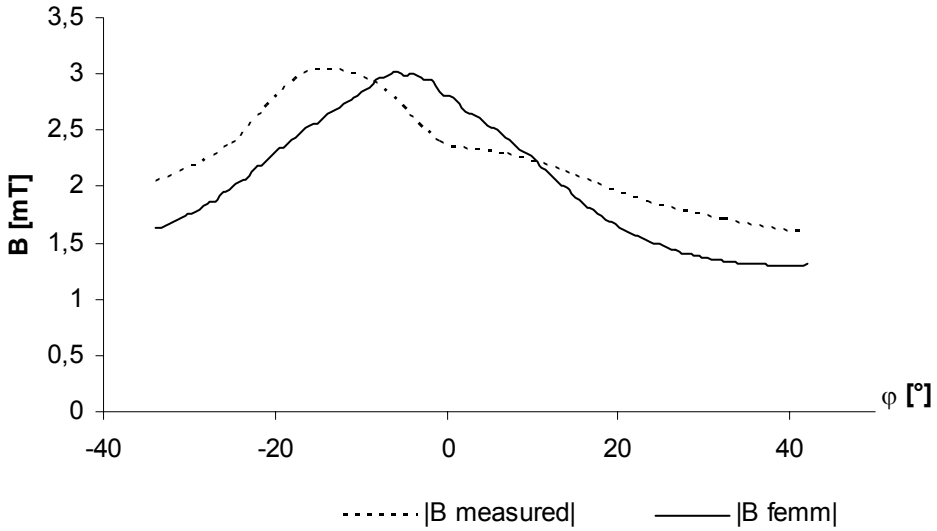

Fig. 4: *Magnetic flux density distribution above the frame of motor*

3 CONCLUSION

External magnetic field of electrical machine has only little disturbing influence on other electric appliances because of low field frequency and intensity. More interesting is utilization of information about magnetic field round machine for machine monitoring. Magnetic field distribution inside machine and its alterations dependent on working conditions is possible to analyze by external field measuring. The value of supply voltage, load, direction and speed of rotation and machine defect influence the properties of external magnetic field. Close investigation of these relationships is subject of further work.

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