Dynamic Characteristics Analysis in A Pole Changing Memory Motor Using Coupled FEM & Preisach Modeling

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Abstract - **This paper deals with the PM performance evaluations in a pole changing memory motor (PCMM) using a coupled transient finite element method (FEM) and Preisach modeling, which is presented to analyze the magnetic characteristics of permanent magnets. The focus of this paper is the dynamic characteristics evaluation relative to magnetizing direction and the pole number of machine on re-, demagnetization condition in a pole changing memory motor.**

I. Introduction

Electric drives in which discrete speed control is required are today equipped exclusively with squirrel-cage induction motors, due to the property of the squirrel cage to always have the same number of poles as the stator winding. Conventional permanent-magnet (PM) machines have a constant number of poles and can be operated from a constant frequency source only at one speed. If a PM machine is built after the principles of memory motors, one can change its number of poles as simply as in a squirrel-cage machine.

The operation of a memory motor is based on its ability to change the magnetization of its magnets with a low amount of stator current. It is illustrated how the magnetization of rotor magnets can be continually varied by applying a short pulse of stator current [1], [2].

If the rotor of a memory motor is built following the same sandwich principle shown in [1], but with more than one magnet per pole one can group equally magnetized magnets in various manners. As a consequence, the number of rotor poles changes. This is the basic principle of operation of a pole-changing memory motor, as illustrated in Figs. 1 and 2.

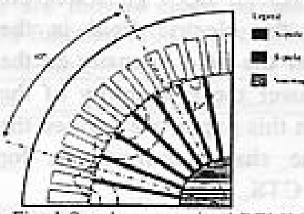
In Fig. 1, the cross-sectional view of a pole-changing memory motor with 32 tangentially magnetized magnets is shown. On the rotor side there are four magnets per pole, all of them being magnetized in the same direction. PMs along with iron segments build the rotor wreath which is mechanically fixed to a nonmagnetic shaft. After the stator winding is reconnected into six-pole configuration, a short pulse of stator current changes the rotor eight-pole magnetization into a six-pole one, as shown in Fig. 2. Since the number of magnets per pole is not any more an integer (32/6=.333...), same magnets can remain demagnetized.

Issues such as magnetizing direction and quantity are important in evaluating the performance of the memory motor. Such characteristics depend upon the characteristic of material and, therefore, require a numerical evaluation.

Whereas in other kinds of machines a rough estimation of hysteresis and magnetizing characteristics can be accepted, their importance in a memory motor justifies a greater effort in calculating them more precisely. The Preisach model is now generally accepted to be a powerful hysteresis model, and is therefore intensively studied [3], [4].

In this paper, a coupled finite element analysis and Preisach modeling for a PCMM are presented and dynamic characteristics analysis are performed under the situations of pole changing due to short pulse current.

Fig. 3 shows the block diagram of whole analysis mechanism. Through the more detailed analysis, the variable performance of the pole changing memory motor will be represented in next extended version



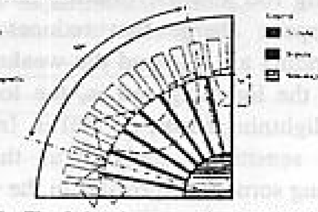


Fig. 1 8-pole magnetized PCMM Fig. 2 6-pole magnetized PCMM

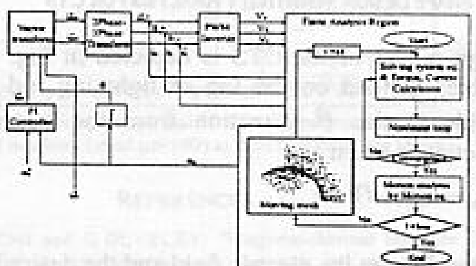


Fig. 3 Block diagram of analysis system

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