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Design Standard Computation based on Capacity of Synchronous Reluctance Motor Using a Coupled FEM & Preisach Model

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Abstract - **This paper deals with an automatic design standard computation based on capacity for a synchronous reluctance motor (SynRM). The focus of this paper is the design relative to the output power on the basis of rotor shape of a SynRM in each capacity. The coupled Finite Elements Analysis (FEA) & Preisach model have been used to evaluate nonlinear solutions. The proposed procedure allows to define the rotor geometric dimensions according to capacity starting from an existing motor or a preliminary design.**

I. Introduction

Reluctance Motor (SynRM) presents many advantages if compare to induction motors that concern the simple, rugged rotor design, no rotor cage and consequently no copper losses and no rotor parameters to be identified.

Issues such as efficiency and torque/ampere are important in evaluating the performance of a SynRM. Such characteristics depend upon the rotor shape of the machine related to the ratio K_w of total flux barrier width to total iron sheet width and, therefore, require a numerical evaluation and design.

If K_w= about 0.5, it is possible to gain a high inductance differential Ld-Lq across a wide current range as well as obtain the maximum output torque [1], [2]. And a paper which discussed the influence of the ratio K_w of total flux barrier width to total iron sheet width on a machine have been presented [3].

However, Reference [1] investigated the axially laminated type and Reference [2] discussed the 6 flux barrier type respectively, and output powers are difference. Reference [3] proposed the design of the 340W home appliance SynRM then, K_w is 1.

Therefore, it is not a fixed value that is applied to all shapes with regard to a variation of rotor in a SynRM. And design should be performed for the condition of maximum torque density of each capacity.

The paper presents an automatic design standard computation based on capacity for a SynRM that combines Finite Element Analysis (FEA) with Preisach model.

In this paper the ratio K_w of total flux barrier width to total iron sheet width of a SynRM is defined as design parameter.

The focus of this paper is found firstly a design solution through the comparison of output power according to shape variations under each capacity condition (350W – 5kW) and, Secondly, is developed an automatic pre-process that includes automatic ACAD file drawing and mesh generation with regard to rotor shape variations. The proposed procedure allows to define the rotor geometric dimensions according to capacity starting from an existing motor or a preliminary design.

II. Design Model

Fig. 1 shows the point variables and direction of shape change according to K_w. Points of W1-W10 that define the flux path in air-gap move according to arrow directions in fig.1. Each pair (W1, W10), (W2, W9), (W3, W8)... move symmetrically on the basis of q-axis. And points of P1-P10 move as a condition that ratio K_w, which is calculated by element area of FEM, is varied. Fig.2 shows the flow chat of total design procedure.

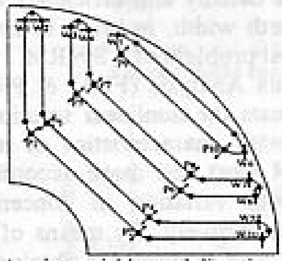

Fig.1 point variables and direction of shape change

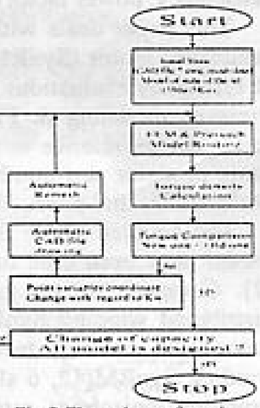

Fig.2 Flow chart of total design procedure

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