Characteristic Analysis and Design of Switched Reluctance Motor for the Improved 2-phase Snail-cam type Fan Motor

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Abstract — **In this paper, the snail-cam type rotor pole and the asymmetric stator pole of 2-phase Switched Reluctance Motor (SRM) are designed to rotate in one direction and to reduce the zero torque zones. It is proved by the finite element method and experimental results that the improved shape is very effective to satisfying the demands.**

INTRODUCTION

Recently, Brushless DC motors (BLDC) have been commonly used in household applications, but the higher cost of permanent magnets and the complexity of the controller are some of their disadvantages. Switched Reluctance Motors (SRM), compared with BLDC, have many advantages such as solidity, economical efficiency due to simple construction and low cost drive topology [1].

In this paper, a 2-phase SRM is investigated for a cooling fan motor of refrigerator. Some design aspects should be treated because a general 2-phase SRM has wide zero torque zone that can lead to starting problem [2], and rotates in bi-direction while the cooling fan requires the rotation in one-direction only. To solve these problems, the snail-cam type rotor pole and the asymmetric stator pole are investigated. These configurations are able to eliminate zero torque and improve torque ripple. The motor characteristics are calculated by the 2D time-stepping Finite Element Method (FEM) coupled with circuit equations.

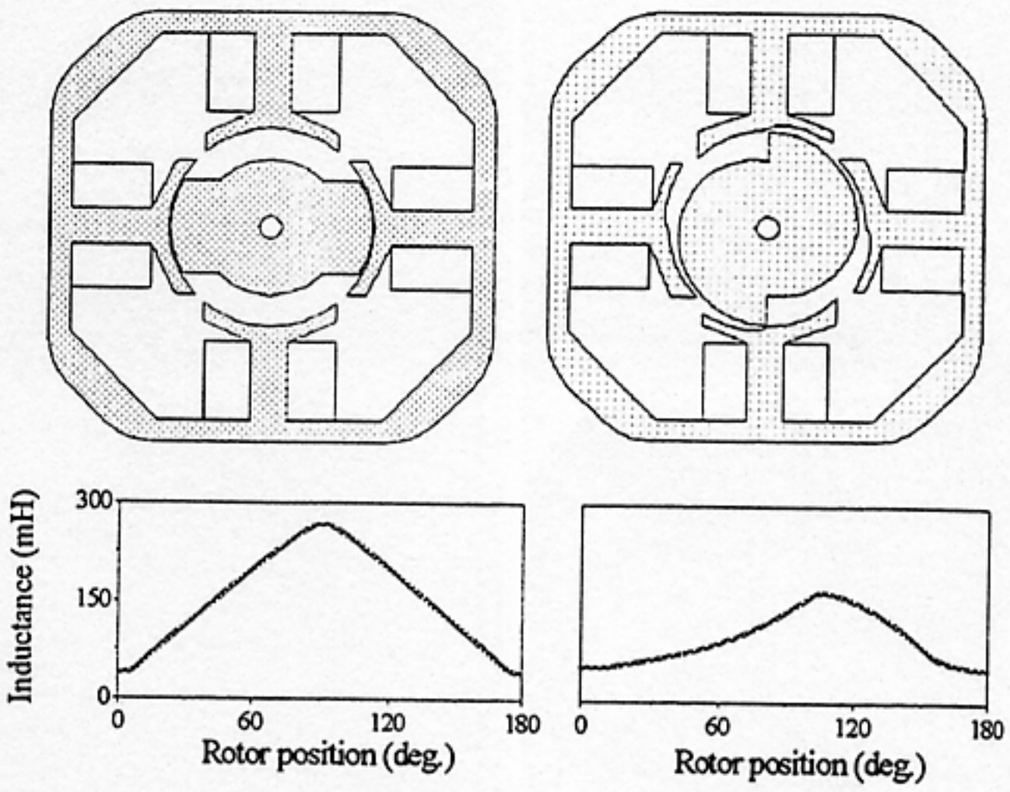
DESIGN AND ANALYSIS

The proposed rotor and stator pole shapes are adopted for the improvement of motor characteristics as follows:

- Snail-cam type rotor pole: rotation in one-direction only and reduction of zero torque zones.
- Asymmetric stator pole: increase of the inductance ratio and torque according to decreasing unaligned inductance and increasing aligned one.

Fig. 1 shows the designed models and their inductance profiles. The initial design employs the conventional model with 2-phase, 4 stator poles and 2 rotor poles. Then the structure modification, shown in Fig. 1 (b), is achieved to satisfy the requirement. The inductance profiles are computed by 2D FEM considering the end-coil inductance and non-linear magnetic characteristic. The asymmetric inductance profile can make one-directional rotation.

Fig. 2 shows the comparison of torque and zero torque zones between the conventional model and proposed one. The dead zone of the proposed model is remarkably reduced and the torque is increased, compared with those of conventional model respectively.



(a) Conventional model (b) Proposed model

Fig. 1 Configuration and inductance profile of 2-phase motors

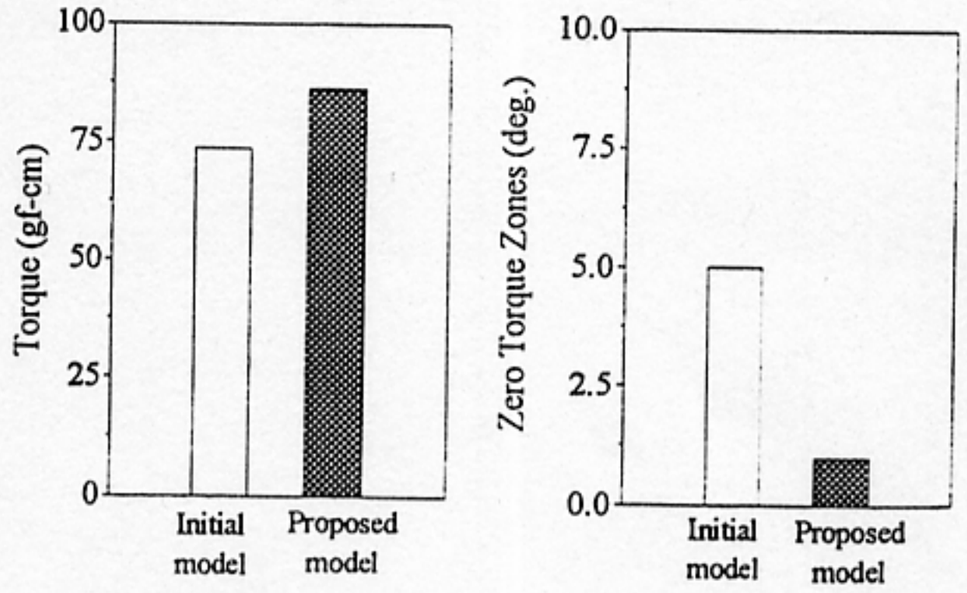


Fig. 2 Comparison of torque and zero torque zones

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