Modelling and Simulation of Switched Reluctance Motor Based on Comsol

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Abstract— Switched reluctance motor (SRM) drives have gained many attentions from researcher which will be used for automotive applications that needs high speed, wider range of constant power capability, ruggedness, and fault tolerance. This paper focuses on modelling and simulation of switched reluctance motor (SRM) based on COMSOL software, two dimensional finite element models of SRM were developed and established. The results show that the models established, are propitious to the accurate analysis of switched reluctance motor torque and flux. SRM 6/4 configuration was selected due to its simple structure and low cost of electronics required for the controller. The model developed will be used to design and build an EV SRM for prototype testing.

Keywords— SRM; Modelling; Simulation; COMSOL; FEA; Finite Element Analysis; Design

I. INTRODUCTION

Switched reluctance motors have gained popular recognition in electric drives market due to power density, torque/inertia ratio, speed range, efficiency, manufacturing cost, and reliability and due to the unidirectional current requirement in the switched reluctance motor, so that its converter has a minimum number of switching devices [1].

An important consideration in the selection of the motor for electric vehicles is its cost, weight and efficiency. A heavy motor will increase the overall weight of the vehicle resulting in lower acceleration and reduce overall performance. A motor that is specifically designed for EV is better choice than purchasing a standard motor. Switched reluctance motor are good choice for EV motor as they are relative cheap and robust, and can be designed to have minimum weight [2]. The recent advances in power electronics technology have made SRM an attractive candidate for EV applications. Because of its desirable features such as simple and rugged motor construction, SRM technology offers an impressive list of advantages that is making industrial users seriously looking at switched reluctance drives.

Building a switched reluctance motor and performing measurements performance for specific application is an expensive and time consuming activity, accurate modelling and simulation become a key element for the success of SRM design and manufacturing process.

This paper mainly focused on modelling and simulation using COMSOL software to verify the influence of excitation current in flux linkage, rotor position and their torque profile.

II. SWITCHED RELUCTANCE MOTOR

A. Basic Theory of Switched Reluctance Motor

A switched reluctance motor is an electrical machine that converts the reluctance torque into mechanical power. In the switched reluctance motor, both rotor and stator have a structure of salient-pole, which contributes to produce a high output torque. The torque is produced by alignment tendency of poles. The rotor will shift to a position where reluctance is to be minimized and thus the inductance of excited winding is maximized [3].

The switched reluctance motor has a doubly salient structure, but there are no windings or permanent magnet on the rotor. The rotor is basically a piece of steel shaped to form salient poles, so it is only motor type with salient poles in both the rotor and stator. As a result of its inherent simplicity, the switched reluctance motor promises a reliable and low manufacturing cost and will undoubtedly take the place of many drives now using the cage induction motor, permanent magnet motor, and DC motor in the short future.

To make an accurate model of switched reluctance motor, the flux linkage and torque profiles, which are the main parameters of the switched reluctance motor, need to be determined. These profiles can be obtained by the finite element analysis (FEA) or measurements, in this paper FEA modelling result are presented. The main electrical and geometrical parameters of the typical switched reluctance motor are given in Table I.