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ORIGINAL ARTICLE

Static and dynamic analysis of non-linear magnetic characteristics in switched reluctance motors based on circuit-coupled time stepping finite element method

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Abstract This paper presents a static and dynamic analysis of non-linear magnetic characteristics in switched reluctance motor (SRM) based on finite element method (FEM). Static performances of the SRM are determined by using two-dimensional FEM under different rotor positions due to variations of the excitation current. Dynamic performances are obtained by the use of circuit-coupled time stepping finite element method. The proposed modeling strategy allows predicting the four-phase 8/6 SRM performances behaviors in both static and dynamic cases. Static torque values and current waveform give dynamic torque profile by using look up table in Simulink software. The advantage of the proposed approach is that it allows minimizing the torque ripples when changing the phase turn-on (θ_{on}) and the phase turn-off (θ_{off}) angles.

Keywords Switched reluctance motor (SRM) · Electromagnetic modeling · Finite elements method (FEM) · Time stepping · Torque ripple (TR) · Static torque (ST)

Abbreviations

SRM	Switched reluctance motor
FEM	Finite elements method
TSFEM	Time stepping finite elements method
TR	Torque ripple
ST	Static torque

1 Introduction

The switched reluctance machine is gaining a progressive attention of researchers worldwide due to its brushless structure, its low cost and its ability to operate at very-high speed. When interested to such machine one know that because of its doubly salient structure, the phase winding flux linkage is function of both rotor position and phase current. This results in the fact that the electromagnetic torque is function too of rotor position and phase current. However, these dependences make the control of an SRM relatively complex due to its highly non-linear electromagnetic parameters and to the coupling relationships among rotor position, current and torque (Nguyen and Ta 2011).

Although profiles of the physical characteristics of an SRM can be obtained using finite element analysis

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