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# Multi- objective optimization of switched reluctance motor drive in electric vehicles☆

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ABSTRACT

Switched reluctance drive (SRD) has become one of the best choices for electric vehicle drive because it exhibits prominent advantages over other kinds of electric drive system. In this paper, the effects of load torque, turn-on and turn-off angle on the torque ripple and electric efficiency of the SRD are thoroughly analyzed based on the nonlinear dynamic model of switched reluctance motor (SRM). To reduce the torque ripple and improve the electric efficiency, a novel double-index synchronous optimization policy is proposed. Under different load torques and speeds, the model of adjustable turn-on and turn-off angle is established using the proposed optimization policy. Compared with conventional optimization strategies, the proposed method is verified to be effective for torque ripple suppression and electric efficiency improvement of the SRD simultaneously.



## 1. Introduction

Switched reluctance motor drive system (SRD) is a new type of Ac speed regulating system with main advantages of both Dc drive and traditional Ac drive. Switched reluctance motor (SRM) has become one of the best considered schemes for electric vehicles (EV) drive system due to its prominent advantages such as low construction cost, simple manufacturing process, high fault-tolerant ability, wide speed range of operation etc. However, the more obvious torque ripple of SRM can do harm to the transmission system of EV, in addition, the electric efficiency of SRM directly decides the travel distance of EV, so it is of great significance to reduce the torque ripple and improve the electric efficiency of SRM applied in EV [1–4].

Due to the high nonlinear characteristics and the unique pulse power supply mode of SRM, effective dynamic optimization methods of SRD for EV drive are difficult to design and realize. At the present stage, there are two main methods to realize the dynamic optimization of SRD for EV drive: one is aiming to optimize the structural parameters of the SRM to improve the dynamic performance of the SRD. Picod et al. [5] researched the influence of stator geometry on performances of the SRM based on a 6/4 SRM, a simultaneous analysis was performed and dynamic performance improvement was verified. In [6], a new rotor configuration is optimized and proposed to reduce the vibration and noise. The FEM analysis and experimental verification were both developed to verify the effectivity of the structure. Wei et al. [7] examined the effects of the stator windings and end-bells on stator modal vibration frequencies. The numerical computations of the stator mode shapes and resonant frequencies were validated with experimental results. These methods can improve the dynamic performance

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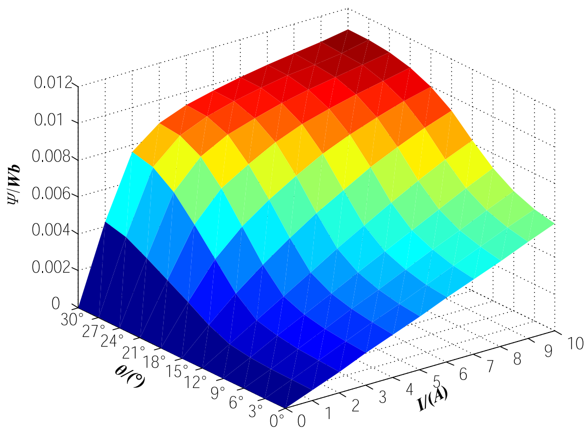


**Fig. 1.** Flux characteristic curve.

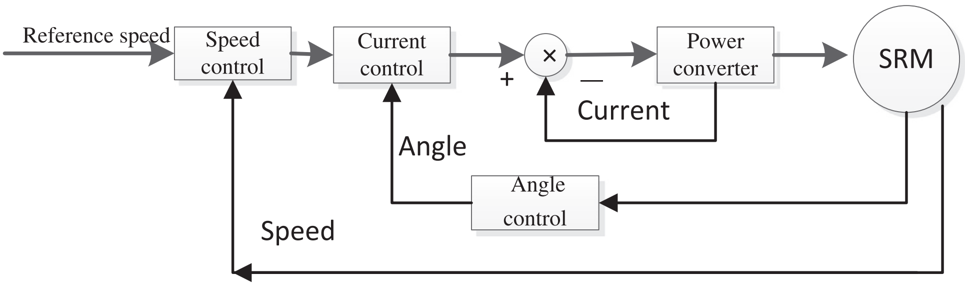


**Fig. 2.** Block diagram of the SRD.

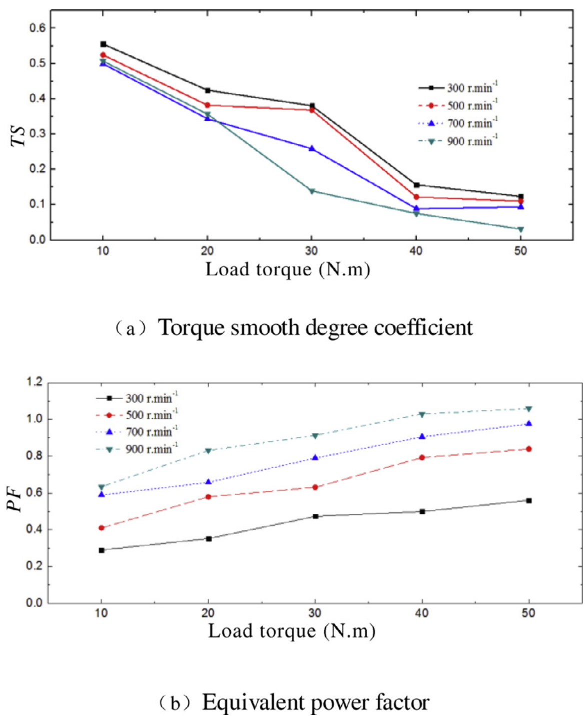


**Fig. 3.** Effects on torque characteristics of load torque at different speeds.