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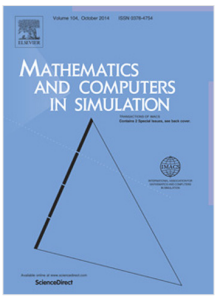

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Cogging Torque Reduction of Permanent Magnet Synchronous Motor using Multi-objective Optimization

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Abstract-

Cogging torque is an important issue in design of permanent magnet motors, especially in certain high accuracy applications. Most of the methods utilized for cogging torque reduction lead to motor structure complexity, increasing manufacturing cost and also influencing the output torque. This research tries to find an optimal solution set of the PMSM with the aim of reducing the cogging torque while the output torque is not affected. For this purpose, multi-objective optimization is a proper and reliable approach which can provide the solution set involving conflicting functions simultaneously. Multi-objective optimization determines the logical range of cogging torque reduction with respect to the output torque. In this paper, the Non-dominated Sorting Genetic Algorithm-II (NSGA-II), which is a powerful and well-known multi-objective optimization method, is applied to find the optimal design of a surface-mounted Permanent Magnet Synchronous Motor (PMSM).Simulation results show efficacy of the NSGA-II. In the suggested design solutions that are selected from the Pareto- optimal set, cogging torque is reduced considerably while the output torque has experienced a slight decrease with respect to the nominal value. At last, time-stepping Finite-element Analysis (FEA) is used to validate the multi-objective optimization.

Index Terms

Permanent Magnet Synchronous Motor (PMSM), Cogging Torque (CT), Multi-objective Optimization, Finite Element Analysis (FEA).

1. Introduction

Permanent magnet synchronous motors (PMSMs) are used increasingly in small and medium power applications. The main advantages of PMSMs are high efficiency, high power density and low size that make them good alternative for conventional motors. However, due to the existence of cogging torque (CT) which is inherent in PMSMs, design of such motors needs further considerations. Cogging torque is one of the main contributors of the total torque ripple that affects the performance of the motor negatively, especially in high-precision