Contribution ID: **214** Type: **Poster Presentation of 1h45m**

Torque Ripple Improvement for Ferrite-Assisted Synchronous Reluctance Motors by Using Asymmetric Flux-barrier Arrangement

Wednesday 30 August 2017 13:15 (1h 45m)

Ferrite-assisted synchronous reluctance motors (FASRM) provide high torque density and a wide range operation speeds for many applications, ranging from electric vehicle and electric home appliance. However, the main drawback of the FASRM is the high torque ripple. This paper is to propose a method of reducing total ripple by changing the opening angle of flux barrier. The key of this method is to consider the reluctance torque ripple because it is the main source of torque ripple in ferrite-assisted reluctance motors. In addition, the ferrite magnet insertion part is not changes compared with original design, and it is expected that the average torque does not decrease with this design. The detailed configuration of the FASRM is 48 slots and 8 poles, with two flux barriers per poles. The original flux barriers are chosen basic unit and designed in the line of symmetry with the magnetic pole center. This method is realized by changing the opening angle of each pair pole of flux barrier respectively. In the proposed arrangement, the opening of angle of flux barrier is enlarged a particular angle based on the basic unit. For example, the opening of angle of one pole enlarges a particular angle, another pole enlarges double. The proposed method is evaluated by a theoretical analysis and finite-element method (FEM). Through this method, several low-order harmonic of torque could be eliminated. It is shown that the proposed flux barrier design is very useful of improving the torque ripple for ferrite-assisted synchronous reluctance motors. Moreover, it is easy to implement and not sacrifice the average torque.

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Session Classification: Wed-Af-Po3.05

Track Classification: E1 - Motors