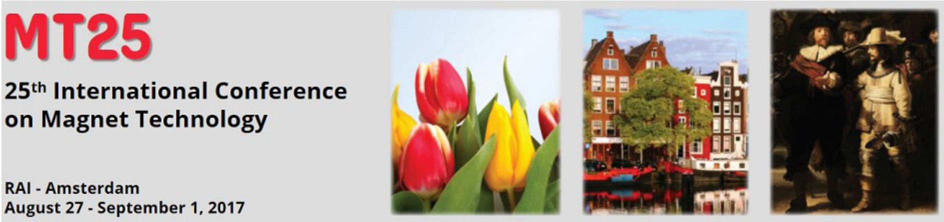

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Design and analysis of a less-rare-earth PM-assisted synchronous reluctance machine considering tradeoffs of PM flux linkage and magnetic saliency

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

In recent years, due to the highly variable cost of rare-earth permanent magnet(PM) and requirement for more efficient motor, PM-assisted synchronous reluctance machine(PMAREL) have attracted increasing attention and become one of the research highlights in the motor field. Generally, the PMAREL machines are characterized by a complex rotor structure, where multi flux barriers are set to achieve a high difference between the d-axis inductance Ld and the q-axis inductance Lq, i.e, a large magnetic saliency ratio, which results in a dominant component of reluctance torque. Besides, an amount of PM materials is inserted into the rotor flux barriers, adds a PM flux linkage to q-axis to offset the armature flux linkage LqIq, which improves the machine' s power factor and makes an assisted contribution to the output torque. Thus, it is not easy to determine the proportion of the magnetic saliency and PM flux linkage incorporating into the design of PMAREL machines to yield satisfactory performance. In this paper, a new PMAREL machine adopting less rare-earth PM is proposed, in which an elliptical barrier are set in its rotor pole tip. One purpose is to obstruct the flux along the q-axis, which influences the level of saliency ratio. Another is to divide the magnet flux into two flux streams, achieving reasonable adjustment for the PM flux linkage. By adopting a sensitivity analysis method, the influences of the variables of the elliptical barrier on the machine performance such as power factor, inductance characteristics, output torque and flux-weakening capabilities in high operation are investigated. The results show that the machine performance can be improved by a proper tradeoffs of the magnetic saliency and PM flux linkage. More detailed theoretical analysis and experiment validation will be presented in the full paper.

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