Comparison of Different Electrical Machines with Permanent Magnets in the Stator for Use as an Industrial Drive

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Abstract : This paper compares three different permanent magnet synchronous machines (Doubly-Salient-Permanent-Magnet-Machine (DSPM), Flux-Reversal-Permanent-Magnet-Machine (FRPM), Flux-Switching-Permanent-Magnet-Machine (FSPM)) with the permanent magnets in the stator of the machine for use as an industrial drive for 400 V Y, 45 kW and 1000 ... 3000 min-1. The machines are compared based on the magnetic co-energy and Finite-Element-Method-Simulations regarding the torque density. The results show that the FSPM provides the highest torque density of the three machines. Therefore, an FSPM prototype was built, tested on a test bench and finally compared with an already built conventional permanent magnet synchronous machine (PMSM) of the same size (stator outer diameter dso = 314 mm, axial length IFe = 180 mm) and rating with surface-mounted rotor magnets. These measurements show that the conventional PMSM and the FSPM machine are roughly equivalent in their electrical behavior.

Keywords : doubly-salient-permanent-magnet-machine, flux-reversal-permanent-magnet-machine, flux-switching-permanent-magnet-machine, industrial drive

Conference Title : ICEMS 2017 : International Conference on Electrical Machines and Systems **Conference Location :** San Francisco, United States

Conference Dates : June 07-08, 2017

1