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2 Design

The Permanent Magnet assisted synchronous reluctance motor (PMSynRelM) is widely used for it's significant advantages of small size, low loss, high efficiency, better performance than plain synchronous reluctance motors SynRelM and wide constant power to speed range. [1], [2]

2.1 Stator and Rotor

There are many solutions on how to connect the stator winding. Research has been carried out for standard Delta or Start winding, but to increase the torque for same stator current the combined Start-Delta winding was proposed. The first research has been caried out for standard SynRelM in [3] and then extended to PMSynRelM prototypes in [4]. The main idea of the hybrid Delta-Star connection is to split the standard phase wiring into two parts. The one part is for the Delta connection, the other for Star connection. Then the coils of wiring are connnected to series. Motors utilizing hybrid stator winding with PMs inserted in the rotor flux bariers exhibit constant power factor over 0.9

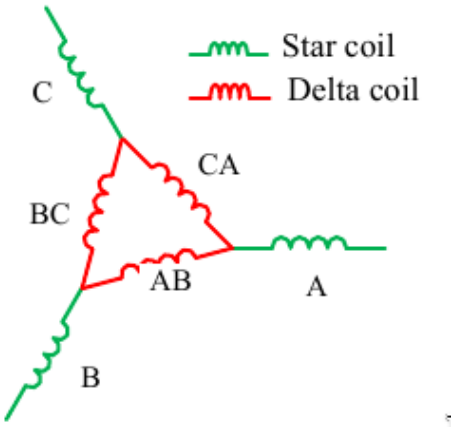

Figure 2 - 1 Hybrid Star-Delta wiring of PMSynRelM. CHANGE THIS IMAGE FOR YOUR OWN, IT IS FROM [4]

In [4] the authors manufactured proposed four prototypes. The prototypes consist of two stators, with either conventional star winding or hybrid star-delta winding, and two rotors, with ferrite permanent magnets or without. Maxwell transient simulations were carried out on the four prototypes, which were then manufactured and experiment using the simulation results was conducted. In many researhes it has been observed, that when inserting the PM in the center of the flux barrier, a magnetic flux lines are forced to pass through the flex barriers in the q-axis. This results in the decreased linked magnetic flux in the q-axis and therefore improves the output torque.

According to [4] the researches state, that when using the hybrid stator winding connection, the efficiency increase is rather low compared to efficiency increase when comparing SynRelM with and without PMs.

2.2 Magnets

PMSynRelM are very often compared to Permanent Magnet Synchronous Motors (PMSM) used in the automotive field in terms of power and torque density, efficiency and costs. Though the PMSM are very popular [5], the PMs used in their design often consist of rare-earth materials such as neodymium or dysprosium. That is the reason why PMSynRelM motors with rare-earth-free materials are now being the

subject of many research studies. Experiments comparing the production-used PMSM and experimental prototype PMSynRelM show, that the proposed prototype in [6] achieve close values of power density and an efficiency as rare-earth PMSM counterpart, but with much lower costs [7].

Conclusion

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Appendix A: List of symbols and abbreviations

A.1 List of abbreviations

ASM	Asynchronní Motor
PM	Permanent Magnets
PMSM	Permanent Magnet Synchronous Motor
PMSynRelM	Permanent Magnet Assisted Synchronous Reluctance Motor
SynRelM	Synchronous Reluctance Motor

A.2 List of symbols

P_n (W) jmenovitý výkon