Design, Construction and Test of a Permanent-Magnet Prototype Machine for Wind Energy Applications

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Abstract

A low-speed radial-flux permanent-magnet (PM) electrical generator with new topology was designed, optimized, built and tested. The equivalent magnetic circuit approach together with the permanent magnet load line method were used as pre-design tools. The finite element technique (FET) was used for detailed characteristics and final adjustments. The design was carried out with high-energy NdFeB magnets with flux concentration arrangement. The topology allows for toroidal (torus) windings placed in flat slots with short ends, which contributes to higher efficiency and higher power to weight ratio. The flux concentration of the permanent magnets is tangential on the rotor support structure, which can be made from light nonmagnetic material. The cogging torque of the machine is estimated using the flux-MMF technique together with the help of FET. Good agreement between theoretical and experimental results has been achieved. Compared with other machine types of close power ratings, the developed prototype machine exhibits relatively high efficiency.