A NONINVASIVE TECHNIQUE FOR IDENTIFYING THE MAGNETIC PROPERTIES OF PERMANENT MAGNET SYNCHRONOUS MACHINES CORE MATERIAL

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Permanent magnet synchronous machines (PMSMs) are widely used in many applications in industry. In order to precisely analyze such applications, the magnetic properties of the PMSMs magnetic circuit need to be known, i.e. stator and rotor back-iron electrical steel, as well as permanent magnets (PMs).

The magnetic material properties of any electromagnetic device (EMD) given by the manufacturer may differ from the true existing ones. In fact, the magnetic material characteristics of the electrical steel may be altered during the construction of the EMD, e.g. due to the introduced cutting stresses [1]. Moreover, the PMs may be deteriorated during the handling process. In practice, electrical machine manufacturers may not be aware of how the magnetic material properties are changed after the manufacturing process. Therefore, it is convenient to characterize the magnetic properties on the specific geometry of the EMD itself. The characterization process should be done in a noninvasive way.

Recently, a coupled experimental-numerical inverse approach is developed for magnetic material characterization of an EMD [2]. This approach has been successfully applied onto a wide range of EMDs with only one type of magnetic materials, i.e. non-oriented electrical steel. In this paper, we aim at extending the approach to identify the magnetic properties of two different magnetic materials located inside a PMSM, i.e. non-oriented electrical steel and PMs, which needs a special caution to assure perfect separation between the effects of the two magnetic materials. To this end, a special measurement is conducted in order to compensate ‘to some extent’ the effect of the PMs. By this way, only one material can be assumed in the PMSM, i.e. non-oriented electrical steel, which can be retrieved by solving an inverse problem. After recovering the *B*-*H* of the stator and rotor iron core, another inverse problem is solved in order to identify the remanence Br value of the PMs.

The proposed approach has been applied to identify the magnetic material of 3-kW, 2-pole surface mounted PMSM. The results, which will be explained in the extended full paper, show a good correspondence between the reconstructed *B*-*H* characteristic of the stator and rotor core material compared to the original magnetic material properties. The value of the recovered B_r is 1.05 T with 5% recovery error.

[1] MIYAGI, D. *et al.*: IEEE Transactions on Magnetics, **46-2** (2010), 318-321.
[2] ABDALLH, A. *et al.*: IEEE Transactions on Magnetics, **48-4** (2012), 1621-1624.

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