



Iron loss prediction with PWM supply: An overview of proposed methods from an engineering application point of view

A. Boglietti*, A. Cavagnino

Politecnico di Torino – Dipartimento di Ingegneria Elettrica, Corso Duca degli Abruzzi, 24, 10129 Torino, Italy

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ABSTRACT

The present work compares three different methodologies reported in the literature for the iron loss prediction in magnetic lamination used in apparatus supplied with PWM waveform. The target is the comparison of these methods from an engineering point of view. In particular, the authors analyze the practical use of the methods, such as the measurement and/or calculation procedure difficulties inherent each method. The theoretical approach and the use of these compared methods have been reported in detail and suitable tests have been performed for a correct comparison of the obtained results. The comparison has shown that the methods are similar from the result point of view. As a consequence, from an engineering approach, the three methods can be considered equivalent and the choice of the method to be used can be based only on the measurement facilities available in the test laboratory.

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1. Introduction

The use of static converters, such as chopper and inverter, is a normal approach when a voltage and/or frequency variable supply is requested by the load. Currently, the simplicity and the flexibility in the use of static supply are not in discussion, but some of the effects of these static converters on the load are still under analysis by the electrical motor and drive designers. In particular, the increase of the core losses due to the static supply in the machine laminations is one of the main drawbacks to be accepted. The evaluation of the extra-losses introduced in the lamination can be still considered as an open research field and every year new approaches or methodologies are proposed in the technical literature. Roughly speaking, the papers presented in conference reports or international journals related to the iron losses prediction with static supply can be divided in two groups. The first one has in some way an origin or an approach based on physics sort, while the second one has an engineering approach. The authors do not discuss if a physic approach to the problem is better than an engineering one; anyway the differences between these two approaches are well evident, as discussed in this work.

The problem to predict the iron losses in lamination when a static supply is used goes back to the beginning of the nineties,

when the first works were presented. The paper by Fiorillo and Novikov [1] can be considered the initiator of the technical literature in this subject. This paper is based on a hard physic approach and it was still far from the actual static supply such as PWM waveform. Anyway, the proposed approach has been the starting point for further studies and researches. In fact, nineties and the first years of the new century are a blossom of interesting papers and [2–18] are the most recurring in the references.

In the present work, the authors have selected three different methodologies reported in the literature in order to compare the results and the requested lab test benches. As a consequence, the paper aim is the comparison of these methods from an engineering point of view. In particular, the authors want to analyze the practical use of the methods, such as the measurement and/or calculation procedure difficulties inherent each methods.

Just for simplicity, the selected methods will be identified in the paper as:

- Method 1: developed by Kaczmarek and Amar in Ref. [2].
- Method 2: proposed by Barbisio et al. in Ref. [3].
- Method 3: carried out by Boglietti et al. in Ref. [4].

Obviously, the reader can find the complete description of the methods in the above-mentioned original papers reported in the references. In order to describe the differences in the methodological approach, a short theoretical summary of each method is reported in Section 2.

* Corresponding author. Tel.: +39 011 5647128; fax: +39 011 5647199.

E-mail addresses: aldo.boglietti@polito.it (A. Boglietti), andrea.cavagnino@polito.it (A. Cavagnino).