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***Abstract* – The paper provides the results of a detailed experimental study on the variations of the characteristics of an interior permanent magnet synchronous motor, when load, speed and/or magnetization conditions vary. In particular, the characterization is carried out by assessing, for several working conditions, the motor parameters that influence its efficiency. From the knowledge of the variability of these parameters, it is possible to develop a dynamic model of the motor, which accurately describes its behaviour and allows estimating the power losses for whatever speed and load. In order to validate the model, the values of the power losses obtained by using the model are compared with the values measured with experimental tests.**

The study shows that it is possible to maximize the motor efficiency just acting on the direct axis current component and, therefore, it can be considered a first step towards the definition of a loss model algorithm for a control drive system able to minimize in real-time the power losses of the motor.

***Keywords* – interior permanent magnet synchronous motors, power loss minimization, speed control drive systems.**

I. INTRODUCTION

The interior permanent magnet synchronous motors (IPMSMs) are more and more employed in several low/medium power industrial drive applications. Their wide spread is due to their better performances with respect to the traditional synchronous and asynchronous motors; in particular the IPMSMs have higher power factor, higher torque/weight ratio and higher power/current ratio. Furthermore, the increasing adoption of IPMSMs for several industrial applications over the last decades has been also supported by the achievement of innovative control algorithms.

A relevant branch of these strategies is represented by the Loss Model Algorithms (LMAs), which consider the power losses minimization of the motor by choosing the appropriate level of magnetization in order to maximize its efficiency for different working conditions. The most diffused losses minimization approaches presented in the literature [1-7] can be classified in two main categories: the Search Control (SC) and the Loss Model Control (LMC).

The first strategy consists of a step-by-step change of a control variable and a real-time measurement of the active power of the motor. More in particular, for every change of the control variable, the active power of the motor is measured and compared with the value corresponding to the previous iterative step. This technique does not require either the knowledge of the model or the values of the machine parameters. However, the torque pulsation generated by the step-by-step change of the control variable can be a significant disadvantage for the SC technique. Some examples are reported in [8-11]. On the contrary, the LMC strategy is based on the development of mathematical and circuital models that estimate the energy losses during the operation of the motor. This technique acts on the control quantities as