Chapter 21

Electrical Motor Parameters Estimator Improved by a Computational Algorithm

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ABSTRACT

In this chapter, two computational algorithms are proposed and applied on an estimation algorithm, in order to improve the global performance of the estimation phase. The proposed system is studied based on the Model Reference Adaptive System (MRAS). The importance of the estimation phase in a large applications number is basically observed on the applications applied on electrical motors, where a lot number of parameters are measured with real measurement equipments, as Tesla Meter, speed shaft, and others. The idea is based generally on the software applications, where it is possible to guarantee the desired estimation phase using a software algorithm. In this chapter the MRAS technique is proposed as the software algorithm, for replacing the measurement materials for online estimate the overall characteristic PMSM parameters. Our approach aims to ameliorate the MRAS technique with intelligent optimization methods called BFO and PSO.

1. INTRODUCTION

In the last decade, the majority applications related to the industrial, militaries, robot and automobile are basing on the electrical motor, due to many causes related to the environment protection and energy saving and especially to the high efficiency. In the literature many motor models and types are presented and each model is requested for a specific application. Electrical vehicles applications will be widely used
in the common years due many advantageous as: simplicity of architecture, robustness, and no need for a periodic maintenance and especially for the rapid depletion of the Earth’s petroleum resources. This system seems interesting for the major researches related to the electrical motor drive.

As presented by Zhu and Howe (2007), which is interested in her study by the electrical vehicles. The electrical vehicle can be operated by at least one electrical motor. The same previous cited authors, was present in them work the importance of the electrical motor choice, face the global efficiency of the vehicle. Many motor models are exposed and compared in his paper. The factors basing on to fix his choice are:

- High reliability and robustness.
- High efficiency over wide speed range.
- High torque density and power density.
- High torque for starting at low speeds and hill climbing.
- Wide speed range.
- Motor size.

In the electrical vehicle application, the most used motors type are the induction motor, switched reluctance motor and the permanent magnet synchronous motor. Zhu and Howe (2007), accomplish a comparative study between these motors type and he proves the efficiency of the Permanent magnet synchronous motors face to the other types. In this context, many researches are established in order to known the control strategy methods, the advantage, disadvantage, difficulty and the problems related to this system. In the control applications, the major new theory, searches the robustness control target, face the external and internal perturbation. Generally, the external perturbation, as load torque, temperature, vibration or dust will affect the system robustness. Those decrease the system performance. In the conventional control methods, the overall system is based on a lot of sensors, for measuring speed, temperature or in some application the vibration. These sensors upgrade the totally cost and increase the architecture complexity. Therefore, many techniques are appeared to reduce the cost of the totally PMSM control loop and to upgrade the control techniques as explain by Lakshmi and all (2013), Kraiem and Messaoudi (2009).

In the electrical vehicle applications, the used motors can be operated at different speed range, and the desired speed can touch the maximum one as demonstrate by Bae and all (2003). However in this running mode, the major problems are appeared in the PMSM parameters variation as discuss by Emadi and all (2008). This is due to the cited previous problems due to the external environment characteristics. Also Flah and Sbita (2012), prove the influence of the high speed mode on the internal motor parameters. These PMSM parameters variations influence are also tested and verified of the identification technique by Chen and all (2012), on the control loop by Lakshmi and all (2013), Stefan and Tomasz. (2011) and Ben Hamed and Sbita (2008) and on the field weakening algorithm by Nalepa and Orlowska-Kowalska (2012) and Tursini and all (2010) etc. So, refers to these reasons, PMSM parameters identification are extremely required. Many methods are proposed aiming to bring up high parameter tracking algorithms. Bolognani in his work was presented the recursive parameters identification method to estimate the PMSM parameters as explain by Bolognani and all (1997).