

PARAMETRIC SENSITIVITY OF A REDUCED ORDER MODEL BASED OPTIMAL CONTROL OF AN ELECTRIC MACHINE

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Abstract. This paper deals with the optimal control applied to the reduced order model of an electric machine system. An original approach to study the effect of the parametric variations of such machine on the optimal control is proposed. A discussion on the sensitivity of the machine parametric variations is carried out using an error criterion. Simulation results show that the obtained performances are practically unaffected by the machine parameter variations.

Keywords. Parametric Sensitivity, Optimal Control, Model Reduction, Singular Perturbation, Doubly Fed Synchronous Machine.

AMS (MOS) subject classification:

1. Introduction

It is well known that systems are difficult to analyze when they are large. Many examples of such systems are encountered. One of the solution which has been used in the literature is to reduce the order of the system without losing its main characteristics. The case of singular perturbation, which is defined below, is particularly important. In fact, the model reduction leads to obtain smaller matrix gain and easier controller. This paper treats the parametric sensitivity on the optimal control strategies of electric machines, with the application to the Doubly Fed Synchronous Machines (DFSM). First of all, the machine is described by a sixth order nonlinear model. The study around an operating point leads to the linearization of this model around an operating point which gives a linear sixth order model. In order to separate the rapidly varying quantities and the slowly varying quantities of the linear model of the machine, we have used the singular perturbation approach (*Kokotovic* 1975 [12]). All electrical quantities (stator and rotor flux components) are considered as rapidly varying quantities. This choice was proven by *Derbel et al.* 1994 [2, 3]. Thus, the machine model will be reduced to a second order system. This needs the computation of the so-called decoupling matrix, solution of a nonlinear algebraic Riccati equation (*Kokotovic* 1975