PERFORMANCE COMPARISON OF SLIM DRIVE WITH ANFIS CONTROLLER

By

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ABSTRACT

Normally speed control of a Single-Sided Linear Induction Motor (SLIM) by an indirect vector control scheme is difficult because the motor's parameters are time-dependent and the performance depends on various factors such as end effect, saturation, location of primary losses, and iron losses. Traditional PI current regulators are commonly used in vector regulators, but there is a tuning problem due to the oscillation of an operating point. This problem can be overcome by substituting an adaptive neuro-fuzzy-based current controller, and this controller improves the operation of a SLIM, such as its motor speed and thrust force. In this adaptive neuro-fuzzy controller, the ID and IQ errors and the error delay are inputs, and its outputs are Vds and Vqs, respectively. It is trained based on available values. A SLIM's dynamic modelling is implemented by dividing current (I) and flux-linkages into two terms. In these two terms, one is dependent on the end effect, and the other is independent of the end effect. The function of a Voltage Source Inverter (VSI)-fed indirect vector-controlled SLIM drive is simulated in MATLAB/Simulink, and its operation under various operating conditions is studied using an adaptive neuro-fuzzy current controller. These results are compared to a traditional P-I controller. The Pulse Width Modulation (PWM) technology that is used for controlling the VSI is called Space Vector Modulation (SVM).

Keywords: d-q Model, Synchronously Rotating Reference Frame, Indirect Vector Control, End Effect, ANFIS.

INTRODUCTION

Recently the use of SLIM has been increasing in many applications such as transportation e.g. trains (Lim et al., 2017; Seo et al., 2018), industrial process fields and sliding doors because of the high starting thrust force, minimizing the gearing between the motor and moving devices, reducing mechanical losses and the size of the Movement devices, high-speed operation, no noise, low cost, low energy consumption, low pollution and so no (Ravanji & Nasiri-Gheidari, 2015). The secondary foil experiences rapid production and disappearance of air-gap flux density at the ends, as well as high eddy current in the opposite direction of the primary flow, affecting the distribution of an air-gap flux along the x-axis (longitudinal) direction; this is known as the longitudinal end effect or end effect denoted. This end effect depends on the speed and performance of SLIM, which are affected by various phenomena such as saturation of primary and secondary, core losses, and half-full slots (Xu et al., 2010). Therefore, this accurate dynamic model is required for the analysis of the operation of SLIM under different operating conditions and also for the application of different speed control techniques (da Silva et al., 2004). This paper is organized as follows: Linear induction motors and sided linear induction motors are used in the first section. In the third section, the d-q axis dynamic model for a SLIM is developed while considering the end effects. Then in the fourth section, an indirect vector control scheme based on the mentioned SLIM model will be derived, including

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