Ain Shams University
Faculty of Engineering
Electrical power and Machines Dept.

Performance Evaluation of Transverse Flux Electrical Linear Motor

M.Sc. Thesis
By

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Submitted in partial fulfillment of the Requirements for the M.Sc. Degree in Electrical Engineering

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APPROVAL SHEET

For The thesis:

PERFORMANCE EVALUATION OF TRANSVERSE FLUX ELECTRICAL LINEAR MOTOR

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Name, title and affiliation	Signature
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Statement

This thesis is submitted to Ain Shams University in partial fulfillment of the requirements for M.Sc. degree in Electrical Engineering.

The included work in this thesis has carried out by the author at the Electrical Power and Machines Department, Ain Shams University. No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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To

My father who is always supporting me and guide me to the success, my brother, my family and my friends who gave me strength till finishing this thesis.

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ABSTRACT

The transverse flux linear motor (TFLM) drive is nowadays one of the most interesting electric drives due to its good features that made it comparable with the other electric drives, for certain application.

In this thesis, The dynamic response of an TFLM has been obtained using information derived from the finite element analysis (FEA), which can determine the exciting coil flux-linkages as a function of both the coil current and the linear position of the mover. This work has been achieved through a digital simulation study of the mathematical model of the motor.

This model comprises a set of phase circuit equations in addition to the mechanical differential equations of motion. These equations are then solved using numerical integration of the nonlinear differential equations of the motor using the magnetization data expressed in the form of a look-up table $\Psi(x, i)$. The cubic spline interpolation is used to determine the intermediate values of the variables given by the look-up table, which, in turn, gives more accurate representation than other methods. This method is applied to compute the instantaneous values of the current and force for each phase and the total thrust force.

Early “traditional” controllers for TFLM have a simple control technique. This control technique causes ripples in the thrust force and speed profiles to take place. Since the thrust force developed by a TFLM is a nonlinear function of phase currents and mover position such ripples often occur. These ripples represent one of the main disadvantages of this type of motors.

The main contribution of this thesis is the development of an artificial neural network controller (ANN) for transverse flux linear motors for the purpose of speed control. The dynamic response of the TFLM with the proposed controller is studied during starting, and under different load disturbances. The effectiveness of the proposed artificial neural network controller is then compared to both of the conventional proportional plus integral plus derivative controller (PID), and the fine tuning of the PID controllers by using Ziegler-Nichols Rules. The dynamic response of the TFLM with this proposed controller is found to be fast and of high speed response.

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