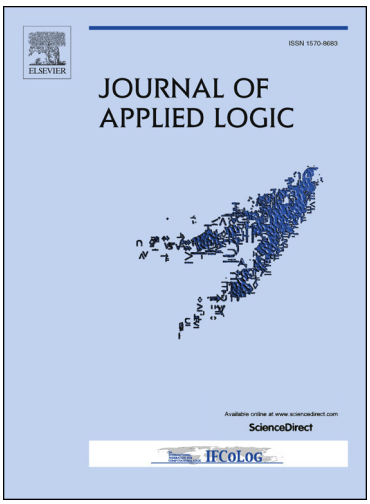
Accepted Manuscript



Sensorless control of variable speed induction motor drive using RBF neural network

Pavel Brandstetter, Martin Kuchar

PII: S1570-8683(16)30071-4
DOI: http://dx.doi.org/10.1016/j.jal.2016.11.017
Reference: JAL 448

To appear in: *Journal of Applied Logic*

Please cite this article in press as: P. Brandstetter, M. Kuchar, Sensorless control of variable speed induction motor drive using RBF neural network, *J. Appl. Log.* (2016), http://dx.doi.org/10.1016/j.jal.2016.11.017

Sensorless Control of Variable Speed Induction Motor Drive Using RBF Neural Network

Pavel Brandstetter[1], Martin Kuchar[1]

[1]VSB - Technical University of Ostrava, Department of Electronics, 17. listopadu 15/2172, 70833 Ostrava-Poruba, Czech Republic
e-mail: pavel.brandstetter@vsb.cz

Abstract. High power of modern digital signal processors and their decreasing prices enable practical implementation of different speed estimators which are used in the sensorless control of AC drives. The paper describes application possibilities of artificial neural networks for the sensorless speed control of the A.C. induction motor drive. In the sensorless control structure of the A.C. drive, there is implemented the speed estimator which uses two different artificial neural networks for speed estimation. The first speed estimator uses a multilayer feedforward artificial neural network. Its properties are compared with the speed estimator using a radial basis function neural network. The sensorless A.C. drive was simulated in program Matlab-Simulink. The main goal of many simulations was finding suitable structure of the artificial neural network with required number of neuron units which will ensure good control characteristics and simultaneously will enable a practical implementation of the artificial neural network in the digital signal processor control system.

Keywords: Artificial neural network, RBF neural network, vector control, sensorless control, induction motor, A.C. drive.

1 Introduction

The evolution of A.C. variable-speed drive (VSD) technology was driven partly by the desire to emulate the excellent performance of the D.C. motor, such as fast torque response and speed accuracy. Development of modern VSDs is characterized by process made in various areas including electrical machines, power electronics, control systems, and control algorithms [1]-[5].

At present, software tools can be used for evaluation of the rotor speed and position without usage of the speed sensor. Due to modern digital signal processors it is possible to implement complex estimation algorithm in real-time with the possibility of monitoring currents and voltages.

Removing rotor position sensor or mechanical speed sensor from the control structure of the electrical drive leads to so-called sensorless electrical drive, which naturally requires other sensors for the monitoring of stator currents and voltages (see Fig.1).

In the scientific literature, there is possible to find many estimation techniques used for the sensorless electrical drives which can be divided into following groups [6]-[8]:

- Estimators working in open loop with monitoring of stator currents and voltages.
- Systems with reference and adaptive models (MRAS).
- Estimators deriving benefits of space saturation of stator voltage utilizing phases voltage monitoring.
- Estimators exploiting possibilities of slot harmonic.
- Estimators with observers (Kalman filter, Luenberger observer, etc…).
- Estimator using injection methods.
- Estimators using soft computing methods.

The applications of the soft computing methods in the control of electrical drives, which include artificial neural network (ANN) applications, discuss ANN based speed or position estimator applications. The ANN speed estimators can lead to improved performance enhanced adaptive capabilities [9]-[15].