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# A NEURO-FUZZY CONTROLLER FOR EFFICIENT OPERATION OF WATER PUMPING SYSTEM

A dissertation submitted to the  
Department of Electrical Engineering, University of Moratuwa  
in partial fulfillment of the requirements for the  
degree of Master of Science

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## DECLARATION

The work submitted in this dissertation is the result of my own investigation, except where otherwise stated.

It has not already been accepted for any degree, and is also not being concurrently submitted for any other degree.

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We/I endorse the declaration by the candidate.

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## ABSTRACT

The need for energy conservation is increasing the requirements for increased levels of electric motor & pump efficiencies. Controlling motor speed with load change has proven very successful in many applications such as water pumping. It is therefore important to optimize the efficiency of motor drive and pump systems if significant energy savings are to be obtained. The system gives best performance when system operates at the rated operating condition with the constant pressure head. But in actual operation the system is operating different operating point due to present system condition. (Actual system head may vary with the sump level, and the designed pump characteristics may not match with the present condition, so on). This causes to inefficient system operation.

This thesis proposes a new control scheme based on Neuro-Fuzzy concepts. The fuzzy logic concept used computes the required motor speed to meet the optimum overall efficiency of the pumping system in the presence of the variation of the output pressure, sump level and tank level. An Artificial Neural Network (ANN) used to predict the required Voltage and Frequency as the speed changes.

The network was trained on a set of data patterns generated by calculation based on the induction motor with pump equivalent circuit, using Matlab/Simulink computer programme. A simulation result of overall efficiency and specific energy consumption has shown a very good concordance between the two methods. (with or without Neuro-Fuzzy controller).

The detail of overall energy saving while proposed Neuro-Fuzzy control shows below table.

Energy savings	433,555 kWh per annum
Benefit	Rs. 3,077,850.00 per annum

The proposed methods can be easily implemented on pumping system equipped with pressure sensors. However, like many pumping system control techniques, the developed model is sensitive to motor and pump parameter variation due to temperature changes.

Finally, the advantages that can be gained by Neuro-Fuzzy controller with the proposed efficiency optimization algorithm are tremendous, and energy saving can be achieved with a very high percentage, specially in the field of water pumping systems.

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