Ain Shams University

Faculty of Engineering

Computer and Systems Engineering Department

ON OPTIMIZED PERFORMANCE OF REAL TIME MULTIPROCESSING SYSTEMS WITH PARTIONED AND RECONFIGURABLE FEATURES

BY

HASSAN MOHAMED HASSAN MOSTAFA

Thesis

Submitted in Fulfillment for the Degree of

DOCTOR OF PHILOSOPHY

IN

ELECTRICAL ENGINEERING

(COMPUTERS & SYSTEMS)

Supervised by

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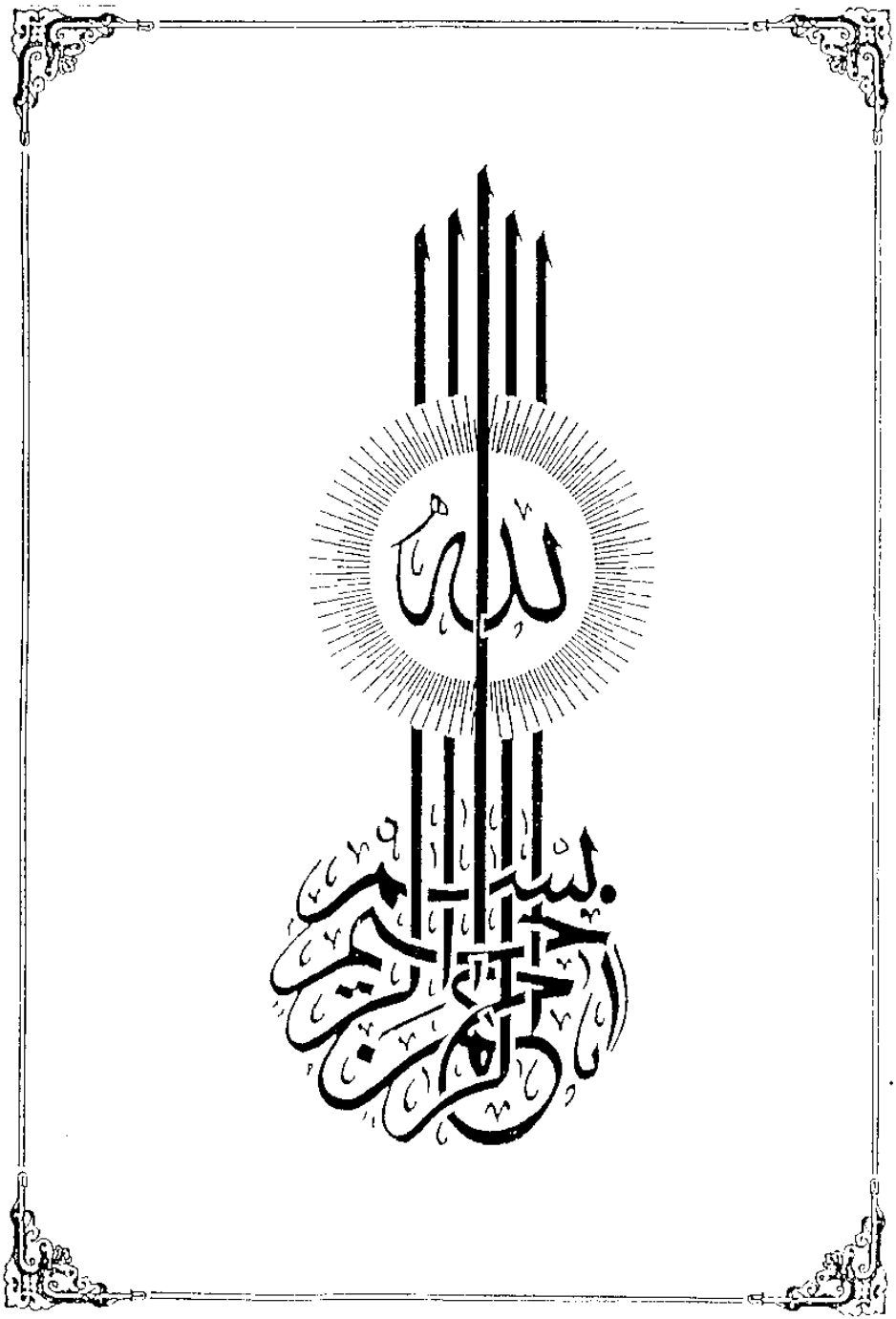

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Date : 10 / 8 / ***1996.***

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Statement

This dissertation is submitted to Ain Shams University for the degree of Doctor of Philosophy in Electrical Engineering.

The work included in this thesis was carried out by the author in the Department of Computer and Systems Engineering, Faculty of Engineering, Ain Shams University, Cairo, Egypt, during the period from 1989 to 1996.

No part of this thesis has been submitted for a degree or a qualification at any other University or Institution.

Date: 10/08/1996.

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Name: H.M. Hassan.

Keywords : *Distributed Detection Systems , Neural Networks , and Multi-sensor Data Fusion .*

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Abstract

Practical distributed multiprocessing system are too huge and diverse to apply centralization processing. This is due to the massive amount of information collected at various elements of the system. Atypical such system is the distributed detection system. Many researchers showed that some problems associated with the distributed detection system are so complex that conventional methods for computing are infusible as solutions of such problems (NP Complete).

This thesis comprises an approach to attack the distributed multiprocessing system. Adaptive neural network models are adopted and suggested to be used to design and optimize the performance of the system. The resulting system acquires its experience from the input information and so improves its behavior. Optimum design of the distributed system is obtained through neural network adaptive estimation of that system parameters. Global decision of the system is

performed using a biological data fusion model that learns by interaction with the environment. Thus the system is adaptive to any environmental changes and responds in real time. Consequently, the optimality of the performance of the distributed detection systems could be reached using only the available raw data. In this case the observations obtained about the considered phenomenon is the only available information So, the optimum decision rule for any of the local detectors is computed. Also, the biological fusion basis is applied for local decisions to come up with the global decision of distributed detection system in the real time.

The thesis is divided into five main chapters as follows:

Chapter I

A review of the detection problem is given. Elements of the detection problem are illustrated. Different versions of the decentralized detection problem are analyzed. Some versions of the decentralized detection problem are presented.

Chapter I concludes that the decentralized detection problem in its simplest case is an NP-complete problem. Only suboptimal solutions are possible and different nonconventional techniques should be attempted.

Chapter II

An analogy between detection networks and neural networks is given. This suggests using adaptive techniques and artificial biological models to solve some of the distributed detection subproblems. Also, an adaptive neuron model is presented that learns by interaction with the environment. The Kohonen self-organized layer could be used to estimate the probability density function of the background noise.

Chapter III

Optimum solution of the decentralized detection problem involves optimizing local decision rules for every fusion rule. Instead of this we suggest and give a procedure for extracting local decision rules from the data through a training process under the null hypothesis. As more observations are available the threshold of each decision rule is more adjusted.

Chapter IV

The fusion rule is based on artificial biological neuron with weights adjusted through the learning process. The neuron counts the agreement and disagreement of each local decision and then estimates the credibility of each local decision rule and updates the weights accordingly. This procedure is based on results from conventional optimum fusion of local decisions if the characteristics of the signals are known. It is also based on the learning with interaction with the environment. The details for the design procedure are shown in this chapter.

Chapter V

The summary of this thesis is given. Also, some conclusive remarks and suggessions for future research directions are introduced.

Contribution of this Dissertation

The main contribution of this dissertation include:

1- Information processing in distributed systems using Neural Networks Techniques.

2- Estimation of optimum local decision rules using a neural networks learning process.

3- Modeling of a data fusion center of local decision based on biological observations and hypothesis.

4- Modeling of single biological neuron to learn the input-output relation by interaction with the environment.