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**ADVANCES IN PATTERN CLASSIFICATION USING  
IMPROVED ANN, SPIKING NEURAL NETWORK AND  
DECISION TREE**

by

**VENKATANARESHBABU KUPPILI**

Department of Mathematics

Submitted

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# Certificate

This is to certify that the thesis entitled which is being submitted by **Mr. VENKATANARESHBABU KUPPILI** for the award of the degree of **Doctor of Philosophy in the Department of Mathematics** to the **Indian Institute of Technology, Delhi**, is a bona fide research work done under my guidance and supervision.

The thesis has reached the standard fulfilling the requirements of the regulations relating to the degree. The results obtained in the thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

**Date:**

**Place:**

**Dr (Mrs.) B. Chandra**  
Professor  
Department of Mathematics  
Indian Institute of Technology Delhi  
Hauz Khas, New Delhi

**Dr M. Hanmandulu,**  
Professor  
Department of Electrical Engineering  
Indian Institute of Technology Delhi  
Hauz Khas, New Delhi

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# Abstract

The thesis aims to evolve improved Architecture for Artificial Neural Network models and efficient Decision tree techniques for pattern classification. New spiking Neural Network models have also been developed for pattern classification. The potential of various proposed algorithms is supported by analytical results and numerical simulations. The focus is on Neural Network architectures in terms of internal and topological adjustments. Development of internal adjustments is based on formulating a new algebraic activation function called Parametric Algebraic Activation function (PAA) for Multilayer Perceptron (MLP). It satisfies all the important properties that an activation function should satisfy. PAA performs superior as compared to transcendental activation functions in terms of classification accuracy. Topological adjustment in MLP is also important since more than the required number of hidden neurons causes overfitting. A new hidden node pruning algorithm called Fisher score pruning algorithm has been developed in the thesis to decide the number of hidden neurons. FPA computes hidden node relevance values using continuous activations and target vector without loss of information. An Improved Architecture for Probabilistic Neural Network (IAPNN) has also been formulated to reduce the number of layers in Probabilistic Neural Network (PNN) IAPNN contains only three layers in contrast to PNN which contains four layers. It is shown that IAPNN takes very less computational time to classify an unknown pattern when compared to PNN.

Neural Networks have also been visualized from the biological point of view. Various new spiking neuron models have been developed. The interspike intervals has been as an aggregation function in Wavelet Radial Basis Neural Network (WRNN) and multiplicative single neuron models for pattern classification. Finally, a new split measure has been designed using local and global information at a split point to construct a compact decision tree for pattern classification.

# Contents

<b>Certificate</b> .....	ii
<b>Acknowledgments</b> .....	iii
<b>Abstract</b> .....	iv
<b>List of Figures</b> .....	ix
<b>List of Tables</b> .....	xi
<b>Chapter 1 Introduction</b> .....	1
1.1 Neural Networks.....	1
1.1.1 Neural Network Models.....	2
1.1.2 Improvement of Generalization Performance of Multilayer Perceptron.....	3
1.1.3 Existing Techniques for Internal Adjustment of MLP.....	3
1.1.4 Existing Techniques for Topological Adjustment.....	4
1.1.5 One Pass Neural Network Models.....	4
1.2 Spiking Neuron Models	
1.2.1 Spiking Neural networks.....	6
1.3 Decision Tree.....	6
1.4 Research Gap.....	8
1.4.1 Research Gap in the Techniques for Internal Adjustment in MLP.....	8
1.4.2 Research Gap in the Techniques for Topological Adjustment in MLP.....	8
1.4.3 Research Gap in the Techniques for Topological Improvement in PNN.....	9
1.4.4 Research Gap in the Area of Spiking Neuron Models for Pattern Classification.....	9
1.4.5 Research Gap in the Development of Efficient Split Measure for Construction of Decision Trees.....	9
1.5 Overview of the Contents of the Thesis.....	10
<b>Chapter 2 Algebraic Activation Function for Internal     Adjustment of Multilayer Perceptron</b> .....	13
2.1 Introduction to Related Work.....	13
2.2 Overview of Activation Functions.....	14
2.2.1 Sigmoid Activation function.....	14
2.2.2 Tan-hyperbolic Activation function.....	15
2.2.3 Piecewise linear function.....	15
2.2.4 Algebraic Sigmoid function.....	15
2.2.5 Elliott function.....	16
2.3 Parametric Algebraic Activation (PAA).....	16

2.4 Resilient propagation using PAA.....	21
2.5 Performance of proposed Parametric Algebraic Activation (PAA).....	23
2.6 Conclusions.....	27
<b>Chapter 3 New Approach for Topological Adjustment of Multilayer Perceptron.....</b>	<b>28</b>
3.1 Introduction to Related Work .....	28
3.2 Overview of Hidden Node Pruning Algorithms.....	29
3.2.1 Mozer-Smolensky value.....	29
3.2.2 Pruning using Cross Validation.....	29
3.2.3 Silent Pruning Algorithm.....	30
3.2.4 Random Deletion Algorithm.....	30
3.3 Proposed Fisher score Based Pruning Algorithm(FPA).....	30
3.3.1 Details of Sequential Process of FPA algorithm.....	31
3.3.2 Details of Iterative Process of FPA algorithm.....	32
3.4 Effectiveness of Fisher score Based Pruning algorithm (FPA).....	33
3.4.1 Performance of Sequential Process of FPA Algorithm(SFPA).....	34
3.4.2 Performance of Iterative Process of FPA Algorithm(IFSP).....	37
3.4.2.1 Implementation Procedure of IFSP.....	37
3.4.2.2 Comparative Performance results of IFSP.....	38
3.5 Conclusions.....	42
<b>Chapter 4 Topological Reduction and</b>	
<b>Incremental Learning in Probabilistic Neural Network.....</b>	<b>43</b>
4.1 Introduction to Related Work.....	43
4.2 Probabilistic Neural Networks.....	44
4.3 Proposed Improved Architecture of PNN.....	46
4.4 Proposed Incremental IAPNN.....	49
4.4.1 Description of Incremental IAPNN model.....	49
4.4.2 Algorithm for Incremental IAPNN (IIAPNN).....	50
4.5 Results.....	52
4.5.1 Experimental Results using IAPNN.....	52
4.5.1.1 Description of Datasets.....	52
4.5.1.2 Performance Evaluation of IAPNN.....	54
4.5.2 Incremental Learning using IAPNN (IIPANN).....	56
4.6 Conclusions.....	58
<b>Chapter 5 Spiking Neuron Models for Pattern Classification.....</b>	<b>60</b>
5.1 Introduction to Related Work.....	61
5.2 Nonlinear Integrate-and-Fire Neuron Models.....	62

5.2.1	Leaky Integrate-and- Fire (LIF).....	63
5.2.2	Quadratic Integrate-and- Fire (QIF).....	64
5.2.3	Exponential Integrate-and- Fire (EIF).....	64
5.3	Proposed Neuron model.....	65
5.4	Results of Proposed Model Vs. Quadratic Neuron Model.....	69
5.5	Proposed Non Linear IFN Model.....	72
5.6	Proposed Single Neuron Model for Pattern Classification.....	73
5.7	Results.....	74
5.8	Conclusions.....	76
<b>Chapter 6 Spiking Wavelet Radial Basis Neural Network</b>		
	<b>for Classification of Gene expression data.....</b>	<b>78</b>
6.1	Introduction to Related Work.....	78
6.2	Proposed Spiking Neuron Model.....	79
6.3	Wavelet Radial Basis function Neural Network.....	82
6.4	Spiking Wavelet Radial Basis Neural Network .....	84
6.4.1	Derivation of new aggregate function .....	84
6.4.2	Construction of Spiking Wavelet Radial Basis Neural Network (SWRNN) .....	85
6.5	Results.....	87
6.6	Conclusions.....	91
<b>Chapter 7 A Heterogeneous Node Split Measure</b>		
	<b>for Efficient Decision Tree Construct.....</b>	<b>93</b>
7.1	Introduction to Related Work.....	93
7.2	Overview of Existing Split Measures.....	95
7.2.1	Information Gain.....	95
7.2.2	Gain ratio.....	96
7.2.3	Gini index.....	96
7.3	Proposed Measure - Heterogeneous Split Measure (HSM).....	97
7.3.1	HSM for a Three Class Problem.....	102
7.3.2	3 D-View of HSM.....	103
7.4	Illustration of HSM.....	103
7.4.1	Construction of Decision Tree using HSM.....	104
7.4.2	Construction of Decision Tree using Gini-index.....	105
7.5	Results.....	107
7.6	Conclusions.....	111
<b>Chapter 8 Conclusions and Future Scope.....</b>		
		<b>112</b>



**References**.....114

**List of Publications**.....124

**Brief Bio-data of the author**.....125