

## ***CONTENTS***

<i>Certificate</i>	<i>ii</i>
<i>Declaration by the Candidate</i>	<i>iii</i>
<i>Copyright Transfer Certificate</i>	<i>iv</i>
<i>Acknowledgements</i>	<i>v</i>
<i>Contents</i>	<i>ix</i>
<i>List of Figures</i>	<i>xii</i>
<i>List of Tables</i>	<i>xviii</i>
<i>Preface</i>	<i>xx</i>

# CONTENTS

<b>1</b>	<b>INTRODUCTION.....</b>	<b>1</b>
1.1	Challenges in the analysis of MRI data.....	3
1.2	Objectives of the Thesis .....	5
1.3	Contribution of the Thesis .....	5
1.4	Organization of the Thesis.....	6
<b>2</b>	<b>THEORETICAL BACKGROUND .....</b>	<b>9</b>
2.1	Noise estimation techniques .....	10
2.2	Methods to De-noise the MRI data.....	11
2.3	Enhancement of MRI data.....	14
2.4	Segmentation of MRI data.....	17
2.4.1	Cluster quality index for unsupervised segmentation.....	21
2.5	Role of optimization in image analysis .....	22
2.5.1	Evolutionary Computation based optimization techniques .....	23
2.6	Stochastic Resonance .....	24
<b>3</b>	<b>ADAPTIVE NOISE ESTIMATOR FOR THE APPLICATIONS OF DE-NOISING AND SEGMENTATION OF MRI DATA .....</b>	<b>27</b>
3.1	Introduction .....	28
3.2	Problem formulation.....	31
3.2.1	Estimation of noise variance .....	31
3.2.2	Multi-objective Particle Swarm Optimization (MOPSO) .....	33
3.3	De-noising of MRI data using non-local Kalman filter.....	36
3.4	Experimental material and algorithm .....	37
3.5	Results and Discussion.....	39
3.5.1	Proposed de-noising algorithms on real MRI data .....	42
3.5.2	Comparison of proposed de-noising algorithms with standard algorithms .....	44
3.6	Conclusions .....	49
<b>4</b>	<b>OPTIMIZATION TECHNIQUES BASED BI-STABLE DYNAMIC STOCHASTIC RESONANCE FOR THE ENHANCEMENT OF MRI DATA .....</b>	<b>51</b>
4.1	Introduction .....	52

4.2	Dynamic stochastic resonance .....	54
4.2.1	Quartic Bistable Model .....	55
4.2.2	Potential Neuron Model .....	56
4.2.3	Cascaded DSR .....	58
4.3	Optimization techniques .....	59
4.3.1	Particle Swarm Optimization .....	59
4.3.2	Bat Algorithm .....	61
4.3.3	Multi-objective optimization.....	62
4.4	Material and Methods .....	63
4.4.1	Fitness functions used in the study.....	63
4.4.2	Selection of the dominant solution from Pareto fronts .....	65
4.4.3	Constraints on variables .....	66
4.5	Results and Discussion .....	67
4.5.1	Optimized quartic bi-stable model of DSR.....	67
4.5.2	Optimized modified neuron model of DSR .....	73
4.5.3	Optimized cascaded model of DSR .....	82
4.6	Conclusions.....	89
<b>5</b>	<b>ENHANCEMENT AND INTENSITY INHOMOGENEITY CORRECTION OF DIFFUSION-WEIGHTED MR IMAGES OF NEONATAL AND INFANTILE BRAIN .....</b>	<b>91</b>
5.1	Introduction.....	92
5.2	Mathematical formulation for removal of shading artefact .....	95
5.3	Material and Methods .....	96
5.3.1	Particle Swarm Optimization .....	98
5.4	Results and Discussion .....	99
5.4.1	Comparative study .....	102
5.4.2	Comparative analysis on real DWI of infantile/ neonatal brain.....	106
5.5	Conclusions.....	109
<b>6</b>	<b>AN OPTIMIZED MULTI-STABLE STOCHASTIC RESONANCE FOR THE ENHANCEMENT OF PITUITARY MICROADENOMA IN MRI.....</b>	<b>111</b>
6.1	Introduction.....	112
6.2	Wavelet based Multi-Stable Stochastic Resonance .....	116

6.3	Multi-objective Ant lion optimization.....	118
6.3.1	Problem objectives .....	120
6.4	Material and Methods.....	122
6.4.1	Patients selection .....	123
6.4.2	Imaging.....	123
6.4.3	Image Analysis & Evaluation.....	124
6.4.4	Image selection and application of multi-stable DSR .....	125
6.5	Results and Discussion.....	126
6.5.1	Image analysis using optimized MSSR .....	126
6.5.2	MSSR for the detection of adenomas in pituitary gland.....	129
6.5.3	Comparison between Multi-stable and classical DSR.....	135
6.5.4	Comparative study of MOALO with other optimization algorithms .....	137
6.6	Conclusions .....	139
<b>7</b>	<b>SEGMENTATION OF MRI DATA USING MULTI-OBJECTIVE ANTLION BASED IMPROVED FUZZY C-MEANS.....</b>	<b>141</b>
7.1	Introduction .....	142
7.2	Multi-objective Antlion optimization.....	144
7.2.1	Fitness Functions.....	147
7.2.2	Selection of optimal Pareto front.....	148
7.3	Determination of cluster number .....	150
7.4	Material and Methods.....	152
7.4.1	Segmentation quality measurements .....	153
7.5	Results and discussion.....	154
7.6	Conclusions .....	161
<b>8</b>	<b>CONCLUSIONS AND FUTURE SCOPE .....</b>	<b>163</b>
8.1	Conclusions .....	163
8.2	Future directions.....	165
	<b>REFERENCES .....</b>	<b>167</b>
	<b>AUTHOR'S LIST OF PUBLICATION (ON PHD WORK) .....</b>	<b>179</b>