MAGNETIC RESONANCE BRAIN IMAGE CLASSIFICATION USING HIDDEN MARKOV RANDOM FIELD FITTED WITH MODIFIED EXPECTATION-MAXIMISATION ALGORITHM

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A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL FEDERAL UNIVERSTY OF TECHNOLOGY, MINNA, NIGERIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE MASTER OF TECHNOLOGY IN MEDICAL PHYSICS

ABSTRACT

The segmentation of brain tissues from magnetic resonance (MR) images is of primary importance for subsequent diagnosis, pathological analysis, prognosis assessment, and brain development monitoring. Accurate segmentation is quite challenging because of the tissue heterogeneity, which is caused by bias field, partial volume effects, noise and magnetic field non-uniformities. The algorithms based on Markov random field (MRF) have shown strong abilities in dealing with noisy image segmentation compared to other methods. In this study, a hidden Markov random field fitted with modified expectation maximisation algorithm (HMRFEM) was proposed for neighbourhood correlation (addressing partial volume effect) and signal non-uniformity (intensity inhomogeneity). The algorithm has been implemented on T1weigthed simulated brain web dataset using R programming's magnetic resonance image tissue classification (MRITC) package. The study obtained a good result for segmenting the three major brain tissue types; white matter (WM), gray matter (GM) and cerebrospinal fluid (CSF) in 18%, 47% and 35% respectively. The validation measures of our results showed average tissue mean square error of 0.02901258, misclassification rate of 0.08698863, and tissue volume error of 0.057795773, 0.02458168, and 0.006265323 for cerebrospinal fluid (CSF), gray matter (GM) and white matter (WM) respectively. Dice similarity measures were found to be 0.9244405, 0.9085912, and 0.9134111 for CSF, GM and WM respectively. These results demonstrated that the algorithms returned good performance for a brain tissue classification and can be considered to be reliable for clinical use.

TABLE OF CONTENTS

Cover Page i

Title Page ii

Declaration iii Certification iv

Dedication v

Acknowledgements vi

Abstract viii

Table of Content ix

List of Figures xiii List of Tables xvi

CHAPTER ONE

1.0 INTRODUCTION 1

1.1 Background to the Study 1

1.1.1 The R package magnetic resonance Image tissue classification (MRITC) 2

1.1.2 Brain tissue 3

1.1.3 Multiple sclerosis lesion (MS lesion) 4

1.1.4 Magnetic resonance imaging (MRI) 5

1.2 Statement of the Research Problem 7

1.3 Aim and Objectives of the Study 8

1.4 Justification for the Study 9

1.5 Significance of the Study 10
1.6 Scope and Limitations of the Study 10

CHAPTER TWO

2.0 LITERATURE REVIEW 11

2.1 Magnetic Resonance Imaging in the clinic 11

2.2 Some Existing Methods of Brain Tissue Classification 12

2.2.1 Manual classification methods 12

2.2.2 Region based methods 13

2.2.3 Thresholding based methods of brain classification 14

2.2.4 Clustering based method of brain tissue classification 15

2.2.5 Classification-based methods feature extraction 16

2.3 Markov Random Field for Spatial Structure (MRF) 17

2.3.1 Model specification 17

2.3.2 Calculation of the normalization constant (β) 20

2.4 MRI Tissue Classification Based on Pure Voxel Assumption 22

2.4.1 Density plot 22

2.4.2 The hidden Markov random field expectation maximisation (HMRF-EM) 24

2.5 MRI Tissue Classification Based on Addressing the Partial Volume (PV) Effect 24

2.5.1 Theory of the mis-classes reclassification (MIXELS) 26

2.5.2 Super voxel approach 28

2.6 Markov Random Field (MRF) Segmentation 30

2.6.1 Addressing the partial effect and spatial inhomogeneity 31

2.6.1.1 Dividing the voxels into sub-voxels 31
2.6.1.2 Neighbourhood correlation and signal inhomogeneity 31
2.7 Parzen-window Distribution 33

2.8 State of the Art in MRI Brain Tissue Classification 33

CHAPTER THREE

3.0 MATERIALS AND METHOD 41

3.1 Materials 41

3.1.1 Main features of mritc 42

3.2 The Dataset 44

3.2.1 Data preparation 44

3.3 Methods 45

3.4 Generating Validation Measures 46

3.5 Generating the Summary for the Classification 49

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION 50

4.1 Result 50

4.1.1 MRITC.EM method of brain tissue classification 50

4.1.2 MRITC.ICM method of brain tissue classification 53

4.1.3 HMRF-EM method of brain tissue classification 56

4.2 Discussion 59 **CHAPTER FIVE**

5.0 CONCLUSION AND RECOMMENDATIONS 82

5.1 Conclusion 82

5.2 Recommendations 84
5.3 Contribution to Knowledge 85

REFERENCES 86

Appendices
92

Appendix A
92

Appendix B
93

Appendix C
95

Appendix D 97

Appendix E
98

Appendix F 100 **LIST OF FIGURES**

Figure Page

1.1: MRI brain scan 6

1.2: Example of T1 weighted, T2 weighted and PD weighted MRI Scan 7

2.1: Tissue classification for region-based methods in brain 13

2.2: Tissue of brain classification types in thresholding-based method 14

2.3: Types clustering based method brain tissue classification 15

2.4: Two neighbourhoods in one dimensional lattice 18

2.5: Four and eight neighbourhoods in two dimensional lattices 18

2.6: Structure illustration of neighbourhoods in three dimensions 19

2.7: Display of Coronal section and its intensity plot of three tissues of a brain from T1-weighted image (a) Coronal section (b) display of intensities in density 23

2.8: Illustration of a voxel spilt into eight sub-voxels 26

3.1: The Rstudio environment with the package MRITC installed 42

3.2: Downloaded compressed data from brain web datasets through the r cran archive 44

3.3: Setting the downloaded unzipped dataset folder as the working directory 44

3.4: The plot of the imported image using the MISC3D 45

3.5: Flowchart of the experimental process 45

3.6: Plot of the classified image base on the gray scale 46

3.7: Plot of the classified image base on colours: white matter appeared as dark green, gray matter appeared as yellow green and cerebrospinal fluids appeared as sandy brown 47

3.8: Density plot of the plotted image with actual and predicted results 47

3.9: Result of the validation measures: MSE, MISLASS, DSM, COTABLE and RSEVOLUME 49

4.1: Plots of (a) T1 image: original (b) segmentation tissue result by EM-NMM and (c) display of the segmented image and original image 51

4.2: Density plots showing the predicted tissue classes and actual using NMM-EM algorithm 52

4.3: T1 image: original (b) segmentation tissue results by EM-HNMM and (c) Display of the segmented image and original image 54

4.4: Density plots showing the predicted tissue classes and actual using HNMM-ICM algorithm 54

4.5: Plots of T1 image: original (b) segmentation tissue result by HMRF-EM and (c) Display of the segmented image and original image. 57

4.6: Density plots showing the predicted tissue classes and actual using HMRF-EM algorithm 57

4.7: Misclassification (Misclass) comparison for different methods using (a) bar charts (b) point plot and (c) box plot 61

4.8: MSE comparison for three methods using (a) bar charts (c) point plot and (c) box plots 62

4.9: RSEvolume of CSF comparison for three methods using (a) point plot (b) bar charts and (c) box plot 65

4.10: RSEvolume of GM matter comparison for three methods using (a) point plot (b) bar charts and (c) box plot. 66

4.11: RSEvolume of WM comparison for three methods using (a) point plot (b) bar charts and (c) box plot. 68

4.12: Dice similarity (DS) of CSF comparison for three algorithms using (a) point plot

(b) bar charts and (c) box plot. 70

4.13: Dice similarity (DS) of GM comparison for three algorithms using (a) point plot (b) bar charts and (c) box plot. 72

4.14: Dice similarity (DS) of WM comparison for three algorithms using (a) point plot (b) bar charts and (c) box plot. 73

4.15: Summary of the Classification for CSF comparison for three algorithms using (a) point plot (b) bar charts and (c) box plot 76

4.16: Summary of the Classification for GM comparison for three algorithms using (a) point plot (b) bar charts and (c) box plot. 77

4.17: Summary of the Classification for WM comparison for three algorithms using (a) point plot (b) bar charts and (c) box plot. 79

4.18: Bar plot of the confusion matrix for the different methods implemented 80

4.19: Line plots of the confusion matrix for the different methods implemented 81

5.1: The six-neighbourhood structure 83

LIST OF TABLES

Table Page

2.1 Some selected literature in state of the art of brain tissue segmentation 34

3.1: MRI Tissue Classification Using Various Methods 43

4.1: Validation measures using NMM-EM 52

4.2: Percentage, mean and standard deviation of the main tissue type using NMM-EM 53

4.3: Validation measures using HNMM-ICM 55

4.4: Percentage, mean and standard deviation of the main tissue type using HNMM-ICM 56

4.5: Validation measures using HMRF-EM 58

4.6: Percentage, mean and standard deviation of the main tissue type using HMRFM-EM 58

4.7: Misclassification rate (misclass) and average mean square error (mse) for the different methods for Brain Web data 59

4.8: Tissue volume error (rsevolume) for the different methods for Brain Web data 63

4.9: Dice similarity measures (DSM) for the different methods for Brain Web data 68

4.10: Summary in percentages of the classification for the different methods for Brain Web data 74

4.11: Confusion table for the different methods for Brain Web data 80