



3-D Representation System of Brain Tumors Using Magnetic Resonance Images (MRI)

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To my dear Mom in Heaven.

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Abstract

THE brain is the most sophisticated and crucial organ to human beings. It controls all the functions of the body, from the involuntary actions such as respiration, digestion and blood circulation, to motor control and sensing and finally feelings, cognition and perception.

Brain tumors are considered one of the most dangerous threats to the health of the human brain. They have various types and classifications, some are treatable and others are not. Diagnosis of brain tumors is mainly done by Magnetic Resonance Imaging (MRI) which has the ability to show the abnormal tissues. After thorough diagnosis, the treatment plan should be set which may include one or more of surgical resection, radio therapy and chemotherapy. For treatable types of tumors, the patient can be totally cured after total tumor resection. While for high grade malignant types, total resection can increase the survival time and the quality of life of the patients significantly.

One of the factors that help in efficient surgical resection of tumors is the prior knowledge of the precise shape,

location and size of the tumor. MRI cannot perform this task because the output images of the scan are in the form of a series of 2-dimensional images containing slices of the brain. Hence, the presence of accurate 3-dimensional images for the tumor will help in the resection efficiency.

This thesis presents a modified shape-based interpolation method to form a 3-D model of brain tumors using a series of MRI images. Due to some technical properties of MRI scanners, the output images have intermediate gaps, this missing information prevents accurate 3-D reconstruction for the tumor volume. Hence, the problem is to interpolate the values of tumor volume at the gap areas to get a complete 3-D model for the tumor.

First, the MRI images are segmented using Wavelet Multi-resolution Expectation Maximization (WMEM) method, then, the tumor image is extracted forming a binary image. Next, all binary tumor images are converted to distance images using a distance transform function. Then, the B-spline interpolation is applied to calculate the gap area. Finally, the resulting values are thresholded to form the interpolated slices. The tumor volume is then displayed as an isosurface in a 3-D view.

To calculate the accuracy of the method, a slice is re-

moved from the images' series, then the proposed method is used to interpolate its value. The original and interpolated slices are compared showing the accuracy. The proposed method results were compared with the original shape-based interpolation method and another method that uses Hermite interpolation. The proposed method demonstrated improvement of 5.61% and 2.78% on the original shape-based method and the Hermite interpolation method respectively.

Contents

1	Introduction	15
1.1	Brain Anatomy	15
1.2	Brain Tumors	17
1.3	Magnetic Resonance Imaging	18
1.4	Motivation	20
1.5	Computer-Aided Diagnosis	24
1.6	Objective	25
1.7	Thesis Outline	26
2	Background and Related Work	29
2.1	Tumor Segmentation	29
2.1.1	Threshold-based methods	31
2.1.2	Region-based Methods	34
2.1.3	Pixel Classification Methods	37
2.1.4	Statistical Methods	43
2.2	Three Dimensional Reconstruction	47
2.2.1	Delaunay and Alpha-shapes	47
2.2.2	Zero-Set Methods	50
2.2.3	Point-based Methods	51
2.2.4	Interpolation-based Methods	52

2.3	Tumor Visualization	55
2.3.1	Z -buffer Gradient shading	55
2.3.2	Grey Level Gradient Shading	56
2.3.3	Adaptive Grey-level Gradient Shad- ing	56
2.4	Discussion	56
3	Tumor Segmentation and Extraction	59
3.1	Expectation Maximization (EM)	59
3.2	Multiresolution-based Segmentation	62
3.3	Tumor Extraction	64
4	Tumor Reconstruction	71
4.1	Distance Image Transform	72
4.2	Slice Interpolation	74
4.3	Interpolated Slice Binarization	77
4.4	Visualization	79
4.5	Summary	81
5	Results, Analysis and Discussion	83
6	Conclusions and Future Work	97
	References	101

List of Figures

1.1	Anatomy of the human brain [1].	18
1.2	Brain MRI obtained from (a) Sagittal Plane, (b) Axial plane and (c) Coronal plane [2].	20
1.3	The MRI dimensions [3].	21
1.4	A 3-dimensional image for a tumor inside human brain [4].	24
1.5	Brain tumor Visualization system for Computer- Aided Diagnosis.	25
2.1	Brain MRI with tumor segmentation result.	30
2.2	Classification of segmentation methods. . .	32
2.3	Classification of 3-D reconstruction methods.	48
2.4	3-D visualized tumor model of IBSR data set using Alpha Shape theory [5].	49
3.1	A: First level of Approximation mask, B: Second level of Approximation mask. . . .	64
3.2	A: The first level of approximation, B:Horizontal Details, C: Vertical Details, D: Diagonal Details	67

3.3	A: The second level of approximation, B:Horizontal Details, C: Vertical Details, D: Diagonal Details	68
3.4	A: The original tumor image, B: The orig- inal segmented image using EM, C: The segmented parent image, D: The segmented grandparent image, E: The final segmented image using WMEM, F: The extracted tu- mor.	69
3.5	Steps of tumor extraction.	70
3.6	Different slices of MRI images for brain tu- mors and the corresponding extracted tumor.	70
4.1	A sample image with its resulting distance image.	74
4.2	A sample image showing the thresholding step.	78
4.3	A comparison between the proposed mod- ified method and the other methods.	79
4.4	Displayed tumor volume without interpo- lation.	80
4.5	The displayed interpolated tumor volume.	81
4.6	System Architecture of the proposed method.	82

LIST OF FIGURES

- 5.1 The accuracy of slice 12 in series 126_21.
Left is the original tumor image, middle is
the interpolated tumor image and right is
the difference image. 95
- 5.2 The accuracy of slice 16 in series 126_21.
Left is the original tumor image, middle is
the interpolated tumor image and right is
the difference image. 95
- 5.3 The accuracy of slice 10 in series 126_26.
Left is the original tumor image, middle is
the interpolated tumor image and right is
the difference image. 96
- 5.4 The accuracy of slice 2 in series 126_26.
Left is the original tumor image, middle is
the interpolated tumor image and right is
the difference image. 96