ABSTRACT

Image segmentation is good way to analyze information in various fields of life. Image processing, especially image segmentation is very important and beneficial especially for the medical image segmentation and many other fields, from the application of segmentation know how the segmentation is important in our life. Image segmentation is the process of partitioning a digital image into sets of pixels. The aim of recognition system is to automatically identify the brain and extract the tumor from it. Several approaches have been proposed for medical segmentation. Some of the methods use color and brightness to reduce the complexity of the problem. Although such approaches solve the detect edges of regions. They are not able to handle almost any variation on the brain physical structure. There are many techniques have been proposed for tumor brain segmentation and Hill climbing is one of these techniques. The combination of the different approaches for the segmentation of brain images is presented in this project. Propose a color-based segmentation method that uses the K-means clustering technique with Hill climbing method to track tumor objects in magnetic resonance (MR) brain images, K-means clustering is used to cluster the image from gray to RGB scale while Hill climbing has been applied for the segmentation after that to overcome the problem with empty holes and Incoherent borders in the image , this project can successfully achieve segmentation for MR brain images to help pathologists distinguish exactly lesion size and region.

ABSTRAK

Sengmentasi gambar adalah cara yang terbaik untuk menganalisis maklumat dalam pelbagai aspek kehidupan, terutama sekali dalam bidang perubatan. Segmentasi gambar adalah salah satu proses untuk mengasingkan bahagian-bahagian gambar digital ke dalam bentuk set piksel. Tujuan utama sistem pengenalan adalah untuk mengenal pasti otak dan juga ekstrak ketumbuhan. Beberapa pendekatan telah dikemukakan untuk bidang segmentasi perubatan. Terdapat beberapa kaedah yang menggunakan warna dan kecerahan untuk mengurangkan masalah. Walaupun terdapat pendekatan yang dapat mengesan masalah ruang, namun ia masih tidak mampu merangkumi hamper kesemua variasi dalam struktur fizikal otak. Terdapat pelbagai teknik yang telah dicadangkan di dalam kertas projek ini, antaranya ialah kaedah segmentasi warna yang menggunakan teknik k-means dan “hill climbing” untuk mengesan objek ketumbuhan pada magnet resonasi (MR). Kelompok k-means digunakan untuk mengklusterkan gambar daripada warna kelabu kepada skala RGB. Manakala kaedah “hill climbing” telah dilaksanakan dalam proses segmentasi dan seterusnya dalam menangani masalah tentang isu lubang-lubang kosong dan kecelaruan di dalam gambar. Projek ini berjaya dalam memperoleh segmentasi untuk mendapatkan gambar MR otak dalam membantu patologi membezakan saiz dan ruang yang tepat.

TABLE OF CONTENTS

CHAPTER	TITLE		PAGE
	DECLARATION		**ii**
	DEDICATION		**iii**
	ACKNOWLEDGEMENTS		**iv**
	ABSTRACT		**v**
	ABSTRAK		**vi**
	LIST OF CONTENTS		**vii**
	LIST OF TABLES		**xii**
	LIST OF FIGURES		**Xiii**
	LIST OF APPENDICES		**xvi**
1	**INTRODUCTION**		
	1.1	Introduction	1
	1.2	Problem Background	2
	1.3	Problem Statement	4
	1.4	Project Aim	6
	1.5	Objectives	7
	1.6	Project Scope	8
	1.7	Project Organization	8
2	**LITERATURE REVIEW**		
	2.1	Introduction	9
	2.2	The Categories of Image Segmentation	10

2.3	Features of Tumor		11
2.4	Some Applications of Segmentation Methods		11
	2.4.1	Visualization	12
	2.4.2	Volumetric Measurement	12
	2.4.3	Shape Representation and Analysis	14
	2.4.4	Image-Guided Surgery	15
	2.4.5	Change Detection	16
2.5	Important Factors in Comparing Segmentation Methods		17
	2.5.1	Segmentation Time	18
	2.5.2	Accuracy	19
	2.5.3	Reproducibility	19
	2.5.4	Generality and Applicability	20
2.6	Supervised and Unsupervised Classification		22
2.7	Some Medical Image Segmentation Methods		21
	2.7.1	K-means Clustering Segmentation	22
	2.7.2	Segmentation by Thresholding	24
	2.7.3	Region Growing Methods	25
	2.7.4	C-means Clustering Methods	28
	2.7.5	Fast Marching Method	29
	2.7.6	Hill Climbing Segmentation Method	32
2.8	List of Segmentation methods, Weaknesses and Strengths		34
2.9	Conclusion		36

3 REASEARCH METHODOLGY

3.1	Introduction	38
3.2	Proposed Method	39
3.3	Reading Image	41
3.4	Noise Reduction and Image Blurring	42
3.5	Clustered the Image to RGB Scale	44
3.6	Segments the Brain Tumor	47
3.7	How Do Enhance the Existing Hill Climbing Method?	48

3.8 The Enhanced of the Results of Hill Climbing Method 50
3.9 Conclusion 52

4 RESULTS AND DISCUSSIONS

4.1 Introduction 52
4.2 Data Collection (the gray scale) 53
4.3 Noise Reduction and Image Blurring 54
4.4 Segments the Brain Tumor 58
4.5 Result after the Segmentation 59
4.6 Evaluation of the Results 62

5 CONCLUSION AND FUTURE WORKS

5.1 Introduction 68
5.2 Conclusion 69
5.3 Future Works 70

REFERENCES

Appendix A 75

LIST OF TABLES

TABLE NO.	TITLE	PAGE
2.1	Division of Segmentation Algorithms by Automaticity	19
2.8	List of Segmentation Methods, Weaknesses and Strengths	35
3.1	Processes in Methodology	41
4.1	Shows the Result of Noise Reduction by Different Filters	54
4.2	Normal Human Brain Before and After the Filtering	55
4.3	Filtering the Brain with Up Normal Cases	56
4.4	Applying the Methodology on Normal Brain Data	58
4.5	Applying the Methodology on Up Normal Brain	60
4.6	Comparing the Results with Radiologist Data Set	63
4.7	The Evaluation of Segmentation's Results	66
4.8	Comparing Pure Hill climbing with Enhanced Algorithm	66

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
1.1	Illustrations of the Human Brain Parts	2
1.2	Segments the Tumor in the Brain	3
1.3	MRI for the Tumor of Human Brain	4
1.4	X-ray for the Tumor of the Human Brain	5
1.5	Human Brain Parts	6
1.6	Segments the Brain Tumor	7
2.1	Category of Image Segmentation	11
2.2	Example of Three-Dimensional Surface Models, Created from Segmented Data Using the Marching Cubes Algorithm	14
2.3	MR and /or CT Scan Along with Three-Dimensional	16
2.4	Preoperative Surface Models During a Surgery	17
2.5	The MRI and MS Lesions	18
2.6	Supervised and Unsupervised Classification	21
2.7	K-means is to Convert a Given Gray-Level MR Image into a Color Space Image	25
2.8a	Segmentation by Thresholding	27
2.8b	Radiotherapy Planning by Thresholding Method	28
2.9	Principle of Fast Marching Method	32
2.10	Segmentation Results of Traditional Fast Marching Method	33
3.1	The Proposed Methodology for the Project	40
3.2	Wiener Filter Processes	43

3.3	Image Contains Many Clusters	45
3.4	The Movement of the Centrid In each Cluster	47
3.5	Hill climbing Domain Solutions	50
4.1	Human Brain Parts	52
4.2	Four Images For Different Cases of Diseases	53
4.3	Process of Filtering Image From Noise	57

LIST OF APPENDIC

APPENDIX	TITLE	PAGE
A	Code of the Hill Climbing Algorithm Applied with K-means Clustering	75

CHAPTER 1

INTRODUCTION

1.1 Introduction

Segmentation is one of the first steps in an image analysis process, it is necessary and important. The main goal for the segmentation is to portioning the image in homogeneous regions in order to facilitate the scene interpretation which is done afterwards. That is why many segmentation methods have been proposed for the last years.

Image segmentation is one of most important task in image processing .It is used to analyze images in different fields; such as medical, science, agriculture and industry fields.

It is a great desire to have a fully automatic operation on image segmentation by the computer, because this process will speed up the process of image

segmentation. To date the manual segmentation is still widely used, due to a lot of constraints, these methods working depend on the place and the environment.

1.2 Problem Background

The segmentation methods are used to analyze images for specific purpose such as the medical and technology. Figure 1.1 illustrates the segmentation process on the human brain; the human brain has many parts, frontal lobe, olfactory blub, temporal lobe, pones and cerebellum, as illustrated in figure 1.1, each one of these parts responsible to do special job.

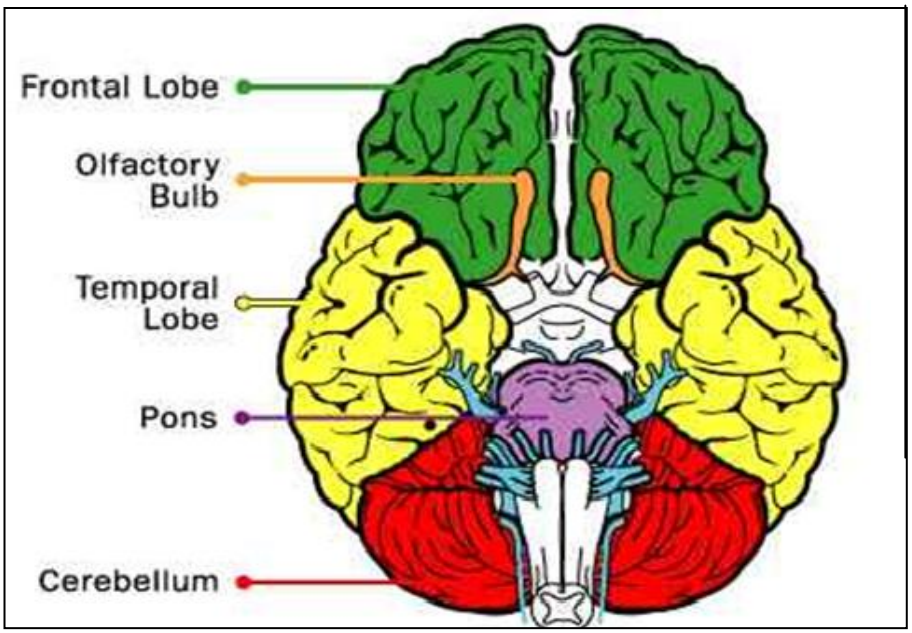

Figure 1.1 Illustrations of the human brain parts

The brain contains different parts with different shapes. The brain segmentation methods capable to recognize the tumor among all the brain parts, as illustrated in figure 1.2.

Figure 1.2 Segments the tumor in the brain

A recognition system aims to automatically identify the brain and extract the tumor from it. Several approaches have been proposed for medical segmentation. Some of the methods use color and brightness to reduce the complexity of the problem. Although such approaches solve the detect edges of regions. They are not able to handle almost any variation on the brain physical structure.

Segments the tumor from the brain is an important for to visualization the situation before do the surgery to achieve the desire result, it is important to raise the medical field to achieve the best result by using all the new techniques and by

utilization all the computer features to enhance the segmentation purpose. Also it is used the computer to speed up the procedure got doing the segmentation.

1.3 Problem Statement

Since the segmentation can be done by depending on the MRI, X-ray and many different ways, as shown in figures 1.3 and 1.4, these different methods have different levels of quality.

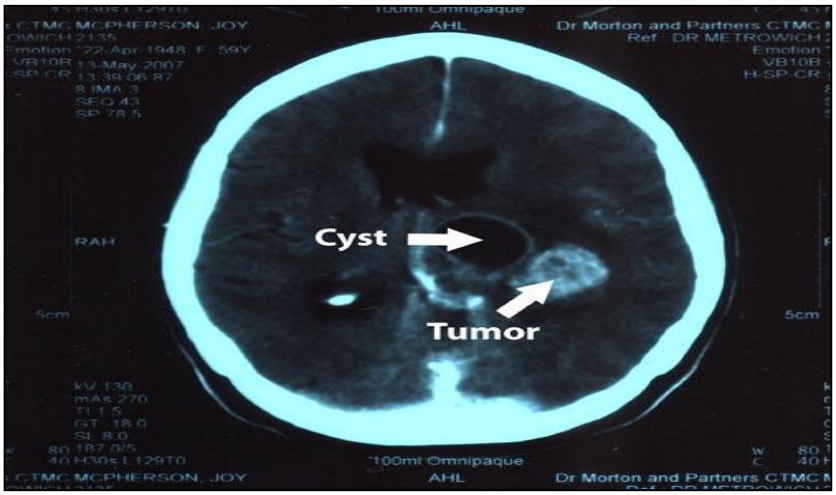

Figure 1.3 MRI for the tumor of the human brain

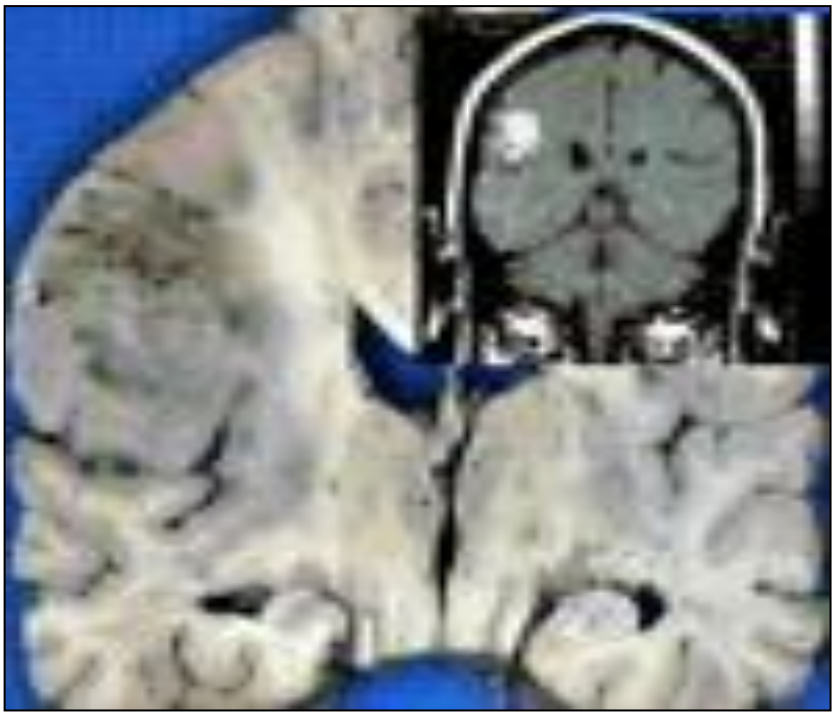

Figure 1.4 X-ray for the tumor of the human brain

The quality results depend on number of factors:

- Different methods.
- Problems with image acquisition.
- Poor quality of the MRI data.
- The homogeneous parts of brain.

The procedure can fail at any stage if the tumor is very homogeneous to the other brain parts. The human brain is greatly in size, shape, location, tissue composition and homogeneity has to be accounted, and because of these features, it's not easy to segment and to recognize it .The problem in this project is about distinguishing between the tumor and the other brain parts. To segment the tumor and ignore other parts.

1.4 Project aim

This project aims to design an enhancement of the Hill Climbing segmentation method to segment the tumor brain by using the MRI database, as shown in figures 1.5; 1.6.The approach is focusing on the tumor affected area only.

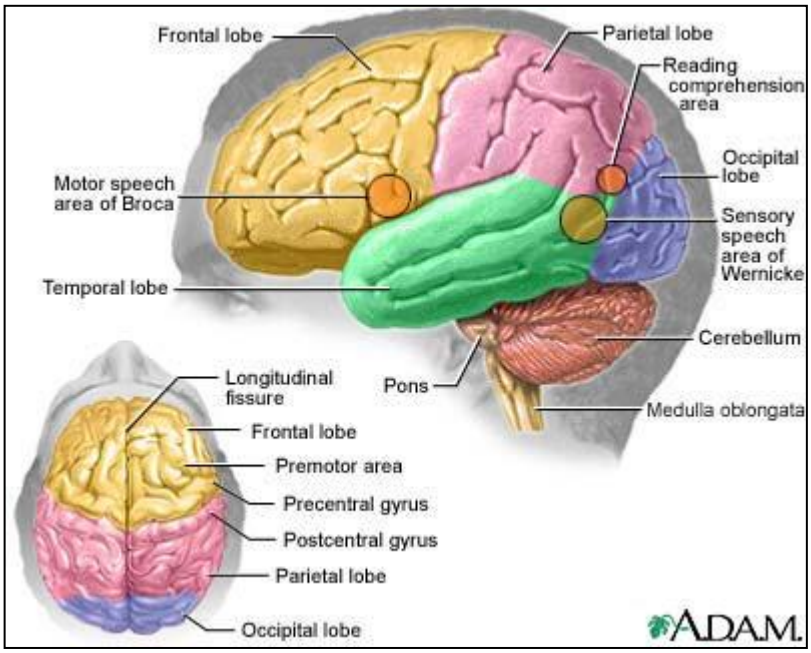

Figure 1.5 Human brain parts

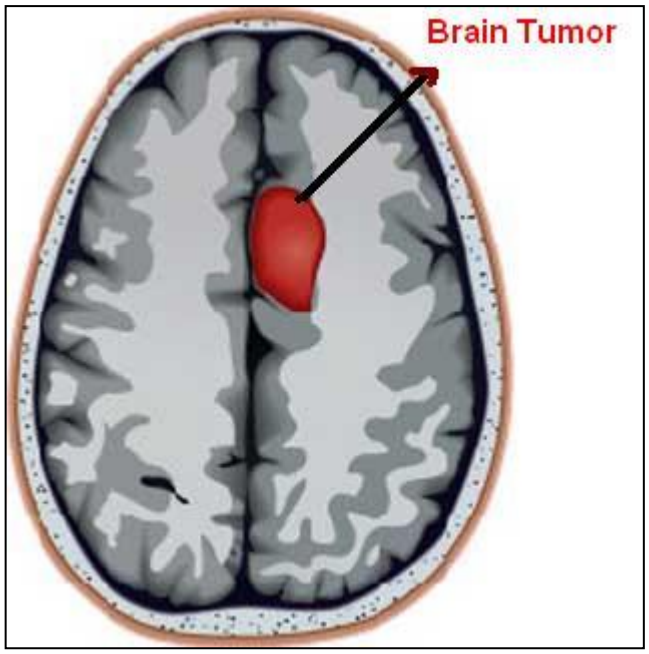

Figure 1.6 Segments the brain tumor

1.5 Objectives of the Project

This project intends to achieve the following objectives:

1. Study the previous methods of medical image segmentation.
2. To enhance the Hill climbing algorithm to segment the tumor.
3. To segment the brain tumor from the MRI data.

1.6 Project scopes

In order to achieve the objectives of the project, it is important to identify the scopes, which cover the following aspects:

1- The project will cover the methods and algorithms that solve the problem of tumor brain segmentation methods.
2- Find a technique by using an image in magnetic resonances so it will be capable to produce a complete division of image in separated region.
3- The project will not cover the other human brain parts.
4- Enhance existing algorithm of Hill Climbing method to achieve the objectives.
5- Brain images are taken from MRI database, the input data are from (Whole Brain Atlas) website for (Harvard University).

1.7 Project Organization:

The report is divided into 5 chapters:

- Chapter 1 describes the introduction and background of the study, as well as the project objectives, scope and the layout of this report.
- Chapter 2 gives literature reviews on the previous researches on the medical image segmentation, tumor features, the categories of image segmentation, some applications of segmentation, important factors in comparing segmentation methods, and the classification for the segmentation methods.
- Chapter 3 describes the project methodology that is been used.
- Chapter 4 gives the project results, result evaluation, overall discussion of the project and conclusion of the report.

- Chapter 5 gives the conclusion for the project and future works.

REFRENCES

1. D. Gering, A. Nabavi, R. Kikinis, N. Hata, L. O'Donnell, W. Eric L. Grimson, F. Jolesz, P. Black, W. Wells III. 2001.
2. W.E. Lorensen and H. E. Cline. Marching Cube: A High Resolution 3-D Surface Construction Algorithm. Computer Graphics 21, 1987.
3. R. W. McCarley, C. Wible, M. Frumin, Y. Hirayasu, J. J. Levitt, I. A. Fischer, M. E. Shenton.MRI Anatomy of Schizophrenia. Biological Psychiatry 1999.
4. P. Golland,W. E. L. Grimson, Martha E. Shenton, and R. Kikinis. Small Sample Size Learning for Shape Analysis of Anatomical Structures Medical Image Computing and Computer-Assisted Intervention - MICCAI'2000 72–82, 2000.
5. M. Leventon. Statistical Models for Medical Image Analysis. Ph.D. Thesis, Artificial Intelligence Laboratory, Massachusetts Institute of Technology, 2000.
6. M. Leventon. Statistical Models for Medical Image Analysis. Ph.D. Thesis, Artificial Intelligence Laboratory, Massachusetts Institute of Technology, 2000.
7. P. Golland,W. E. L. Grimson, Martha E. Shenton, and R. Kikinis. Small Sample Size Learning for Shape Analysis of Anatomical Structures Medical Image Computing and Computer-Assisted Intervention - MICCAI'2000 72–82, 2000.
8 S. Warfield et al. Adaptive, Template Moderated, Spatially Varying Statistical Classification. Medical Image Analysis, 4(1):43–55, 2000.
9. C. R. G. Guttmann et al. Multiple Sclerosis Project Website, BWH

Surgical Planning Lab.

10. http://splweb.bwh.harvard.edu:8000/pages/projects/ms/ms.html
11. C. R. G. Guttmann, H. L. Weiner, L. Hsu, S. J. Khoury, E. J. Orav, M. J. Hohol, S. S. Ahn, R. Kikinis, F. A. Jolesz. The natural course of relapsing-remitting and chronic progressive multiple sclerosis. International Society for Magnetic Resonance in Medicine, 2:1327, 1998.
12. C. Guttmann et al. Computerized Image Processing for Quantitative Follow-up of Patients. Journal of Magnetic Resonance Imaging 1999.
13. Medical Image segmentation using K-means clustering and improved watershed algorithm. H.P. Ng1, 2, S.H. Ong3, K.W.C. Foong1, 4, P.S. Goh5, W.L. Nowinski2 (2005).
14. Brain Tumor Detection Using Color-Based K-Means Clustering Segmentation, Ming-Ni Wu1 Chia-Chen Lin2 Chin-Chen Chang13 (2003).
15. Chen, C. W, Luo, J., Parker, K. J., "Image Segmentation via Adaptive K-mean Clustering and Knowledge-based Morphological Operations with Biomedical Applications," IEEE Transactions on Image Processing, Vol. 7, No, pp. 1673-1683., Ng, H. P., Ong, H. H., Foong, K. W. C., Goh, P. S., Nowinski, W. L. 12, Dec. 1998.
16. "Medical Image Segmentation Using K-Means Clustering and Improved Watershed Algorithm" IEEE Southwest Symposium on Image Analysis and Interpretation, 2006.
17. http://document.wolfram.com
18. Dzung L.Pham , Chenyang Xu, Jerry L.prince ;"A survey of current methods in medical image segmentation " Technical Report JHU/ECE 99-01 , department of Electric and computer Engineering . The Johns Hopkins University, Baltimore MD 1998.
19. M. Sezgin, B.Sankur "survey over image thresholding techniques and quantitative performance evaluation "J. Electron. Image 13(1) 2004.
20. Adams and Leanne Bischof ,Seeded Region Growing, IEEE Transaction on Patten Analysis and Machine Intelligence, Vol. 16, No. 6, June 1994
21. Zhou , J.;Chan, K.L.;chong ,V.F.H.;Krishnan, S.M" Extraction of Brain

Tumor from MR Image using one-classes support vector Machine “27th Annual International conference of the engineering in Medical Biology Society, 2005 . IEEE-EMBS 2005.

22. Pan, Zhigeng; Lu, Jianfeng;;”A Bayes-Based region-Growing algorithm for Medical Image segmentation “ Computing in science & Engineering , Volume 9 , Issue 4,july0Aug. 2007.
23. Dzung L.Pham , Chenyang Xu, Jerry L.prince ;”A survey of current methods in medical image segmentation “ Technical Report JHU/ECE 99-01 , department of Electric and computer Engineering . The Johns Hopkins University. Baltimore MD 21218, 1998.
24. Segmentation using a region-growing thresholding · Matei Mancas, Bernard Gosselin, Benoît Macq .en.scientificcommons.org/benoît_macq (2008).
25. J. Kittler, J. Illingworth On threshold selection using clustering criteria, IEEE Transaction on Systems, Man and Cybernetics(2003) .
26. J. Z. Liu, Y. Q. Tu Thresholding of images using an efficient C-mean clustering algorithm, Journal of Electronics (in Chinese), 1992.
27 J. Z. Liu. A fuzzy clustering method for image segmentation based on twodimensional histogram, Acta Electronica Sinica (in Chinese) 1992.
28. X. P. Zhang, J. L. Fan, J. H. Pei. Texture segmentation based on spatial information and fuzzy clustering, Fuzzy Systems and Mathematics (in Chinese), 2002.
29. W. Z. Zhen, J. L.Fan, W.X. Xie .A new fuzzy clustering algorithm for image segmentation based on two-dimensional histogram, Computer Engineering and Applications (in Chinese), 2003.
30. Image Segmentation by Multi-level Thresholding Based on C-Means Clustering Algorithms and Fuzzy Entropy Feng Zhao and Jiulun Fan 2004.
31. A. Struyf, Mia Hubert, Peter J .Rousseeuw, Integratung Robust Clustering Techniques in S-PLUS, 2003.
32. Semantic Segmentation Tree for image content Representation Ruba Al-Haj and Zaher Al Aghbari. Int. J. Virtual Technology and Multimedia, Vol. 1, No. 1, 2008.

33. A Parallel Hill Climbing Algorithm for Pushing Dependent Data in Clients-Providers-Servers Systems Francisco Javier Ovalle Martínez1, Julio Solano Gonzalez 2002.
34 Garrido et al., 1998; Comaniciu and Meer, 2002.
35. Malik et al., 2001; Schluter et al., 2000.
36. R. Malladi& J.A.Sethian, ``A Real-Time Algorithm for Medical Shape Recovery", in Proceedings of the IEEE International Conference on Computer Vision (ICCV'98) 1998.
37. L. Vincent, Algorithms Morphologiques à base de Files d'Attente et de Lacets - Extension aux graphes, Ph.D. thesis, Ecole des Mines de Paris, Xerox Imaging, Palo Alto, 1991.
38. Modified fast marching and level set method for medical image segmentation (Fuping Zhu and Jie Tian/ Journal of X-Ray Science and Technology2003.
39. Jian-Jiun Ding, The class of "Time-Frequency Analysis and Wavelet Transform", the Department of Electrical Engineering, National Taiwan University (NTU), Taipei, Taiwan, 2007.
40. http://home.dei.polimi.it/matteucc/Clustering/tutorial_html/kmeans.html.
41. E. Arias-Castro and D.L. Donoho, "Does median filtering truly preserve edges better than linear filtering?", Annals of Statistics, vol. 37, no. 3, pp. 1172–2009.
42. http://local.wasp.uwa.edu.au/~pbourke/miscellaneous/imagefilter/
43. Wiener, Norbert (1949), Extrapolation, Interpolation, and Smoothing of Stationary Time Series. New York: Wiley. ISBN 0-262-73005-7.
44. C.W. Chen, J. Luo, K.J. Parker, “Image segmentation via adaptive K-mean clustering and knowledge based morphological operations with biomedical applications”, IEEE Transactions on Image Processing, Vol.7 (12), 1998, pp 1673-1683.