Detection and Three Dimensional Visualization of Gliosis in Magnetic Resonance Brain Images

彭富民、傅家啟

E-mail: 9511051@mail.dyu.edu.tw

ABSTRACT

Gliosis is a fibre pathological change of brain glia cell. State of gliosis is related to many diseases, such as diabetes and multiple sclerosis. Since Magnetic Resonance Images are clear and contain rich physical parametric information, it is a main tool to acquire gliosis image. An effective computer aided diagnostic tool is highly desired for clinical applications and medical research. In this thesis, the Active Contours Without Edges (i.e. Active Contours using Level Sets, ACLS) algorithm and Genetic Algorithm are applied to search near optimal parameters for detecting the borders of parenchyma and gliosis. The performance of ACLS and Expectation Maximum（EM） is compared in the simulated images. The results showed that ACLS is superior to EM both in segmentation quality and computational time. The ACLS is applied to a real case of parenchyma and the gliosis segmentation. The segmentation output is post-porcessed by 3D surface rendering reconstruction for visualization of the location of brain gliosis.

Keywords : Gliosis ; Magnetic Resonance Image ; Image Segmention ; Genetic Algorithms ; Level Sets ; Three Dimensional Visualization

Table of Contents

授權書 iii 中文摘要 iv ABSTRACT v 誌謝 vi 目錄 vii 圖目錄 ix 表目錄 xi 第一章 緒論 1 1.1研究背景與動機 1 1.2研究範圍及目的 2 1.3研究方法 3 第二章 文獻探討 5 2.1膠樣變性檢測之相關研究 5 2.2影像分割演算法 7 2.2.1 Expectation Maximum介紹 8 2.2.2 Active Contours using Level Sets介紹 9 2.3最佳化參數選擇 14 2.3.2基因演算法 14 2.3.3廣義迴歸神經網路 17 2.4績效評估 17 第三章 研究架構與方法 19 3.1研究架構 19 3.2基因演算法搜尋ACLS分割演算法最佳參數 20 3.3模擬膠樣變性影像分割方法及績效比較 22 3.4實際腦部膠樣變性影像分割及三維成像 27 第四章 實驗結果與分析 29 4.1分割演算法參數選擇 29 4.1.1分割演算法參數選擇實驗設置 29 4.1.2分割演算法參數選擇實驗結果與分析 32 4.2模擬影像分割績效評估 39 4.2.1模擬影像來源及參數設定 39 4.2.2分割演算法參數設置 40 4.2.3模擬影像分割結果與績效衡量 41 4.2.4模擬影像分割實驗結果分析 41 4.3實際膠樣變性影像分割 43 4.3.1實際膠樣變性影像分割實驗設置 43 4.3.2實際膠樣變性影像分割實驗結果 45 4.4腦部三維成像 47 第五章 結論 49 參考文獻 51

REFERENCES

1. 何易展，＂細胞顯微影像之分割、追蹤與運動分析＂，成功大學資訊工程學系研究所碩士論文，2002。 2. 徐錫川、鍾添東，＂利用模糊推論決定懲罰參數之結構最佳設計遺傳演算法＂，台灣大學機械工程系碩士論文，2000。 3. 黃一展，＂磁振影像腦瘤分割與三維重建＂，大葉大學工業工程與科技管理學系研究所碩士論文，2005。 4. 葉怡成，＂類神經網路模式應用與實作＂，儒林，2000。 5. 楊濟華，＂邊界檢測演算法之最佳參數選擇-以左心室磁振影像為例＂，大葉大學工業工程與科技管理學系研究所碩士論文，2005。 6. 羅華強，＂類神經網路-MATLAB的應用＂，清蔚科技，2001。 7. Chan T. F. and L. A.Vese,“ Active Contours Without Edges ”, IEEE Transactions on Image Processing, Vol. 10, No. 2, pp. 266-277, 2001. 8. Dempster A.P., N.M. Laird and D.B. Rubin,“ Maximum Likelihood from Incomplete Data via the EM Algorithm ” J. Royal Statistical Soc., Ser. B., Vol. 39. No. 1, pp. 1-38, 1977 9. Goldberg-Zimring D., A. Achiron, S. Miron, M. Faibel and H. Azhari,"Automated Detection and Characterization of Multiple Sclerosis Lesions in Brain MR Images",Magnetic Resonance Imaging, Vol.16, No.3, pp. 311-318 ,1998. 10. Mumford D. and J. Shah,“ Optimal Approximation by Piecewise Smooth Functions and Associated Variational Problems ”, Communication on Pure and Applied Mathematics, Vol. 42, pp. 577-685, 1989. 11. Osher S. and J. A. Sethian,“ Fronts Propagating with Curvature Dependent Speed: Algorithms Based on Hamilton-Jacobi Formulation ”, Journal of Computational Physics, Vol. 79, pp. 12-49, 1988. 12. Petronella Anbeek , Koen L. Vincken , Matthias J. P. van Osch , Robertus H. C. Bisschops and Jeroen van der Grond,"Probabilistic segmentation of white matter lesions in MR imaging",NeuroImage, Vol. 21, No.3, pp. 1037-1044 ,2004. 13. Sheep L. A. and Y. Vardi,“ Maximum Likelihood Reconstruction for Emission Tomography ”, IEEE Transactions on Medical Imaging, Vol. 1, pp. 113-122, 1982. 14. Van Leemput, K., F. Maes, D. Vandermeulen, A. Colchester and P. Suetens,"Automated segmentation of multiple sclerosis lesions by model outlier detection",Medical Imaging, IEEE Transactions on Vol. 20, No. 8, pp.677 - 688 , 2001. 15. Wasilewiski M.,“ Active Contours Using Level Sets for Medical Images Segmentation ”, University of Waterloo, 2004. 16. http://www.ms-gateway.com.hk/dfx/shenmo/duofaxing-1.htm 17. http://www.dls.ym.edu.tw/neuroscience/nsdivide_c.htm 18.

http://wordpedia.pidc.org.tw/Content.asp?ID=23976 19. http://www.ms-gateway.com.hk/dfx/shenmo/duofaxing-2.htm 20. http://www.genes.at-taiwan.com/Sense/har.htm 21. http://www.bic.mni.mcgill.ca/cgi/bw/submit_request