Optimal Image Segmentation and Three Dimensional Reconstruction for Functional Magnetic Resonance Imaging

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ABSTRACT

Recently, the Functional Magnetic Resonance Image (fMRI) is used to evaluation the risk before surgical operation. The MR images processed by image segmentation and three dimensional reconstruction for fMRI, the output can be used to evaluate the functional region to help doctors to evaluate the risk and the plan of the treatment. In this thesis, Pulse Coupled Neural Networks (PCNN) are combined with Expectation Maximum (EM) algorithm to segment MR images. The EM algorithm is used to estimate the distribution parameters of image information to serve as the objective functions. The PCNN is used to segment images into gray matter (GM)、white matter (WM) and cerebrospinal fluid (CSF). The experimental results are compared with Fuzzy C-Mean (FCM) and Bias Corrected Fuzzy C-Mean (BCFCM). Since the PCNN+EM and the BCFCM include spatial factor, the visual effect of their output is better than the FCM. We use Jaccard Similarity index to measure segmentation performance under variour levels of noise or ununiformity. Experimental results show that the FCM is the best and PCNN+EM out performs BCFCM. The major reason of the FCM performing better than the PCNN+EM is that the PCNN+EM will accumulate the error during its iterative procedures. In the future, we can try to embed the EM into the PCNN to provide a more robust segmentation mechanism to provide a more adaptive segmentation output.

Keywords : Functional Magnetic Resonance Image ; Image Segment ; Pulse Coupled Neural Network ; Fuzzy C-Mean ; Bias Corrected Fuzzy C-Mean

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REFERENCES

[1].黃信憲，影像之分割重建與立體視覺化-以磁振肝門靜脈影像處理為案例，大葉大學工業工程所碩士論文，民國90年 [2].楊順欽，二維影像資訊於時間序列中訊號細微變化之檢測-以功能性磁振造影為案例，大葉大學工業工程所碩士論文，民國91年 [3].Caulfield, H. J., and M. K. Jason “ Finding the shortest path in the shortest time using PCNN ’ s “ . IEEE Transactions on Neural Networks, 10(3),604-6064 ,1999.
[4]. Eckhorn, R.,H. J. Reitboeck,; M. Arendt, and P. Dicke, “ Feature linking via synchronization among distributed assemblies: simulation of results from cat visual cortex, ” Neural Computation,Vol.2,pp.293-307,1990.
[5].Fu, J. C.; C. C.Wu; 2000, Border Detection by Branch-and-Bound Dynamic Programming, 第十三屆電腦視覺、圖形暨影像處理研討會論文集, Vol. 1, pp. 445 - 449.
[6].Hall, L.O.; A.M. Bensaid; L.P. Clarke; R.P.Velthuizen; M.S.Silbiger;and J.C.Bezdek; “ A Comparison of Neural Network and Fuzzy Clustering Techniques in Segmenting Magnetic Resonance Images of the Brain, “ IEEE Transactions on Neural Networks,Vol 4,No.5,pp.672-682,1992 [7].Keller, P. E.; A.D.Mckinnon, “ Segmentation of medical imagery with pulse-coupled neural networks “ IEEE international Joint Conference on Neural Networks,Vol 4,2659-2663,1999 [8].Mohamed,N.A., M.Y.Sameh, Nevin,M.A.F “ A Modified Fuzzy C-Means Algorithm for Bias Field Estimation and Segmentation of MRI Data “ IEEE Transactions on Medical Imaging, 21(3), pp193-199 ,2002.
[9].Ranganath,H.S. ,G.Kuntimad, “ Perfect image segmentation using pulse coupled neural networks “ IEEE Transactions on Neural Networks,10(3)591-598 ,1999.
[10].Santago,P., H.D.Gage, “ Quantification of MR Brain Images by Mixture Density and Partial Volume Modeling “ IEEE Transactions on Medical Imaging,12(3),pp566-574 ,1993.
[11].Shattuck, D.W., S.R.Sandor-Leahy, K.A. Schaper, D.A. Rottenberg, and R.M. Leahy, "Magnetic Resonance Image Tissue Classification

Using a Partial Volume Model," NeuroImage, Vol. 13, No. 5, May 2001, pp. 856-876.
[12].Wolfer, J.; S.H. Lee,; J.Sandelski,; R.Summerscales,; J.Soble,; J.Roberge,; " Endocardial border detection in contrast enhanced echocardiographic cineloops using a pulse coupled neural network " Computers in Cardiology,185-188,1999.
[13] http://class.kmu.edu.tw/~hist/Basic/Nerve/index.html [14] http://hic.ch.ntu.edu.tw/~mri/ [15] http://www.bic.mni.mcgill.ca/brainweb/anatomic_normal.html