Automatic Location and Border Detection of the Left Ventricle in Magnetic Resonance Imaging

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ABSTRACT

The improvement of Magnetic Resonance Imaging technique and hardware had significantly improved the efficiency of the diagnosis on cardiac disease; however, the software technique still falls behind. In order to effectively analyze the large quantity of cardiac MRI ’s, the computer aided diagnosis system should include the functions of automatic left ventricle locating and automatic left ventricle border detecting. In this thesis, the cross correlation based matching pursuit algorithm has been developed to automatically locate the left ventricle. The performance of the proposed method is compared with convolution based matching pursuit algorithm. In addition, a canny-based GVF Snake algorithm has been developed to detect the endocardium and epicardium of left ventricle. The border detection performance is compared with the Dynamic Programming algorithm and conventional GVF Snake algorithm. Experimental results show that the proposed cross correlation based matching pursuit algorithm can reduce the CPU time of locating left ventricle. The detection performance of the Canny-based GVF Snake algorithm out performs the Dynamic Programming and the GVF Snake.

Keywords : Left Ventricle ; Magnetic Resonance Imaging ; Patten Feature Searching ; Border Detection ; Cross Correlation ; GVF Snake

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REFERENCES

[1]李俞璽，應用梯度向量流動態輪廓模型於BGA球格陣列之邊界搜尋，大葉大學工業工程所碩士論文，民國92年。

[2]高文清 譯，心血管系統磁共振，藝軒圖書出版社，1996。

[3]莊家銘，二維圖樣特徵偵測—以磁振左心室影像及其特徵搜尋為案例，大葉大學工業工程所碩士論文，民國90年。

[4]曾裕仁，自動化數位封閉曲線平滑化之處理與分析—以核磁共振心室影像邊界檢測為案例，大葉大學工業工程所碩士論文，民國89年。

[5]盧宗斌，數位影像二維最佳化自動分割及三維視覺化重建—以功能性磁振掃描影像處理為案例，大葉大學工業工程所碩士論文，民國92年。

[6]Fleagle S. R., Thedens D. R. , Stanford W., Pettigrew R. I., Reichek N., Skorton D. J. , “ Multicenter Trial of Automated Border Detection in Cardiac MR Imaging ” , Journal of Magnetic Resonance Imaging, Volume: 3 , No.2 , pp.409-15, 1993.

[7]Fleagle S. R., Thedens D. R., Stanford W., Thompson B. H., Weston J. M., Patel P. P., Skorton D. J., “ Automated Myocardial Edge Detection on MR Images: Accuracy in Consecutive Subjects ”, Journal of Magnetic Resonance Imaging, Volume: 3, No.5, pp.738-41, 1993.

[8]Fu.J.C., Tseng.Y.J., Chai.J.W., Wong.S.T.C., Deng.J.J., “ De-noising of Left Ventricular Myocardial Borders in Magnetic Resonance Images ”, Magnetic Resonance Imaging, 20, pp.649—657, 2002.

[9]Ioannou D., Huda W., Laine A. F., “ Circle Recognition through a 2D Hough Transform and Radius Histogramming ”, Image and Vision Computing, Volume: 17, Issue: 1, pp.15-26, 1999.

[10]Kass M., Witkin A., Terzopoulos D., “ Snake:Active Contour Models ” , International Journal of Computer, Vision 1, pp.321-331, 1998.
[11]Perona P., Malik J., “ Scale-space and Edge Detection Using Anisotropic Diffusion ” , Pattern Analysis and Machine Intelligence, IEEE Transactions on, Volume: 12, Issue: 7, pp.629-639, 1990.
[12]Ray N., Chanda B., Das J., “ A Fast and Flexible Multiresolution Snake with a Definite Termination Criterion ” , Pattern Recognition, IEEE Transaction on, Volume: 34, Issue: 7, pp.1483-1490, 2001.
[13]Sahiner B., Petrick N., Chan H. P., Hadjiiski L. M., Paramagul C., Helvie M. A., Gurcan M. N., “ Computer-aided Characterization of Mammographic Masses: Accuracy of Mass Segmentation and Its Effects on Characterization ” , Medical Imaging, IEEE Transactions on, Volume: 20 , Issue: 12 , pp.1275-1284, 2001.
[14]Santarelli M. F., Positano V., Michelassi C., Lombardi M., Landini L., “ Automated Cardiac MR Image Segmentation:Theory and Measurement Evaluation ” , Medical Engineering and Physics, Volume: 25, Issue: 2, pp. 149-159, 2003.
[15]Xu C., Prince J. L., “ Snake, Shapes, and Gradient Vector Flow ” , Image Processing, IEEE Transaction on, Volume: 7, No. 3, pp.359-369, 1998.
[16] http://dcmrc.mc.duke.edu/about_dcmrc/duke_north_construction.html [17] http://www.astrazeneca.com.tw/ [18] http://www.bayareahospital.org/images/mri.jpg [19] http://www.cts.usc.edu/graphics/heart-crosssection1.jpg http://www.hmhd.org/ [20] http://www.muhealth.org/~pharm204/cardiac.jpg