Evaluation of Semi-Automated Border Detection Algorithms for the Left Ventricular Endocardium from Magnetic Resonance Images

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Accurate quantification of left ventricular (LV) volume is important for therapeutic management, risk stratification and prognostic assessment of patients with cardiovascular disease. Magnetic resonance (MR) imaging has proved to be an accurate and reproducible imaging modality for quantitative analysis of left ventricular function, and it is normally treated as the standard for left ventricular volume measurements. However, to perform accurate volume measurements on MR images, the endocardial wall surface is normally traced manually slice by slice, which requires much effort and is very time consuming. Because of large variations of MR image quality and large variations of the ventricular geometry during cardiac cycles, it is a challenge to develop automated or semi-automated techniques that can provide comparable accuracy in left ventricular volume measurements

In this study, we developed two semi-automated border detection algorithms to trace the left ventricular endocardial wall borders by examining intensity change distributions approximately perpendicular to the ventricular wall, and then calculated the left ventricular volumes. By comparing with the measurements from the manually traced endocardial borders, we evaluated the performance of each algorithm, and studied the factors that affect the automated tracing for the left ventricular endocardium on MR images.

Six patients were recruited for a MR scan. Comparing results with the manual measurement of the left ventricular volumes, the overall bias$\pm$standard deviation was 5.9$\pm$20.4ml (algorithm 1) and 23.4$\pm$6.9ml (algorithm 2, $p<0.05$) in end diastole, 6.2$\pm$4.6ml (algorithm 1, $p<0.05$) and 11.1$\pm$8.9ml (algorithm 2, $p<0.05$) in end systole and -0.3$\pm$22.8ml (algorithm 1) and 13.6$\pm$8.4ml (algorithm 2, $p<0.05$) in stroke volume. The major factors affecting the automatic tracing of endocardial wall borders are the image intensity changes caused by papillary muscles and epicardial wall borders.