Automated Heart Localization for the Segmentation of the Ventricular Cavities on Cine Magnetic Resonance Images

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The automated segmentation of the ventricular structures is necessary for the routine evaluation of clinical parameters such as the ejection fraction or the left ventricular mass. Thus, a region of interest around the heart is essential but, in most cases user-defined. We propose an automatically defined region to reduce manual interactions. First, the hearts beating was exploited. Borderline pixels of the cavities have a higher gray level variation than pixels inside the cavities during the cardiac cycle. A rectangular function was chosen to model these variations. An image containing only the pixels showing movement (i.e. with gray level variations) over time was then produced. However, if the patient moves during data acquisition then falsely detected pixels that do not normally correspond to the beating heart can appear in this image. Thus, the second step consisted of taking advantage of the connected components throughout the slices with a 3D labeling followed by 2D labeling in each slice to keep only the pixels that truly correspond to the heart. This method was tested on the MICCAI 2009 challenge database of 45 subjects with various pathologies. Overall, detection of the whole cardiac structure was successfully achieved on almost all subjects except 2 subjects suffering from hypertrophy where failure on detecting the whole cardiac structure due to reduced motion and thickening of the left ventricle was noticed. The method was designed for the regions to always enclose the whole myocardium even if this may result in a region larger than necessary. Knowing that, only 17.5% of the total number of slices for all subjects was found to have an overgrown region of interest that needed reducing. Our method is simple, built with few plausible assumptions, and robust compared to other methods due to the accumulation of variability information from all slices.