

Simultaneous left and right ventricle segmentation using topology preserving level sets

Cita:

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Abstract

Cardiovascular Magnetic Resonance (CMR) has been successfully used in clinical practice to evaluate the cardiac function. Heart functional indexes, such as end-systolic volume and end-diastolic volume, are usually computed from manual segmentations performed by an expert using short-axis cine MR images. This process is tedious and time consuming. Despite semi-automatic methods have been proposed, including pixel-based, atlas-based, active contours and level sets, most of them allow the segmentation of only one ventricle at a time, and methods for segmenting both ventricles simultaneously tend to fail in the presence of abnormal anatomies.

We propose a method based on level sets with preserved topology that allows simultaneous, fast and accurate segmentations of the left and right ventricles. We compared our segmentation results of the left and right ventricles with those obtained with clinically validated software (Viewforum, Philips, Best and Segment, Medviso, Lund) using two-tailored paired *t*-test, Pearson's correlation, Bland-Altman plots of standard functional indexes and voxel-by-voxel analysis with Dice. Two-tailored paired *t*-test showed no significant difference between our method and gold standards ($P < 0.05$), Pearson's correlation showed a high correlation of our measurement with gold standards (over 0.98), Dice showed an average agreement over or equal to 0.90 and Bland Altman analysis showed that our method has a good agreement with the gold standard segmentations.

We were able to segment both ventricles simultaneously, without any training process and taking less than 15 s per cardiac phase. The process was semi-automatic with only minor manual corrections needed at the basal slices. Our results show high levels of accuracy considering functional indexes and also in a voxel-to-voxel comparison.