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Meeting abstract

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1108 On the use of cardiac contour propagation methods

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Introduction

Quantitative analysis of cine CMR requires a delineation of the cardiac contours on all images. Cardiac contour propagation tools are used to enable a quick delineation. Such tools can be used to propagate cardiac contours from a single initial delineation at end diastole (ED) to the other phases, as we described in [1]. In 2007, [2] presented a dual approach requiring initial contours at ED and end systole (ES). Although it seems obvious that the dual initialized approach is more accurate, little is known on the effects of dual initialization on inter-observer variation.

Purpose

The purpose of our work is to compare the accuracy and variability of resulting contours after single and dual propagation.

Methods

We have implemented a cardiac contour propagation algorithm based on active contours, allowing initialization at ED only or at ED and ES. Both approaches have been used on 34 cine CMR acquisitions.

All acquisitions contained 3 slices and 25 phases. All images were 256 × 256 in size and covered a field of view of 350 × 350 mm – 410 × 410 mm. The images were obtained with flip angle 60°, TE 1.5–1.6 ms and TR 3.1–3.2 ms. We are grateful to the Deutsches Herzzentrum, Berlin, for supplying image data.

Golden standard delineations were obtained by averaging contours provided by several users. Four scans have been manually delineated twice by three users. The remainder of scans has been delineated twice by two users, by editing the result of the contour propagation tools described in [1].

The accuracy of resulting contours has been assessed by measuring the mean ± SD RMS error with respect to the Golden Standard. The inter-observer variability has been measured as the average RMS error with respect to the golden standard.

Results

We have measured the RMS errors for the LV endocardium and LV epicardium respectively. For single propagation, this resulted in 1.30 ± 0.53 mm and 0.85 ± 0.38 mm, as compared to 0.86 ± 0.43 mm and 0.58 ± 0.29 mm for dual propagation. However, the initial contours are subject to inter-observer variability of manual delineation, which increases from 0.77 ± 0.37 mm at ED to 1.52 ± 0.87 mm at ES for the LV endocardium. Consequently, the inter-observer variability of LV endocardium contours after single and dual propagation is equivalent, 1.54 ± 0.71 mm vs. 1.47 ± 0.74 mm. See figures 1 and 2 for a detailed representation of accuracy and inter-observer variability over time for the LV endocardium contour. For the LV epicardium contour, inter-observer variability for single and dual propagation is 1.13 ± 0.46 mm and 0.93 ± 0.40 mm.

Single propagation has been used on 30 additional acquisitions. Inter-observer variability after propagation, but before editing was 1.26 ± 0.98 mm and 1.08 ± 0.46 mm for the LV endocardium and LV epicardium respectively. After editing these numbers decreased to 0.98 ± 0.55 mm

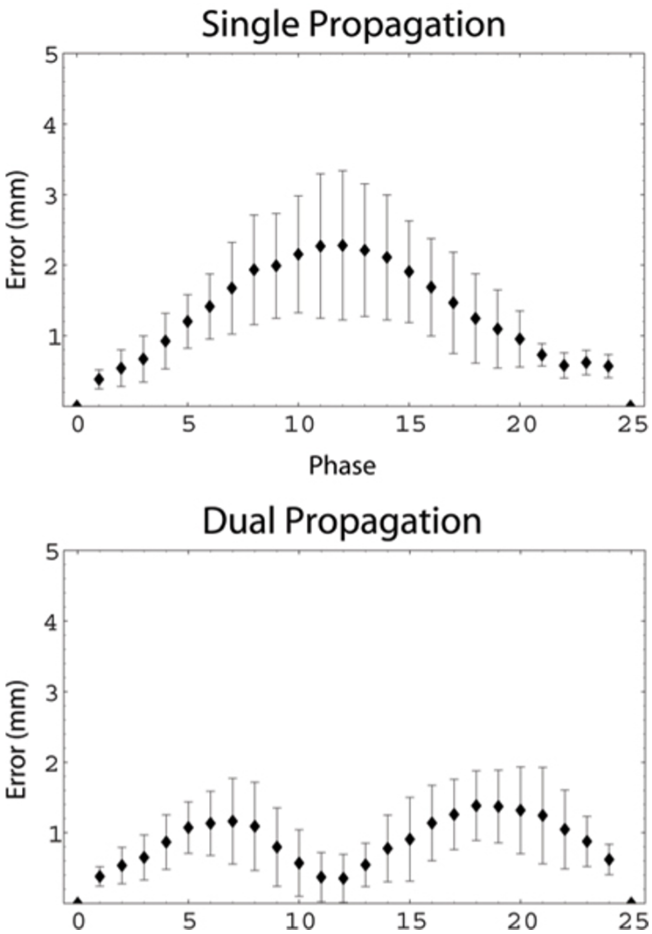

Figure 1
Accuravy of LV endocardial contour propogation.

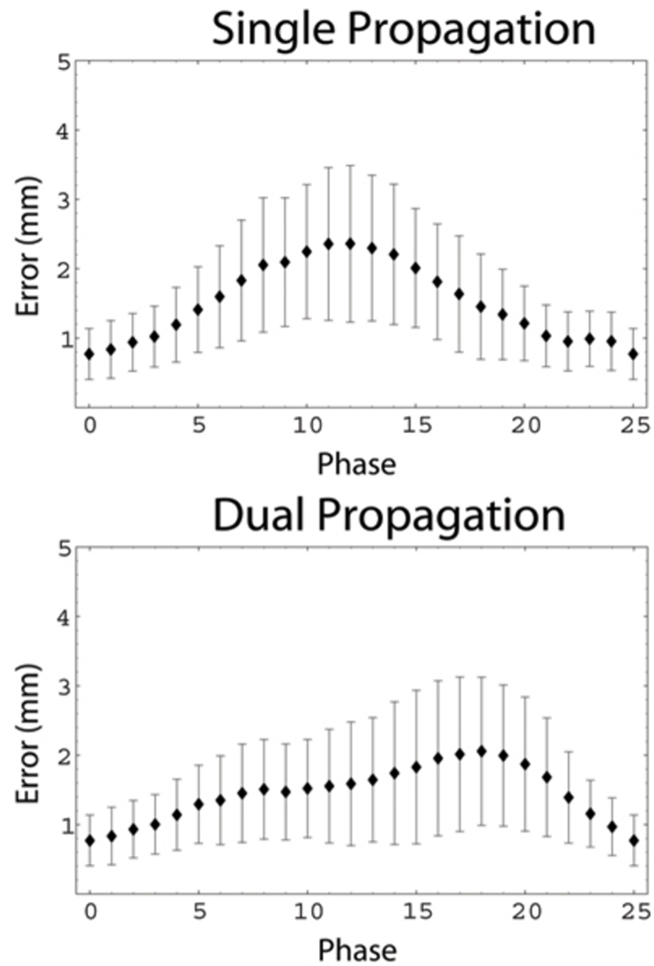

Figure 2
Variability after LV endocardium contour propogation.

and 1.07 ± 0.44 mm. Performing a dual propagation of an edit at ES resulted in endocardial and epicardial contours within 0.19 ± 0.27 mm and 0.15 ± 0.14 mm of the intended segmentations.

Conclusion

Dual contour propagation is more accurate than single contour propagation. However, due to the increased interobserver variability at ES, the dual approach does not provide more reproducible contours. Nevertheless, the dual approach can be considered to be a powerful method for editing results obtained using the single approach.

References

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