TRACKING MOTION IN TMRI DATA USING BINARY IMAGE PROCESSING TECHNIQUES

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Background: Tagged magnetic resonance imaging (tMRI) has found wide-spread applications in various clinical and research areas [1-3]. The strength of this technique lies in its ability to reveal regional motion of tissue such as that observed in cardiac studies [1]. For purposes of quantification, offline applied algorithms are developed to track the tissue motion of user-selected regions of interest (ROI). Examples of such algorithms include harmonic phase (HARP) techniques [2, 3] and others. To further enrich the library of tracking algorithms, we present an automated method that utilizes binary image processing techniques to follow the tissue motion of user-selected ROI in tMRI data.

Aims: The goal of this work is to develop fully automated software that enables users to track the tissue motion of ROI in sequential tMRI data sets.

Methods: Figure 1 shows a flow chart describing the developed algorithm which was implemented in a MATLAB code. The procedure starts by uploading the first image frame (I1) of the tMRI data set before converting it into binary form. Next, connected regions in the image frame are defined as areas of values of one (tissue) surrounded by strips of value zero (tags), and are uniquely labeled. The user is then prompted to select an ROI before calculation of the ROI's centroid is executed. When the next image frame (I2) is uploaded, the software locates the coordinates of the ROI centroid of I1 in the currently uploaded image frame I2. Under small motion approximation, the location of the ROI centroid of I1should lie in the same connected region in I2, and hence the ROI is tracked. Next, the third image frame I3 is uploaded and the procedure is repeated. It is noteworthy that prompting the user to select an ROI occurs once in the entire procedure.

Results: Figure 2 shows synthetic data of a tagged donut undergoing deformation mimicking that observed in the myocardium. The user-selected ROI (red) was tracked throughout the simulated motion. Figure 3 shows experimental cardiac tMRI data of a rat's left ventricle captured in the short axis view. The user-selected ROI (red) was successfully tracked for the entire data set.

Conclusion: We have developed a fully automated algorithm that is capable of tracking ROI motion in tMRI data sets. The algorithm operates under the small motion assumption, and is successfully applicable in cardiac studies.

References:

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2. Osman NF, McVeigh ER, Prince JL: **Imaging heart motion using harmonic phase MRI**. *IEEE Trans Med Imaging* 2000, **19**(3):186-202.
3. Liu W, Chen J, Ji S, Allen JS, Bayly PV, Wickline SA, Yu X: **Harmonic phase MR tagging for direct quantification of Lagrangian strain in rat hearts after myocardial infarction**. *Magn Reson Med* 2004, **52**(6):1282-1290.

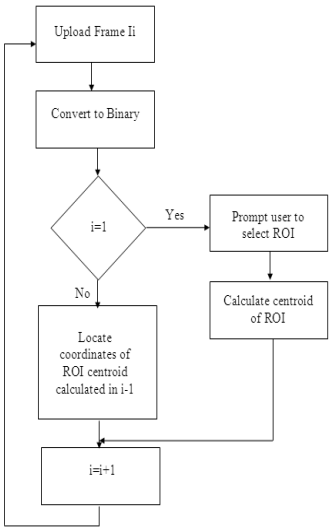

Figure 1
Algorithm procedures

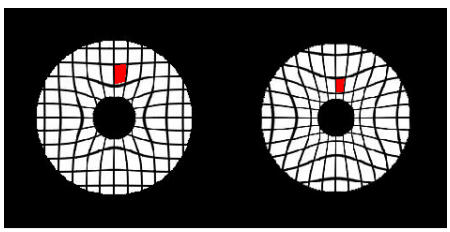

Figure 2
ROI (red) successfully tracked in a simulated motion in synthetic data.

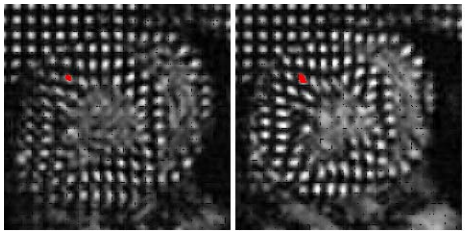

Figure 3
ROI (red) successfully tracked in experimental data of systolic motion of a rat.