AbstractID: 8899 Title: Registration based automatic segmentation and wall motion analysis for 4D cardiac micro-CT in mice

Purpose: We present an automated method for segmentation and tracking of hearth anatomy using 4D cardiac micro-CT datasets in mice. Cardiac motion is determined and analyzed using the deformation field obtained after non-rigidly deforming a template to all the time frames of the 4D dataset

Methods and materials: 4D micro-CT image sets were acquired with a temporal resolution of 10 ms and 100 microns spatial resolution in four mice using the Duke in-house developed micro-CT scanner and cardio-respiratory gating. Ten cardiac phases were used in the data acquisition. The images of the heart at different phases were registered using a BSpline deformable model. The contour points on the diastolic phase were automatically mapped to the corresponding points on the images of other phases following the mapping relation established by the deformable model. The method's stability to noise and artifacts in the input images was assessed using the 4D virtual mouse Moby phantom

Results: The deformable model was capable of accommodating significant variability of cardiac motion over time and across different individuals. The template was warped to the first phase of the 4D dataset with an accuracy of 0.95, 0.96 and for the left ventricle, myocardium and right ventricle as compared by the Hausdorff measure to manual segmentation. In between phases, worst segmentation accuracy was 0.93, 0.95 and 0.94 for left ventricle, myocardium and right ventricle. Additionally, the method automatically measures regional motion and deformation by probing the deformation field on the segmented contours.

Conclusion: Heart wall contour evolution in 4D micro-CT images can be easily defined and tracked using a BSpline deformable model, with no user interaction required. The method provides pre-clinical accuracy while eliminating the labor-intensive segmentation procedure.

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