LV Motion and Strain Computation from tMRI based on Meshless Deformable Models

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Abstract

Tagged Magnetic Resonance Imaging (tMRI) is a non-invasive way of tracking the in-vivo myocardial motion during cardiac cycles. Tags are material points which deform along the myocardiam uring the cardiac cycle. Cardiac diseases such as myocardial ischemia, injury and infarction can be diagnosed by detecting myocardial areas with local abnormal motion patterns and strain magnitudes.

We propose a meshless deformable model for in-vivo Left Ventricle (LV) 3D motion estimation and analysis based on tagged MRI. The meshless deformable model can capture global deformations such as contraction and torsion with a few parameters, while tracking local deformations with Laplacian representation. In particular, the model performs well even when the control points (tag intersections) are relatively sparse. We test the performance of the meshless model on a numeric phantom, as well as on the in-vivo heart data of healthy subjects and patients. The experimental results show that the meshless deformable model can fully recover the myocardial motion and strain in 3D. Compared with 2D analysis, 3D motion and strain fields provide a more comprehensive description and understanding of myocardial motion. The method is validated by comparing the projection of the deformed tagging planes on the image planes and the ground truth in tMRI. Further validation would be part of our future work.

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