Comparative Study of Fast Quantitative Analysis Techniques of Tagged Magnetic Resonance Images

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Tagged Magnetic Resonance Imaging (tMRI) is a powerful non-invasive method used to study the regional function of the heart. In tMRI, a pattern of varying magnetization is induced in the myocardium to act as tissue landmarks that can be tracked throughout the cardiac cycle. The myocardial deformation and function can then be quantified by analyzing the tracked points. Manual tracking of the tagging pattern is the gold standard analysis technique but it is a very tedious and time consuming process. Two major techniques have been proposed in literature to provide fast analysis, namely HARP and optical flow. Although much work has been devoted to each technique alone, literature lacks any comparative study that evaluates the performance of these two techniques. This work presents a comparative study of the major two tracking techniques i.e. optical flow and HARP using a test database. To do that, a manually-drawn myocardial mesh is drawn on the initial timeframe defining the endocardium and epicardium. The points of this mesh are then tracked for all timeframes using the two techniques. The tracking error is measured as the Euclidean distance between the tracked points and its correct location determined by an expert grader. The myocardial rotation and strain for each point on the mesh are also calculated and the results of the two methods are compared together. The computation speed is recorded for each method and the failure cases are analyzed. Our conclusion is that although HARP technique is faster, it fails near the edges of the myocardium and also when the tags fade out. On the other hand, optical flow method is relatively slower but is more reliable especially near the edges. This finding means that optical flow can reliably track the myocardial borders and thus be used to estimate the global cardiac function from tMRI.