

Patient-Specific Correlation of Perfusion Defects to Coronary Arteries

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Patient-specific correlation of perfusion defects to coronary arteries responsible for blood supply in the affected territories has the potential to improve accuracy of diagnosis and intervention planning. Cardiac cycle phase difference between perfusion and angiography datasets explains the vast variation of the shape of the myocardium between these datasets and precludes the use of standard methods of 2D/3D registration. Research published to date does not provide a reliable method of registering 2D perfusion and 3D coronary angiography datasets.

This paper presents a work-flow for non-rigid registration of 2D perfusion series and 3D angiography volumes; the solution of the registration problem relies on the use of the 4D wall motion series (spanning the complete cardiac cycle) as a mediator for non-rigid registration perfusion and angiography datasets. The work-flow assumes the availability of the localisation/segmentation of the main coronary arteries in the angiography dataset. In the first two steps the phases corresponding to perfusion and angiography datasets are determined through rigid registration of those datasets to the cine series. In the next step, an Eulerian framework-based sequential non-rigid phase-by-phase registration of the 4D cine series provides a transform spanning the phase difference between perfusion and angiography datasets. Finally, the phase-difference transform from the previous step is used to transform the angiography dataset containing the localised/segmented main coronary arteries into the corresponding perfusion phase where coronary arteries can be directly associated with perfusion defects.

The presented work-flow for mediated spatiotemporal registration is first validated on synthetic cine series derived from clinical data; the second part of the evaluation is carried out on clinical data. The results of the evaluation show the utility of the method in this particular context while highlighting its potential applicability to other areas of cardiac image analysis.