Right ventricular strain from cardiac cine MRI: a flattening approach

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1. Motivation

The right ventricle (RV) is responsible for the pulmonary circulation but few image-based indices focus on the RV shape or deformation [1]. This omission is likely due to the complex RV morphology with respect to the left ventricle (LV). Therefore, it is relevant to find new methods able to quantify RV shape and function. In this abstract, we present a novel automatic method to analyze RV deformation from cine cardiac magnetic resonance images (cMRI).

2. Materials

To illustrate the method, we used cMRI images covering the whole cardiac cycle acquired from a volunteer. The RV was segmented using a model-based segmentation tool ([2]). The output of the procedure was a sequence of closed surface meshes that correspond to different time instants from end-diastole (ED) to end-systole (ES).

3. Method

To study the deformation in both longitudinal and circumferential directions we established a quasi-conformal mapping from the RV surfaces in all time instants to a disk similarly to [3], using a cut along the geodesic connecting the centers of the tricuspid and pulmonary valve. The apex was mapped to the center of the disk. Subsequently a grid was generated on the disk by subdividing it into 12 longitudinal and 12 circumferential segments, and mapped that grid back to the RV mesh. The grid has been used to calculate the longitudinal and circumferential strain.

4. Result and discussion

Fig. 1 shows the generated grid along the cardiac surface at ED and ES. The gridlines follow longitudinal and circumferential direction of the ventricle. Fig. 2 reports the engineering strain curves computed using the relative length changes of the grid. We didn't observe any artefacts in the mesh temporal point-to-point correspondence during the grid tracking.

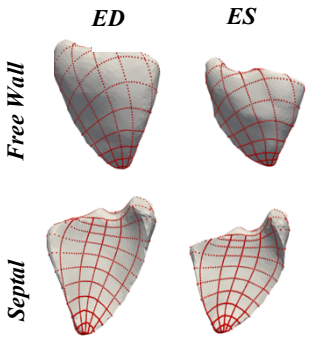

Figure 1. *Grid superposed on the RV in the ES and ED..*

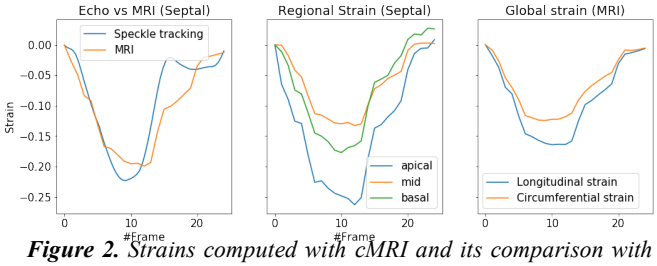

Figure 2. *Strains computed with cMRI and its comparison with 2D echo*

A qualitative comparison with longitudinal septal strain obtained using 2D speckle tracking (Echopac v201) showed reasonable agreement with the septal longitudinal strain. Regional septal apical, basal and global strains are in physiological range and shape.

5. Conclusion

This is a preliminary result towards a complete automatic assessment of the RV function. Computing regional strains using cMRI seems feasible. However, a quantitative validation is still needed, and the use of feature tracking to establish reliable point to point correspondence still needs to be incorporated.

References

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