GENERATION OF ANATOMICAL MODELS FOR BIOMECHANICAL SIMULATION OF TRANSSEPTAL PUNCTURE

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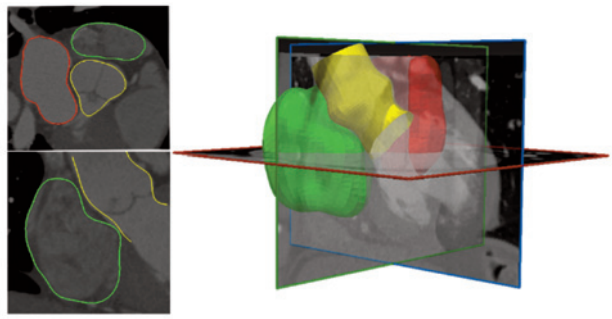
Access to the left atrium (LA) is required for several minimally invasive cardiac interventions of the left heart, such as catheter ablation for atrial fibrillation. Hereto, the septum is punctured using a catheter inserted in the right atrium (RA) via the venous system using fluoroscopy. Although this approach has been used for many years, complications and procedural failure are common.

This project aims therefore to develop technologies to assist the physician in performing atrial transseptal punctures. The goal is to use a subject-specific biomechanical approach to identify the optimal puncture position and consequently plan the entire procedure. Thus, a methodology to accurately obtain patient-specific atrial models from cardiac computed-tomography (CT) images is required. As such, here is presented the methodology used to generate these anatomical models.

The B-spline Explicit Active Surface framework was used to semi-automatically segment the LA, RA and aorta [1]. The segmentation process requires an initialization obtained through a manual definition of the desired structures (mitral valve, aortic valve, tricuspid valve and vena cava) and their boundaries. Then, a contour evolution strategy is used to delineate the entire cardiac chambers automatically.

The proposed methodology was tested on 8 CT datasets and the results compared against manual landmarks. APD errors of 1.48±0.26, 1.56±0.52 and 2.51±0.87 and DICE values of 91.50±1.31, 89.54±2.95, 82.24±3.98 were obtained for the LA, RA and aorta, respectively, which is very promising.

Figure Caption: Result obtained with the semi-automatic segmentation approach.



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References:

[1] D. Barbosa et al.: B-spline explicit active surfaces: An efficient framework for real-time 3-D region-based segmentation. Image Processing, IEEE Transactions on 2012; 21:241-251.