Title : 3D SPECT Cardiac Sequence Segmentation

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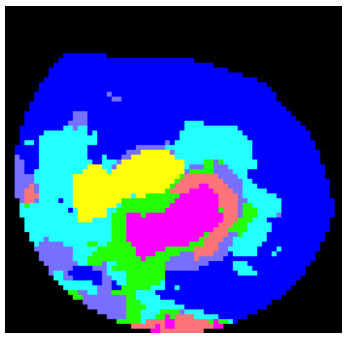
Keywords :

Medical Imaging, Applied Mathematics, Programming

Context



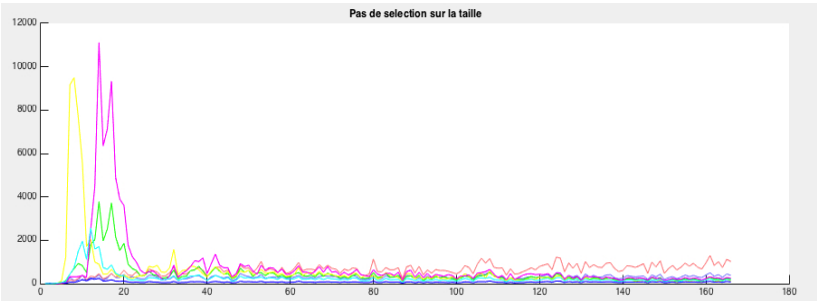
Cardiovascular diseases are the leading cause of mortality worldwide, with coronary diseases as the first provider of cardiovascular deaths. Nuclear medicine allows the diagnostic with myocardial perfusion scintigraphy (SPECT imaging). This could be significantly improved by determining coronary reserve (Coronary Flow Reserve, CFR), which corresponds to the maximum capacity of the myocardium to increase the coronary perfusion in response to exercise or pharmacological stress. The reference method of the CFR is invasive and requires the placement of intracoronary catheter. The CFR can also be determined from nuclear image sequences of perfusion (PET, MRI and 3D SPECT). Using new SPECT gamma cameras with efficient sensors Cadmium-Zinc-Telluride (CZT), it seems possible to measure the CFR.

Objectives

The main problems are the data analysis and the image processing steps. SPECT 3D sequences are quite noisy, their resolution and sensitivity is lower and the signal/noise is less favourable than PET imaging. From these sequences, we have to extract the spatial information: where is the Left ventricles (LV) , the Right ventricles (RV) and the Myocardium (MY), and the average temporal signal in these objects.

A first manual analysis (Figure 1) of the image sequence gives several basic signals, including those corresponding to the ventricles (LV: yellow and RV: Parma). The myocardium is separated into 2 objects (pink and purple). It can be seen many false detections corresponding to similar time signals, especially at the edges.

An average signal of these areas gives access to the kinetics in the right ventricles, left and myocardium (Figure 2) and then the CFR can be computed.



The objective is to propose an automatic segmentation method. The weaknesses of the previous solution are intrinsic to ill-posed problems, which can only be solved by adding a priori information. We propose to study a 3D+t deformable model, with spatial constraints between the objects of interest (Right Ventricle, Left Ventricle, Myocardium). In addition, the temporal dimension must be continuous and smooth. The coarse initial segmentation can be achieved through graph-cut and/or clustering tools..

Laboratory :

Working Place : LRB (UMR_S 1039) and GIPSA-LAB, Grenoble. ≈ 540 Euro monthly; can be continued in PhD

References :

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