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Automatic Angiography Segmentation based on improved Graph-cuts

Motivation

Angiography image

Multi-Sliced Computed Tomography (MSCT)

Registration

However, registration methods are sensitive to the background noise present in angiography images. In order to obtain a more precise registration we need a pre-processing step.

Chronic total occlusions (CTO) are obstructions of native coronary arteries. Recanalization of a CTO still remains a challenge for invasive cardiologists [1].

MSCT is a valuable technique for the non-invasive visualization of both the lumen and the features of the arterial wall of coronary vessels.

Registration of CT to X-Ray images is a valuable tool to provide complete and high quality 3D information in addition to the poor X-ray images [2].

Segmentation!
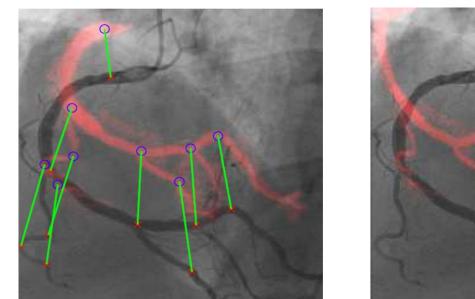
Automatic Vessel Segmentation

Our automatic vessel segmentation method is based on the graph-cuts [3] energy minimization framework. In this framework, an energy function is minimized in order to find the optimal segmentation of the image, using region and context information.

$$\mathbf{E}(\underline{\alpha}, \mathbf{k}, \underline{\theta}, \mathbf{z}) = U(\underline{\alpha}, \mathbf{k}, \underline{\theta}, \mathbf{z}) + V(\underline{\alpha}, \mathbf{z})$$

Region potential

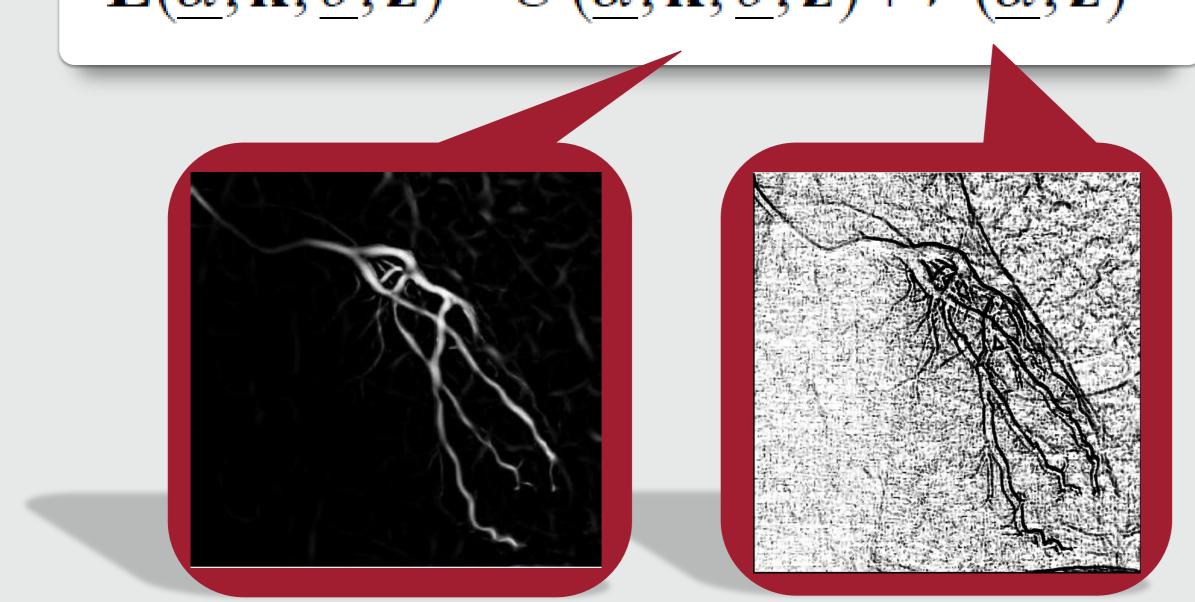**Boundary potential**

Region potential

This potential encodes local information, computing a vessel probability or vesselness [4] at each pixel. This vesselness is quite poor at vessel bifurcations, so we add geodesic paths information [5] in order to improve this region information at those critical points.
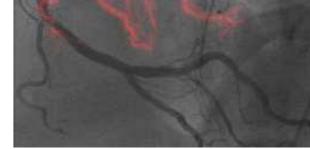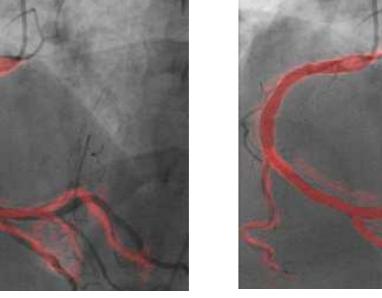
Boundary potential

With this potential we provide contrast information to the segmentation framework. Simple pixel differences are computed, but the result is quite noisy. We propose a multi-scale approach in order to smooth this noise.

Registration [6]

Not registered   **Gray-level**

Vesselness   **Segmented**

Results

IO — Graph-Cuts — Ours

Overlapping

Acknowledgements

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