

Automatic vessel segmentation from CDSA image sequences

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An automatic segmentation of coronary arteries from cardiac digital subtraction angiograms (CDSA) is hereby presented. The basic idea of the research is based on the term used in interventional cardiology: Myocardial Blush (MB). Assessment of MB in general practice of invasive cardiology is performed by a physician with eyeball estimation. The main goal of this research is the quantitative assessment of the myocardial blush grade in the human heart using coronary angiograms.

For assessment, a software toolkit is under development, which consists of the following distinct modules:

- CDSA image processor
- Vessel Mask Calculator (VMC)
- Moving Region Of Interest Tracker
- Measurement Unit

To protect the patient from high-dose X-ray, we have to consider significant noise level throughout the whole sequence. Depending on when and for how long the contrast medium is injected, the intensities of vessels and the myocardium vary by time. The algorithm has to deal with these issues. An ideal DSA sequence only contains contrast medium without any background structure, but in most cases artifacts are present due to patient movement, therefore subtraction errors are visible, which can easily be mistaken for vessels. Creation of DSA sequence is performed by CDSA image processor module.

The first module produces sequences of 8 bits/pixel, gray-scale images with the size of 512x512, containing 8-12 cardiac cycles at the frame rate of 15 fps.

The proposed, fully automated segmentation algorithm exploits the fact that the segmentation is performed on sequences, not on stand-alone images, so it has the opportunity to look back to previous frames or to look ahead to forthcoming ones. Due to the nature of CDSA sequences, we also utilize the fact that on identical frames of the cardiac cycles, vessels - most likely - appear at the same position. In spite of the fact that the images are very noisy due to the low-dose X-ray, the algorithm shall detect thin vessel structures as well. Not having the myocardium segmented enables us to measure the grade of perfusion.

Keywords: *vessel segmentation, cardiac digital subtraction angiogram, myocardial blush, myocardial perfusion*