

METHOD FOR SEMI-AUTOMATED IMAGE SEGMENTATION OF BLOOD VESSELS IN MRI IMAGES

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INTRODUCTION

Carotid atherosclerosis is considered a major risk for thromboembolic cerebrovascular issues. This pathology involves the accumulation of fatty materials (plaque) in the wall of blood vessels. This phenomenon causes the vessel to thicken, which consequently results in less expansion of the vessel within a cardiac cycle [1].

Medical imaging techniques such as Magnetic Resonance Imaging (MRI) have been greatly used for diagnosis of atherosclerosis through visual evaluation of the images. However, due to the qualitative nature of these procedures, one can lead to ambiguous results depending on the quality of the obtained images and on the accuracy of the operator. Also, this procedure is very time-consuming, taking about 7-9 minutes per sequence of 16 phases.

This project proposes a method for segmentation of vessels in MRI images with the use of image processing techniques coded in MATLAB, in order to solve time and accuracy issues.

METHODS

The developed program consists of five main parts: Data Input, User Input, Analysis and Correction, Radial Segmentation and Data Output.

Data Input gathers all the necessary data such as the MRI scans and its parameters. The images are resized and contrast is increased. User Input prompts the user to click in specific spots on the desired vessel. These points are used as references for setting threshold values in respect to each direction from the center of the vessel.

Then, the program runs Analysis and Correction by evaluating intensity values as a function of the angle from the center of the vessel (where zero degrees is east), interpolating and then calculating intensity threshold as a function of the angle.

In Radial Segmentation, sets of vectors are grown radially from the center of the vessel. They stop growing once the threshold value in the current direction is reached in its extremity. Each vector length is recorded in an array that is

used to calculate an average area of the vessel for each phase. Finally, in Data Output, the boundaries of the vessel are shown in a set of images (Figure 1), and the area values and dilation percentage are printed on the screen.

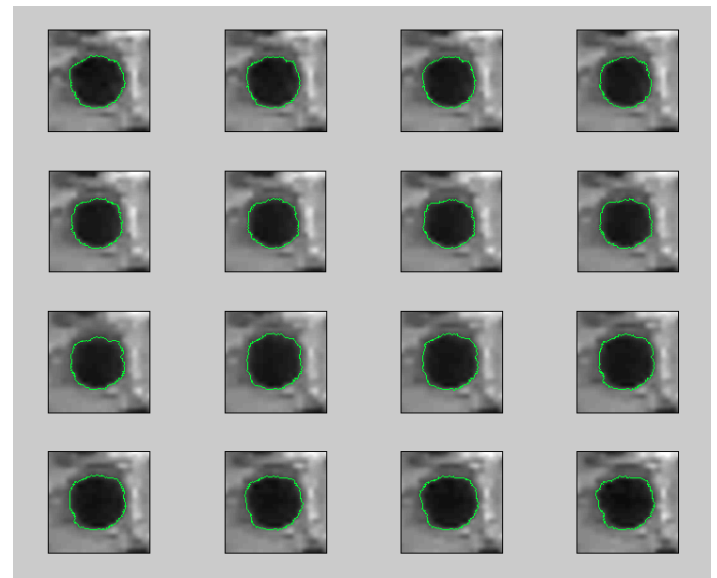


Figure 1. Final plots. Each frame corresponds to one cardiac phase. The segmented boundaries are shown as green lines.

RESULTS AND CONCLUSIONS

Manual measurements made by 3 individuals on 1400 images of 10 volunteers have been compared to the same measurements made by the program. Statistical analysis between these measurements demonstrated a p-value of approximately 0.94, implying that there is no significant statistical difference between manual and the semi-automated measurements. The time consumed in the process was reduced by a factor of 24, from ~8min to ~20s per sequence of 16 phase slides. In conclusion, both the time and accuracy problems have been addressed with the new program.

REFERENCES

1. C. Porsche. Assessment of Vessel Wall Thickness in Carotid Atherosclerosis using Spiral CT Angiography, *European Journal of Vascular and Endovascular Surgery*, Volume 23, Issue 5, May 2002, Pages 437-440