AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Computer Engineering and Systems

Automatic Segmentation Of Small Vascular Structures in 3D Medical Images

A Thesis submitted in partial fulfilment of the requirements of the degree of

Master of Science in Electrical Engineering

(Computer Engineering and Systems)

by

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(Computer Engineering and Systems)
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Cairo - (2016)

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Statement

This thesis is submitted as a partial fulfilment of Master of Science in Electrical Engineering, Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Abstract

The automation of the blood vessel segmentation is a very helpful tool to aid the doctors in the diagnostic process. In this thesis, the segmentation of vascular structures in 3D medical images (CTA and MRA) is discussed. Many methods for vessel segmentation and tracking is discussed and reviewed in detail. A new approach for fast tracking, quantization and centreline extraction of small vascular structures is introduced, with the problem of coronary arteries segmentation used as an example.

The main purpose here is to achieve near interactive vessel segmentation process that is accurate and does not miss smaller vessels even in a noisy environment. This is achieved by propagating an explicit surface in a vessel tracking manner. This surface is represented as a triangular adaptive mesh where the element size is adjusted based on the current size of the vessel. Adaptive re-meshing is performed on–the–fly during propagation in an efficient manner. An effective self-intersection prevention method is introduced to address one of the major issues in triangular mesh offsetting.

The algorithm was compared to many state of the art methods in vessel tracking and showed great accuracy and low miss rate of smaller vessels in the coronary tree while performing the whole operation in less than a minute.

Keywords:

Segmentation, Vessels, Tracking, Active contours, Explicit Surface, Vessel Contrast Enhancement, Coronary Arteries

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