Retinal image blood vessels segmentation – Vessel width estimation

Abstract

The purpose of this thesis is the development of an algorithm for the segmentation of Retina vessels' from RGB images of fundus. Retina plays a fundamental part for the function of our fundus but can also suffer from many possible diseases like retinopathy.

The proposed algorithm can be partitioned on four different parts. A) The detection of the retina vessels' centerlines using differential geometry B) The creation of structures called convex sets, based on three equations which ensure that the created structures will belong to the same ridge. C) The extraction of some spatial characteristics, such as edge strength, edge height, standard deviation curvature etc. in order to create regions with many different convex set that will be straight elements. D) The classification of the convex set regions using feature vectors from the pixels using a K-nearest neighbour classifier. This final step will give us the segmented image containing the vessels.

For the training phase of the classifier we employ the publicly available database DRIVE which includes 40 RGB images of fundus, as well as a segmented image from a trained observer for each of the 40 images. The manual segmentations are very useful for the calculation of the a posteriori probability.

At the second part we propose an algorithm for the estimation of the vessels' width by finding the bifurcation areas of the vessels, which denote a change of the cross point between two vessels, indicating that we have a new vessel. Finding these areas we obtain the starting point so, as soon as we find the end point, we can calculate the mean, maximum and minimum width of the whole vessel.

Regarding the part of the segmentation, the algorithm identifies the large vessels, whereas it misses some pixels that belong to the smaller vessels, making them seem noisy.

For the part of the width estimation, the algorithm identifies the vessels from the image's skeleton and estimates the width with pixel accuracy.

SUBJECT AREA : Medical Informatics, Medical Image Processing, Pattern recognition

KEYWORDS : K-nearest neighbour, Retina , Ridge, Vessel width