An efficient retinal blood vessel segmentation in eye fundus images by using optimized top-hat and homomorphic filtering

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Digital Image Processing Course Project

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Proposed method

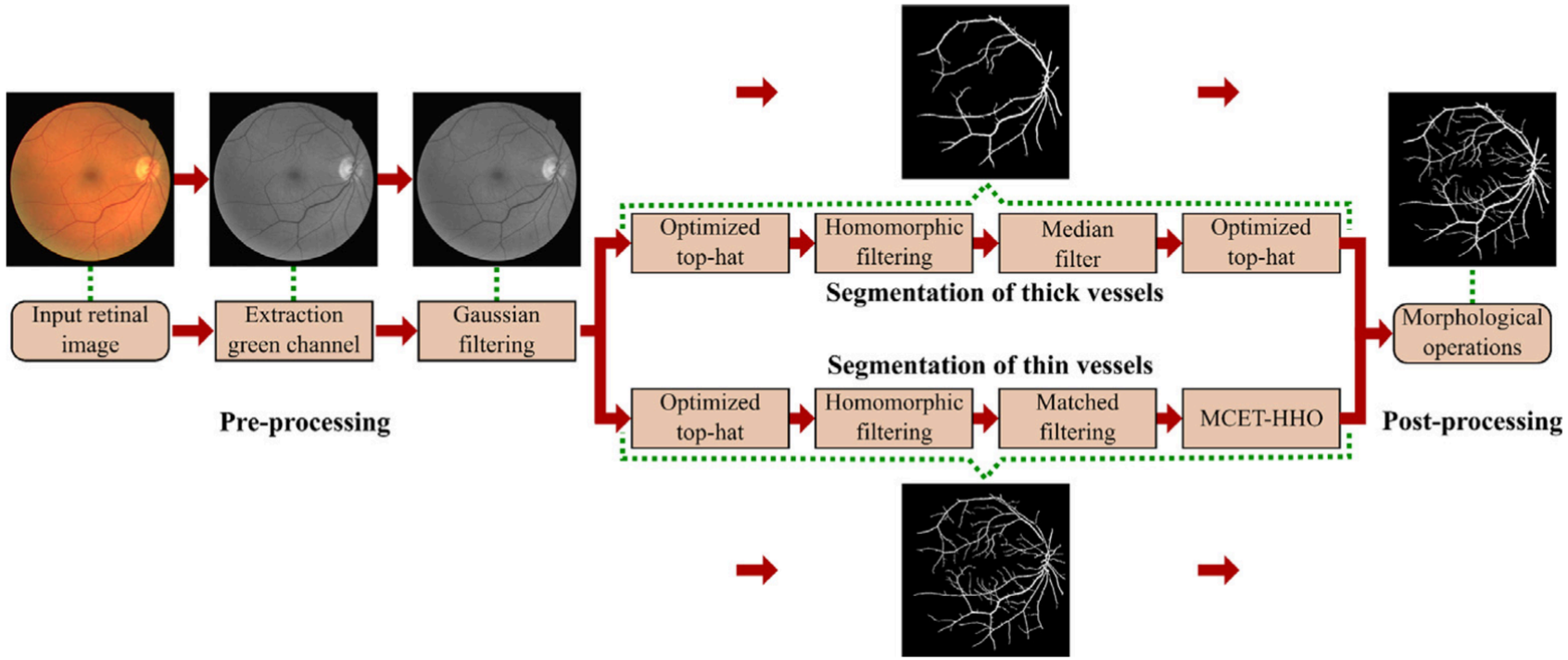


Fig. 1. Flowchart of the proposed method for vessel segmentation

Matched filtering

- Designed to enhance image regions that match a specific distribution
- Detect piecewise linear segments of blood vessels in fundus images, whose profile can be estimated by a Gaussian-shaped curve

$$f(x,y) = -k\exp\left(\frac{-x^2}{2\sigma^2}\right) \quad for\ |y| \le L/2$$

- $\theta = 0,7,14,...,182$, 7x7 kernel

MCET-HHO

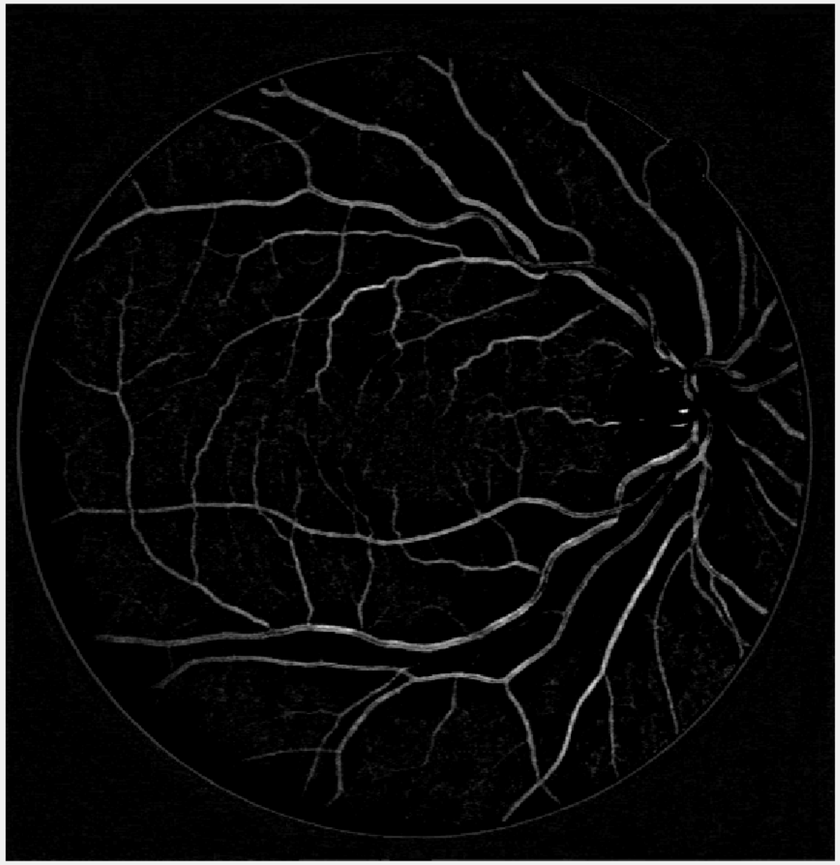
Minimum Cross-Entropy Thresholding - Harris Hawks Optimization

- Segmentation algorithm
- Minimizing cross-entropy through the Harris Hawks Optimization (HHO)

$$f_{cross}(th) = \sum_{i=1}^{L} ih(i)log(i) - \sum_{i=1}^{nt} H_i$$

Results

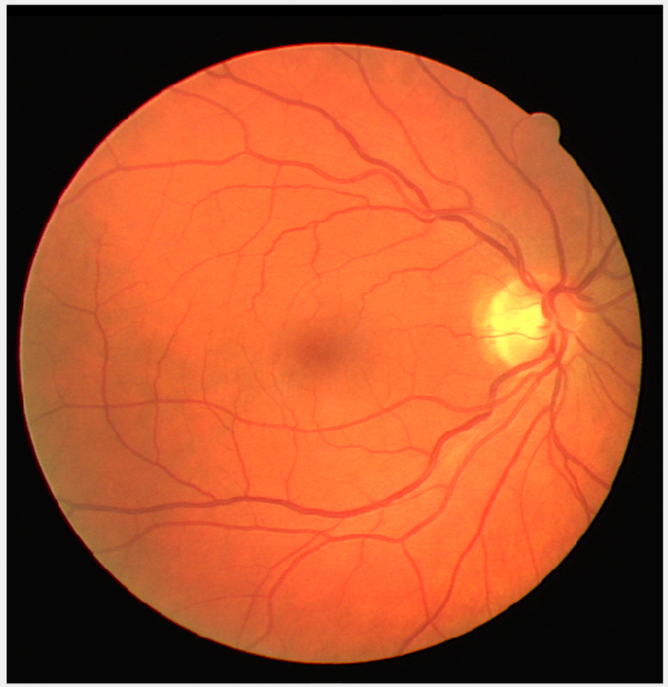
Thin vessel enhancement



Thick vessel enhancement

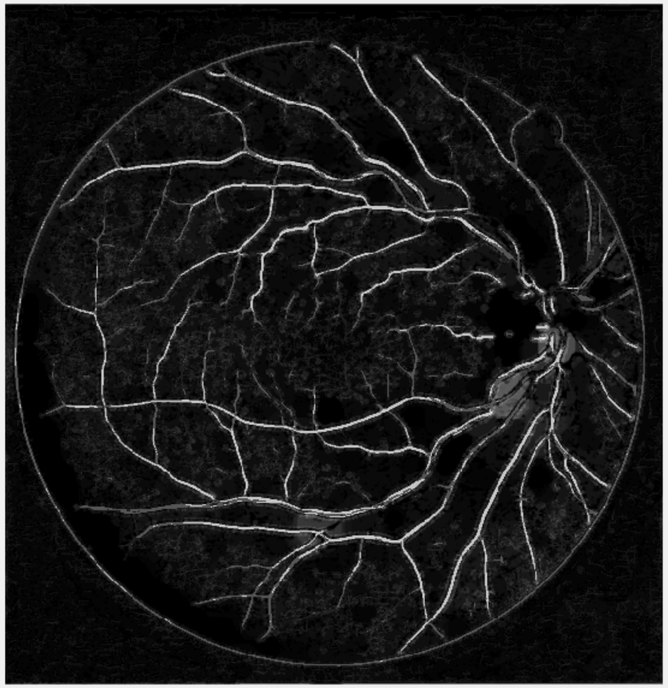
Results

Original Image



Green channel

Enhancement



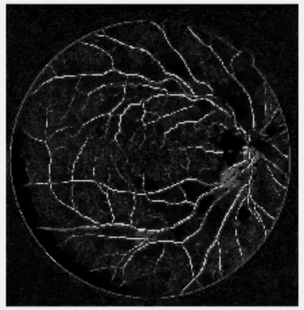
Optimized Top-hat vs. Top-hat

$$T_O = I^c - \left(I^c \circ S_o\right) \bullet S_c$$

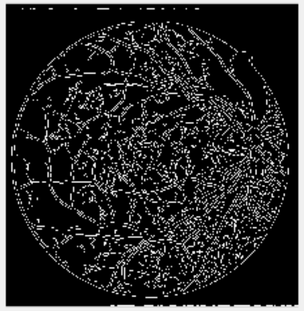
$$T_{HAT} = I - \left(I \circ S_o\right)$$

Comparison

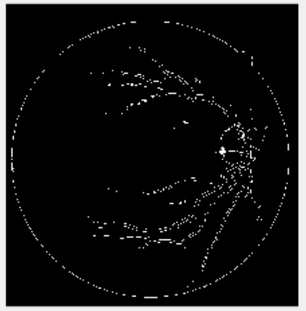
Paper



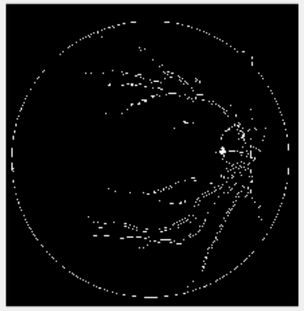
Canny



Sobel

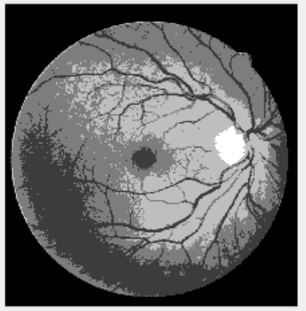


Prewitt



adaptive threshold

Otsu



Thank you!