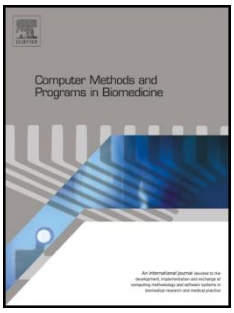
Accepted Manuscript



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PII: S0169-2607(16)30545-4
DOI: http://dx.doi.org/doi: 10.1016/j.cmpb.2016.10.015
Reference: COMM 4284

To appear in: *Computer Methods and Programs in Biomedicine*

Received date: 28-5-2016
Revised date: 22-9-2016
Accepted date: 18-10-2016

Please cite this article as: Malihe Javidi, Hamid-Reza Pourreza, Ahad Harati, Vessel segmentation and microaneurysm detection using discriminative dictionary learning and sparse representation, *Computer Methods and Programs in Biomedicine* (2016), http://dx.doi.org/doi: 10.1016/j.cmpb.2016.10.015.

Vessel Segmentation and Microaneurysm Detection using Discriminative Dictionary Learning and Sparse Representation

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Highlights

- Our method can diagnose Diabetic retinopathy through analyzing retinal image.
- This method is based on discriminative dictionary learning and sparse representation.
- Previous methods relied on fixed dictionary but we obtain dictionary via learning.
- The results indicate that our method achieves high accuracy especially in abnormal image.

Abstract - Diabetic retinopathy (DR) is a major cause of visual impairment and the analysis of retinal image can assist patients to take action earlier when it is more likely to be effective. The accurate segmentation of blood vessels in the retinal image can diagnose DR directly. In this paper, a novel scheme for blood vessel segmentation based on discriminative dictionary learning (DDL) and sparse representation has been proposed. The proposed system yields a strong representation which contains the semantic concept of the image. To extract blood vessel, two separate dictionaries, for vessel and non-vessel, capable of providing reconstructive and discriminative information of the retinal image are learned. In the test step, an unseen retinal image is divided into overlapping patches and classified to vessel and non-vessel patches. Then, a voting scheme is applied to generate the binary vessel map. The proposed vessel segmentation method can achieve the accuracy of 95% and a sensitivity of 75% in the same range of specificity 97% on two public datasets. The results show that the proposed method can achieve comparable results to existing methods and decrease false positive vessels in abnormal retinal images with pathological regions. Microaneurysm (MA) is the earliest sign of DR that appears as a small red dot on the surface of the retina. Despite several attempts to develop automated MA detection systems, it is still a challenging problem. In this paper, a method for MA detection, which is similar to our vessel segmentation approach, is proposed. In our method, a candidate detection algorithm based on the Morlet wavelet is applied to identify all possible MA candidates. In the next step, two discriminative dictionaries with the ability to distinguish MA from non-MA object are learned. These dictionaries are then used to classify the detected candidate objects. The evaluations indicate that the proposed MA detection method achieves higher average sensitivity about 2-15%, compared to existing methods.

Keywords – Blood vessel segmentation, Microaneurysm detection, Discriminative dictionary learning, Sparse representation.