Detecting Streaks from Dermoscopic Images of Pigmented Skin Lesions

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In the 23rd World Congress of Dermatology - Vancouver 2015

Abstract

Background: Interpreting dermoscopic images requires a steep learning curve; without proper training, their complex visual features could confuse even experienced dermatologists. Recently, a few works have been proposed towards automating pigmented skin lesion (PSL) classification in dermoscopic images. A typical computational pipeline for PSL classification system includes the following stages: feature extraction, machine learning, and feature classification.

Objective: In our work, we focus on extracting features for streak detection due to the clinical importance of the absence or presence of the streaks in dermoscopic images. We propose a novel streak descriptor.

Methods: Our underlying assumption is that, in the presence of streaks, the majority of the image pixels have high tubularness (ridge like appearance) with a coherent direction of the tubular structures, i.e. pointing along the same direction. To capture this key feature, the magnitude and direction of a streak vector field (with a vector per pixel) is defined as the computed tubularness (magnitude) and the eigenvector (direction) of the Hessian matrix at that pixel. The Hessian is the matrix of 2nd derivatives of colour channels defined using Quaternions (an extension to complex numbers to encode 3 colour channels simultaneously). Then, the streak descriptor is set as a function of the histogram of the eigenvectors weighted by the quaternion tubularness.

Results: We evaluated our method on 674 images of Argenziano et al.'s atlas of dermoscopy; 344 images in the absence of the streaks and 330 images in the presence of them. A 10-fold cross validation was carried out to determine the effectiveness of the descriptor. The experimental results indicated that applying the proposed feature descriptors improves the streaks classification accuracy over a set of global feature descriptor using different classification methods. The proposed descriptor achieved the sensitivity of 0.72 and specificity of 0.80 comparing to competing global features of 0.7 sensitivity and 0.74 specificity.

Conclusions: We presented a novel descriptor for streak detection, which is important for early skin cancer detection. Our next step is developing a polished GUI-based software system for use by collaborating dermatologists (beta testers).

Keywords: pigmemnted skin lesion (PSL); classification; feature extraction; classification.