Retinal Fundus Image Constrast Normalization using Mixture of Gaussians

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Abstract

We present a fast and robust method to correct contrast variation in retinal fundus imagery. The technique uses a mixture of Gaussians to model the bias of the intensity variation. Typically a two or three component mixture is sufficient to characterize the principal variation due to the spherical geometry of the retina, the high-contrast reflection off the optic nerve and the darker macula. By learning priors on the component parameters, it is possible to reliably locate and quantify the macular region and the optic nerve. Although the mixture-model fitting is non-linear, it can be achieved at a low cost by random sampling the source image.

We detail the methodology and algorithm. We present results on at set of 50 retinal images and show both qualitative and quantitative measures of its performance (using ROC analysis) and compare it to a variance based local normalization. The use of the mixture to globally model the illumination bias make it more robust over point-estimate based methods. The technique is shown to greatly simplify the task of identifying vessels, hard exudates and potential micro-aneurysm spots. This contrast normalization is currently being used as a pre-processing step in our computer aided screening system to detect early signs of sight-threatening retinopathy.

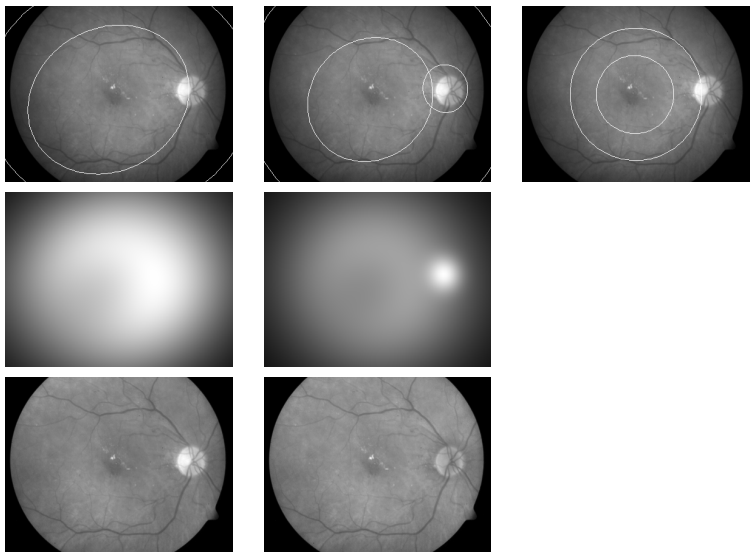

Figure 1: Illustration results of Mixture of Gaussian fitting and Contrast Normalization. Top: input with spatial extents of mixture components overlaied. Middle: Shape of bias fields. Bottom: constrast normalized. Top right: Location of macular region identified.