IMPLEMENTATION OF OPTIMAL ILLUMINANTS FOR RETINAL IMAGING USING A SPECTRALLY TUNABLE LIGHT SOURCE BASED ON DIGITAL MICROMIRROR DEVICE

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Abstract

White light illumination (e.g. Xenon flash) is typically used for the optical imaging of human retina. However, these broadband light sources are not necessarily optimal for getting the best possible visibility of different features-of-interest in retinal images. The use of optimal light sources, which have optimized spectral power distributions (SPDs) for the contrast-enhancement of various retinal features or lesions in fundus images, would therefore be preferred [1].

In order to implement these optimal illuminants, a spectrally tunable light source based on a digital micromirror device (DMD) was constructed, and retinal images were captured from an artificial eye.

Setup of Device

Chosen illumination patterns were generated with MATLAB. Patterns were calculated using previously designed algorithms [1]. Illumination patterns were designed to enhance contrast of several retinal features or lesions:

1. Arteries/veins
2. Blot Bleedings
3. Fibrosis
4. Hard Exudates
5. Laser photocoagulation scars
6. Macula
7. Microaneurysms
8. Microinfarcts

Illuminants

Fig. 1 Schematic of optical setup
Fig. 2 Implementation of setup
Fig. 3 Texas Instruments DMD
Fig. 4 Reconstructed RGB image of an artificial eye
Fig. 5 Optimal SPDs in the case of fibrosis
Fig. 6 Fibrosis. Top row: generated DMD pattern for the optimal SPD in Fig. 5 (top left) and for the most significant SPD (top right). Bottom row: the respective images taken from an artificial eye in grayscale and pseudo-color.
Fig. 7 SPD of Thorlabs HPLS-30-04 light source
Fig. 8 Optimal SPDs in the case of macula
Fig. 9 Macula. Top row: generated DMD pattern for the optimal SPD in Fig. 8 (top left) and for the most significant SPD (top right). Bottom row: the respective images taken from an artificial eye in grayscale and pseudo-color.

References


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