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Suppression of the Eyelash Artifact in Ultra-Widefield Retinal Images

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Abstract

Retinal imaging is used by optometrists and ophthalmologists to screen for and diagnose eye and non-eye diseases. It is believed that indicators of systemic diseases and precursors to different eye conditions often exhibit first on the periphery of the retina. Current retinal examination methods provide a narrow field of view (about 5%) and can therefore miss eye and non-eye disorders that may be present and can be detected on the periphery of the retina. However as the field of view becomes greater, certain artifacts can be captured in the image making its analysis more challenging. An example of this is the presence of eyelashes.

In this work, an automated image-pair registration method known as the Generalized Dual-Bootstrap Iterative Closest Point (GDB-ICP) algorithm [2]-[4], was used to suppress the eyelash artifact, of ultra-widefield retinal images. The percent of suppression evidenced in the mosaic created by the algorithm was quantified. For the pair of images used in this work the percent of suppression obtained, was 6.13% in regards to the overall image.

State of the Art

• Current analysis of eye conditions is been done with images taken over a field of view of 30º.

•To capture a greater percentage of the retina, either the patient's eye must be dilated, causing patient discomfort, or multiple images of the retina must be taken, at additional cost and time to the practitioner [1].

Optomap ® Instrument

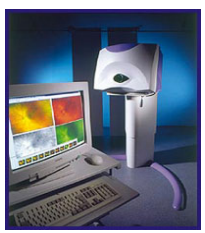


Figure 1. Picture of the **opto**map® imager

•**Opto**map® is the core product of the company Optos ® and generates a digital wide-field (200 degrees internal angle) image of the retina.

•Image capture takes a quarter of a second once the patient is positioned relative to the device.

•The device is designed to be able to take an image through a 2mm aperture, and therefore the dilation is not necessary.

Conventional Retinal Imaging: Technology only captures a small area of the retina at one time.

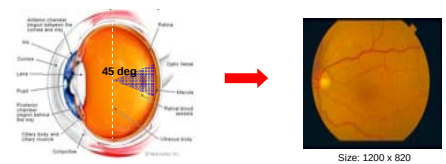


Figure 2. Field of view of conventional retinal imaging.

Retinal Imaging with Optomap ® : The majority of the retina is captured with a single image.

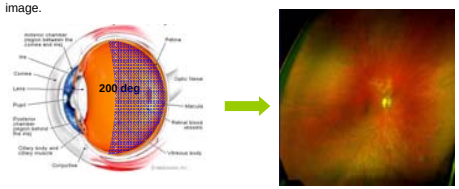
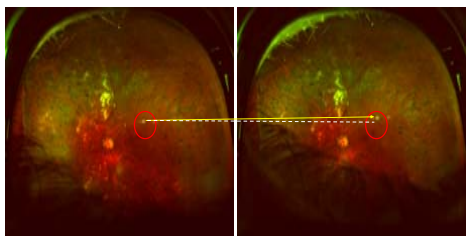


Figure 3. Field of view with optomap® .

Ultra-widefield images

The following pair of images were analyzed in this work:



(a) (b)

Figure 2. Original images

•The red circles are used to illustrate the different positions of a common feature among the images. The misalignment (represented by the line's angle) as well as the presence of the eyelash artifact are evident.

Methodology

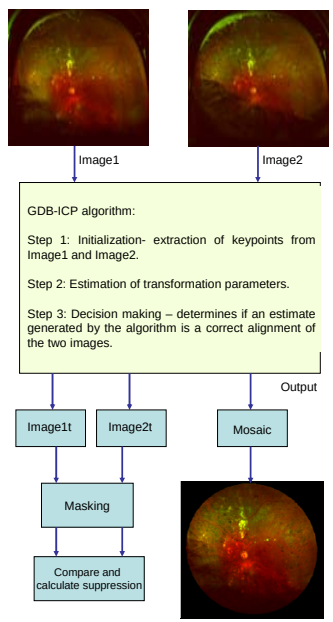
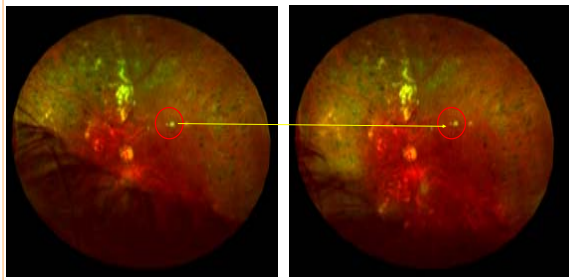


Image1t, Image2t: Transformed images

Experimental Results

A) The following images were obtained as a result of the image registration stage:



(a) (b)

Figure 3. Registered images

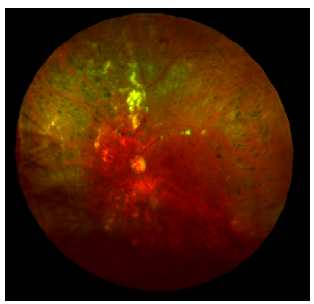


Figure 4. Mosaic obtained from registered images.

B) The percent of eyelash suppression exhibited in the mosaic, was quantified by comparing both Image1t and Image2t.

As a result a mask was obtained. In Figure 5(a), white pixels represent areas from which the eyelashes were suppressed.

(a) (b)

Figure 5. (a) Area of eyelash suppression. (b) Overall image area.

The percent of suppression was calculated from the ratio of white pixels on mask (a) and white pixels on mask (b).

This is: $$\frac{422478}{6892271} = 0.0613 \rightarrow 6.13\%$$

Conclusions

- GDB-ICP image registration algorithm successfully registered the set of images used for this work.
- From preliminary results, the algorithm seems to be robust to the presence of eyelashes in the images.
- The mosaic created from the transformed images shows a degree of suppression of the eyelash artifact, which was quantified to be 6.13% in regards to the overall image.
- Further analysis should be performed by using new data sets in order to validate the results presented.

Acknowledgments

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References

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Value Added to CenSSIS