

Foreground-background registration for angiography fundus images



Hugang Ren, PhD; Susan Su, OD; Archana Koli, BS; Angelina Covita, BS; Neil D'Souza, MS; Niranchana Manivannan, PhD

Poster #241 – F0088

Carl Zeiss Meditec, Inc., Dublin, CA, USA

PURPOSE

- The predominant descriptive features of fundus images are the retinal vessels.
- The performance of a registration algorithm when applied to fundus angiography images is often not optimal due to the poor contrast of retinal vessels in the early stages of angiography.
- We propose a weighted foreground-background registration (FBR) to improve the performance.

METHODS

- The workflow of the proposed method is shown in Fig. 1.
- Retinal vessels images (RVI) are detected using first-order derivative of the Gaussian filter in image pairs.
- Registration is applied in two steps:
 - Coarse registration: Harris corner detection is applied to RVI pairs followed by non-maximal suppression. Feature point matching is done between the RVI pairs, and the transformation is applied to form a coarse registered image.
 - Fine registration: retinal background image (RBI) is computed for the coarse registered image pairs by eliminating the retinal vessels and applying contrast limited adaptive histogram equalization (CLAHE) for simultaneous noise reduction and contrast enhancement.
- Feature point detection and matching are done between the RBI pairs.
- The transformation is then applied to form a fine registered image.

Foreground-background registration may improve registration accuracy for early and late phase angiography fundus images

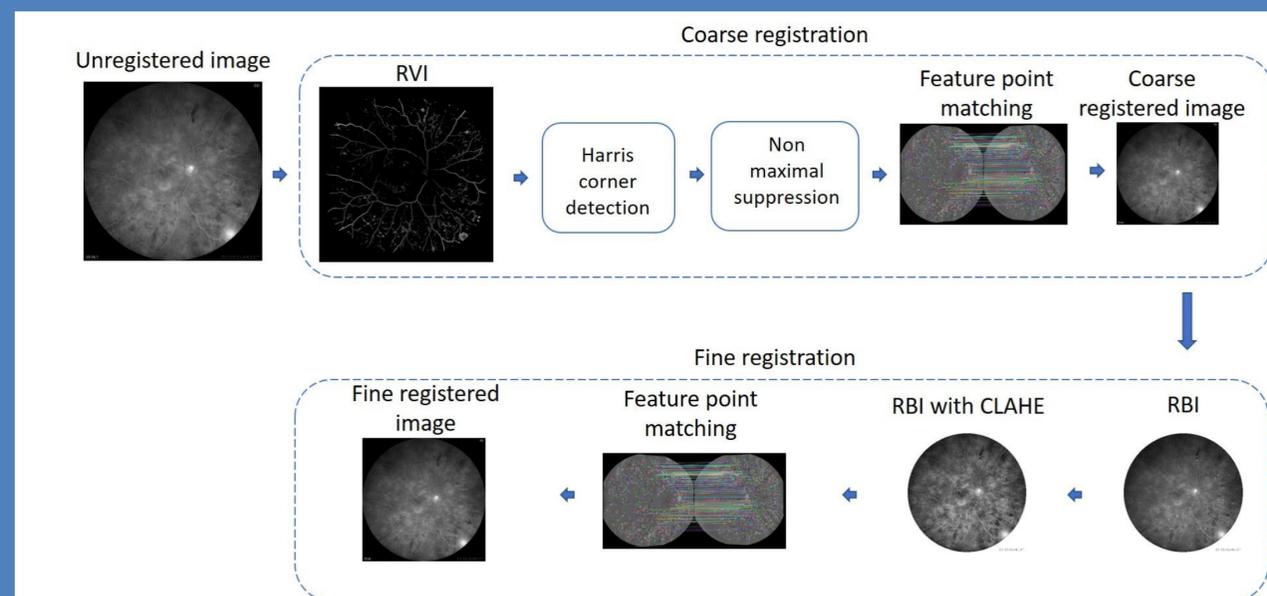


Figure 1. Workflow of the foreground-background registration (FBR) method

Image pairs from angiography phases	MAD for Registration without FBR [degrees]	MAD for Registration with FBR [degrees]
Early phase	0.95±0.36°	0.84±0.40°
Mid phase	0.62±0.29°	0.62±0.37°
Late phase	0.98±0.43°	0.91±0.41°

Table 1. Summary of mean angular distance (MAD) for different angiography phases

Email: hugang.ren@zeiss.com

Disclosures: HR (E), SS (E), AK (E), AC (E), ND (E), NM (E) – Carl Zeiss Meditec, Inc.



- Fluorescein angiography image sequences from 22 eyes (5 healthy and 17 subjects with various retinal pathologies) were acquired using CLARUS™ 700 (ZEISS, Dublin, CA).
- Three image pairs from each of the eyes were randomly selected (1 image pair each from early, mid, and late phase) and six landmarks were labeled for each pair of the images [1].
- The angular distance between the landmarks in the registered images should be minimal for ideal registration.
- The mean angular distance (MAD) with and without FBR was calculated for the quantitative evaluation.

RESULTS

- Table 1 shows the MAD for image pairs from different angiography phases.
- With FBR, the performance of the registration is improved by 9.5% in early phase and 7.1% in late phase.
- In the mid phase the performance does not show any improvement with FBR.

CONCLUSIONS

- The proposed FBR algorithm may improve the registration in early and late phase angiography images.
- This improvement is achieved by augmenting the feature point matching of retinal vessels with histogram equalized background information.

REFERENCES

- [1] Manivannan et al. *IOVS* 2021; 62(8):1794.