SUPPLEMENTARY MATERIAL FOR JOINT VESSEL SEGMENTATION AND DEFORMABLE REGISTRATION ON MULTI-MODAL RETINAL IMAGES BASED ON STYLE TRANSFER

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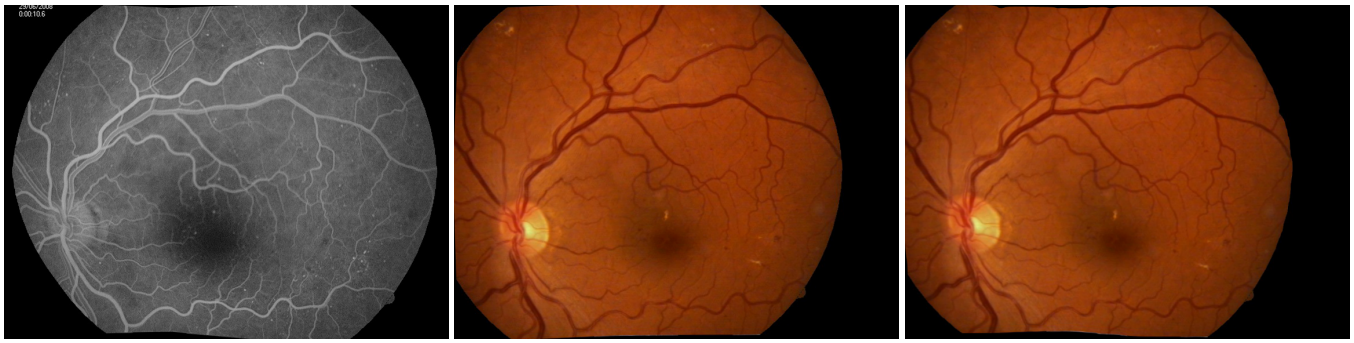
ABSTRACT

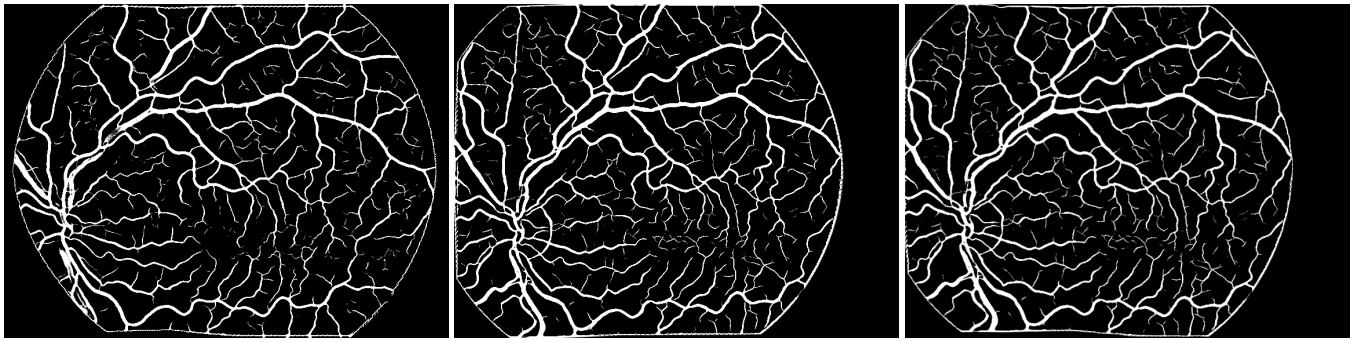
This is the supplementary material for our ICIP submission. It includes a set of results produced my our model, in order to provide a more comprehensive understanding of our method's mechanism. Project page: `https://github.com/JunkangZhang/RetinalSegReg`.

1. ALL IMAGES GENERATE BY OUT MODEL

Fig. 1 shows an example of our model's inputs and outputs. In the figure, (d) and (e) show the results of segmentation networks, and F in (g) is generated from the registration field estimation network. The process of warping segmentation map I_{flt}^{seg} towards I_{ref}^{seg} is demonstrated from (h) to (i), which is also involved in $\mathcal{L}_{content}$ in Eq. (3) in the main paper. By comparing (h) with (i), or (k) with (l), it can be seen that most corresponding vessels in both modalities are aligned. **Note that** the directions of registration vectors in F indicate the inverse of pixels' warping directions from I_{flt}^{seg} to $\mathrm{STN}(I_{flt}^{seg}, F)$. This is because $\mathrm{STN}(I_{flt}^{seg}, F)$ is constructed by sampling from I_{flt}^{seg}, and F represents the sampling offset pointing from integer coordinates in the reference image to the corresponding points in floating image, which is adopted by $\mathrm{STN}()$ in PyTorch.

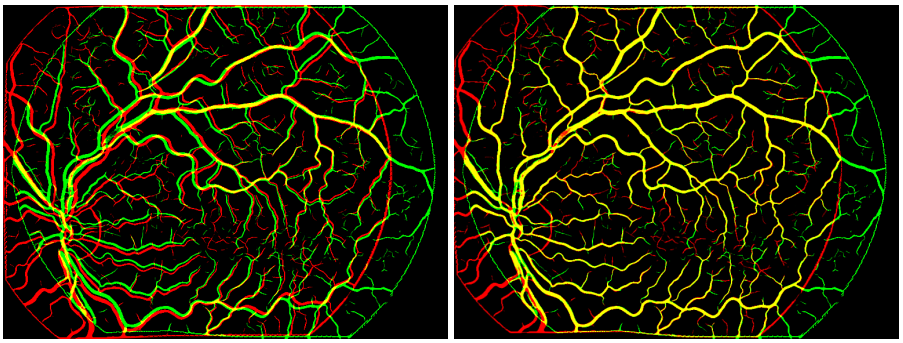


(a) I_{ref} (b) I_{flt} (c) $\mathrm{STN}(I_{flt}, F)$

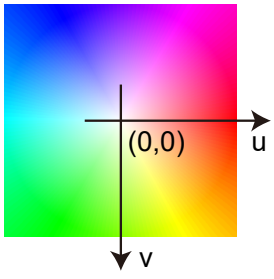


(d) I^{seg}_{ref} (e) I^{seg}_{flt} (f) $\mathrm{STN}(I^{seg}_{flt}, F)$

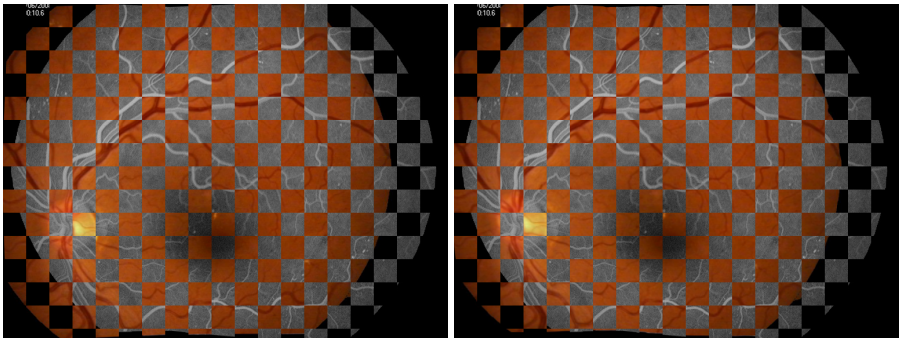
(g) F



(h) Overlapping I^{seg}_{ref} (green) and I^{seg}_{flt} (red) (i) Overlapping I^{seg}_{ref} and $\mathrm{STN}(I^{seg}_{flt}, F)$



(j) Legend for F, indicating directions and magnitudes of offsets



(k) Grid overlaying of I_{ref} and I_{flt} (l) Grid overlaying of I_{ref} and $\mathrm{STN}(I_{flt}, F)$

Fig. 1: An illustration of results generated by our model. Please zoom in to view details.
(a), (b) show the input retinal images of the model, i.e. reference image I_{ref} and floating image I_{flt}.
(d), (e) show the segmentation results of input images, i.e. I^{seg}_{ref} and I^{seg}_{flt}.
(g) visualizes the estimated deformable registration field F. The lower left value is the rounded maximum magnitude among offset vectors.
(j) shows the legend for registration filed in (g). Color hue indicates offset direction, and saturation indicates offset magnitude.
(c), (f) show the warped floating image and warped floating segmentation map based on F.
(h), (i) overlay two segmentation maps from reference and floating images, both before (h) and after (i) warping. Yellow indicates overlapping areas of both segmentation maps.
(k), (l) show the overlaying of reference and floating images, both before (k) and after (l) warping.
Note that the offset vectors in F point to the inverse direction for warping I_{flt} and I^{seg}_{flt}.