

Generating Fundus Fluorescence Angiography Images from Structure Fundus Images Using Generative Adversarial Networks

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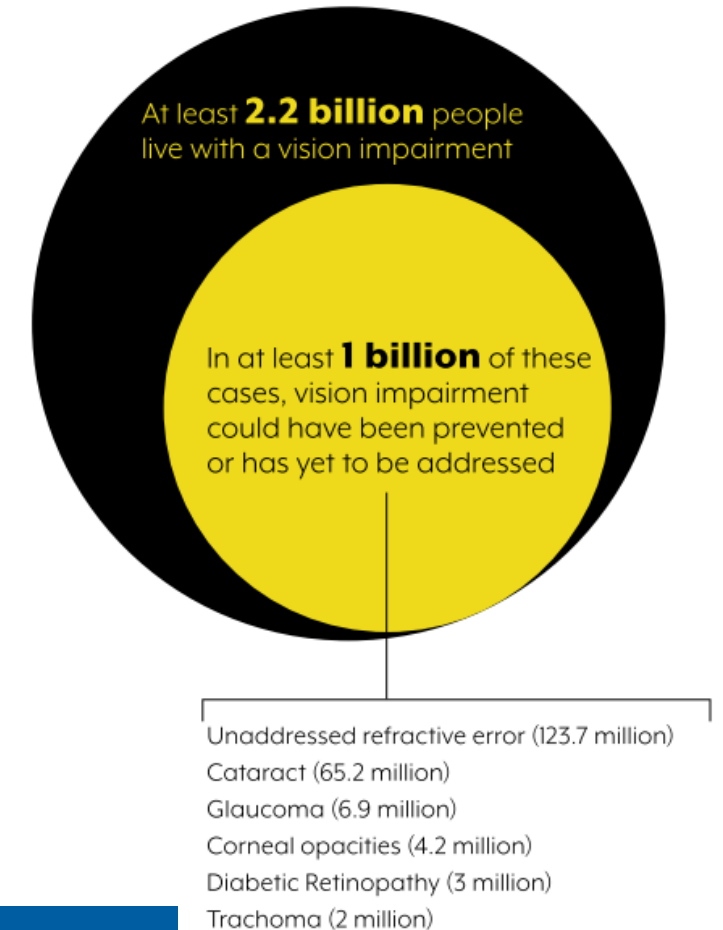
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Motivation

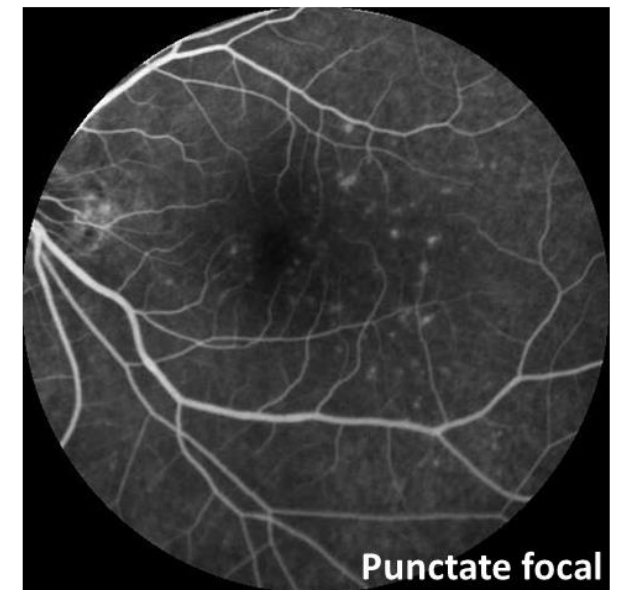
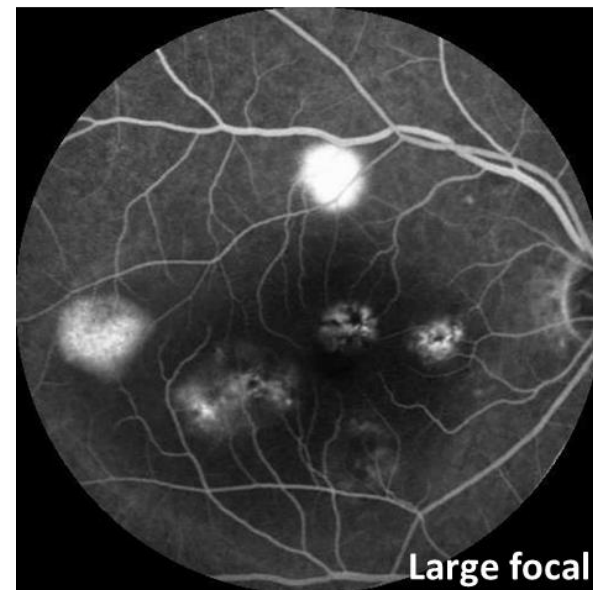
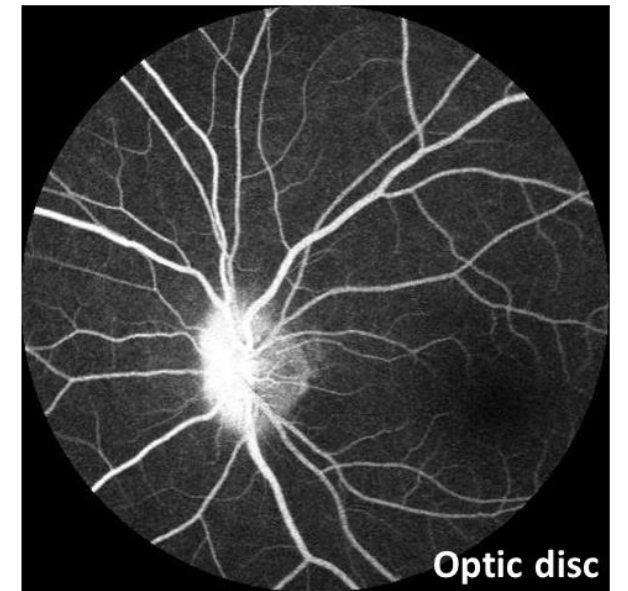
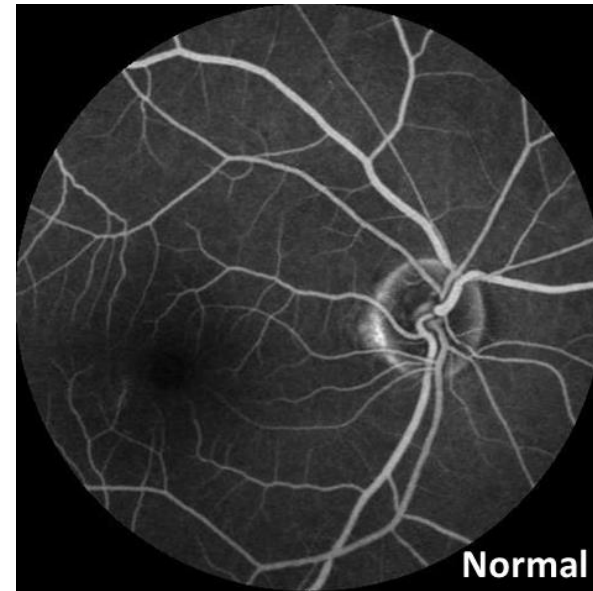
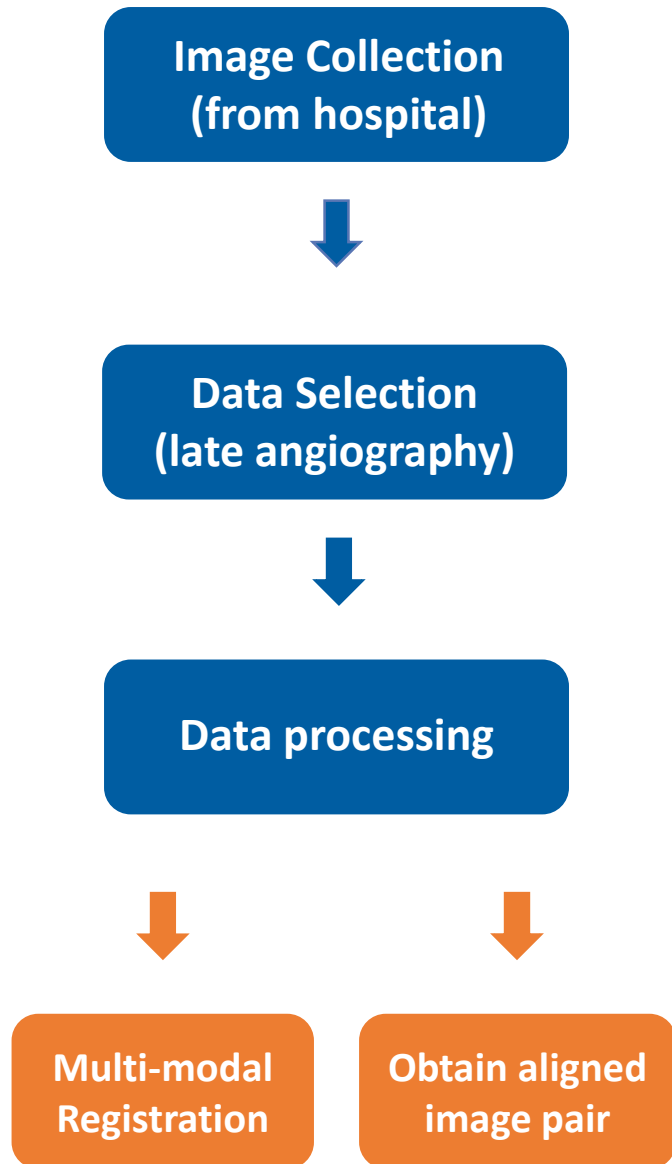
- Data from WHO shows that more than 2.2 billion people have a vision impairment or blindness so far.
- Fluorescein angiography (FA) can reflect the damaged state of the retinal barrier in *vivo* eyes, and is regarded as the “gold standard” of retinal diseases diagnosis.
- FA imaging has some potential serious adverse effects and is contraindicated for severe hypertension, heart disease, and etc.



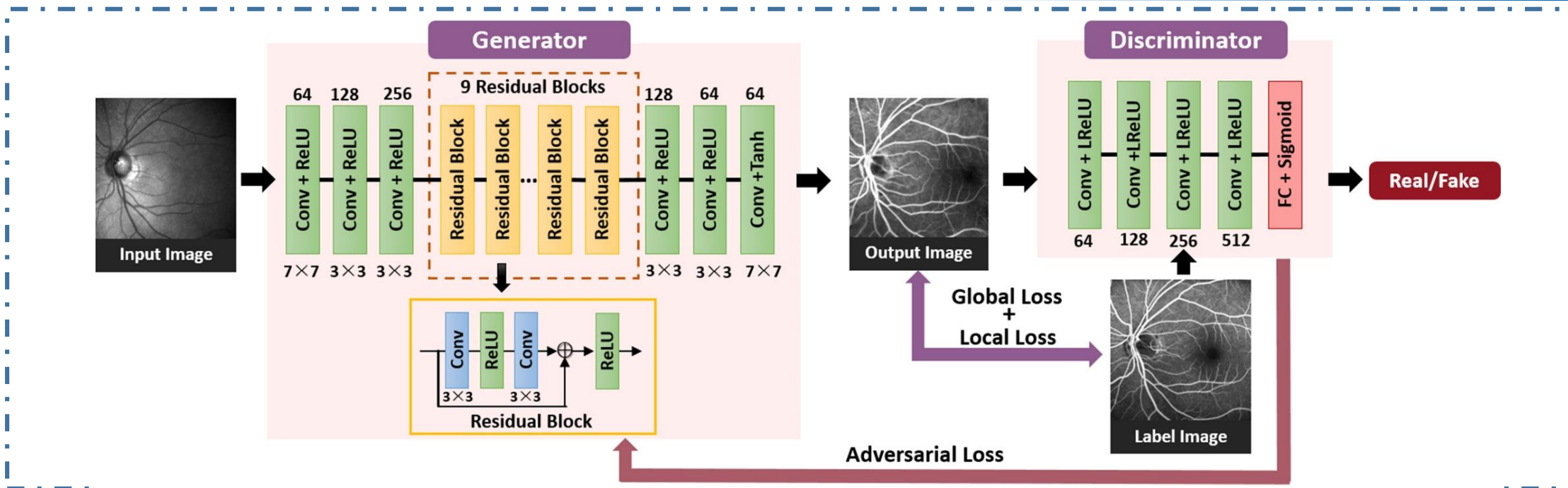
A method that can generate the corresponding FA image from structure image is needed.



Datasets



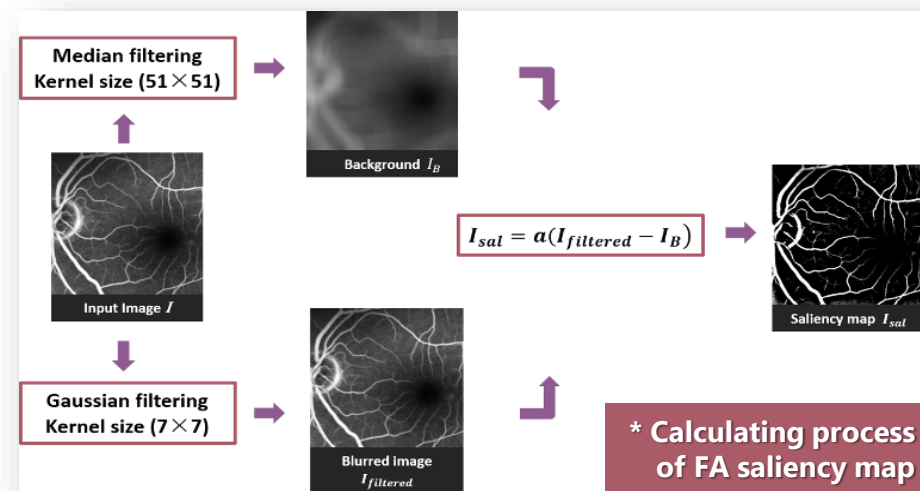
Method



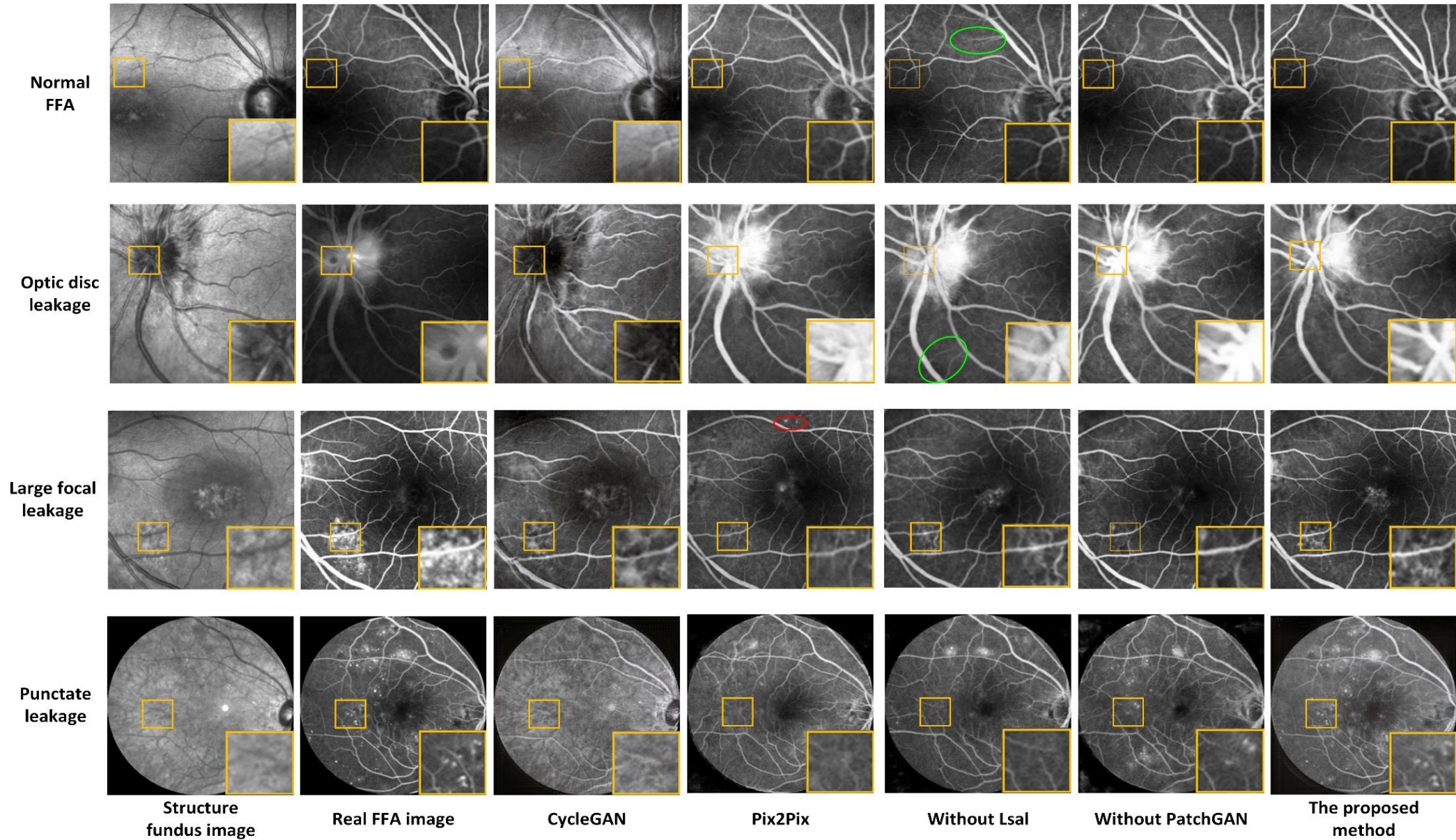
$$L = L_{Global} + L_{Local}$$

$$= (L_{GAN} + \alpha L_{pixel} + \beta L_{perceptual}) + \gamma L_{sal}$$

$$L_{sal} = \frac{1}{W_{ij}H_{ij}} \sum_{x=1}^{W_{ij}} \sum_{y=1}^{H_{ij}} \left((I_F^{sal})_{x,y} - (G_{\theta_G}(I_S)_{sal})_{x,y} \right)^2$$



Results – HRA dataset



Results – HRA dataset

Normal FFA

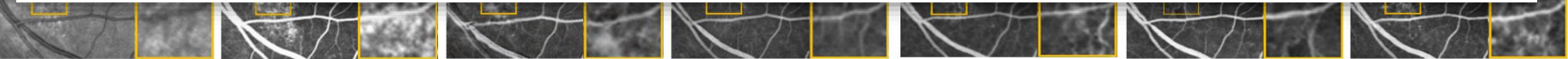


Optic disc leakage

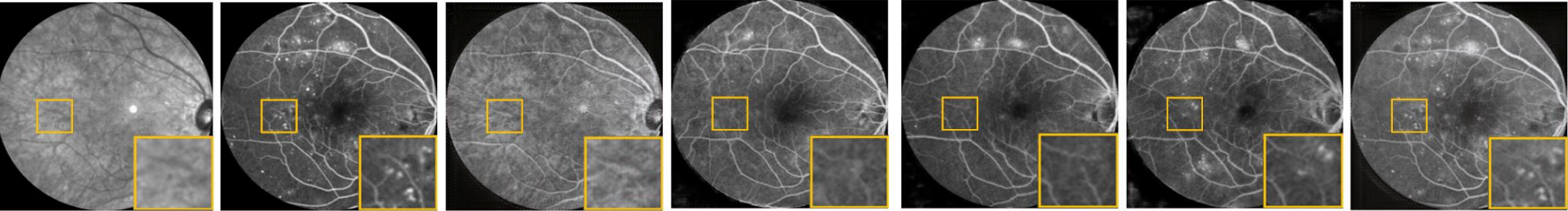
Table 1 Performance comparison with different methods tested on HRA dataset

Metrics	CycleGAN	Pix2Pix	Without Lsal	Without PatchGAN	The proposed method
PSNR(dB)	15.15	18.68	19.32	18.61	19.98
SSIM	0.5949	0.7825	0.7887	0.7632	0.8655

Large focal leakage



Punctate leakage



Structure fundus image

Real FFA image

CycleGAN

Pix2Pix

Without Lsal

Without PatchGAN

The proposed method

Results – Infahan MISP dataset

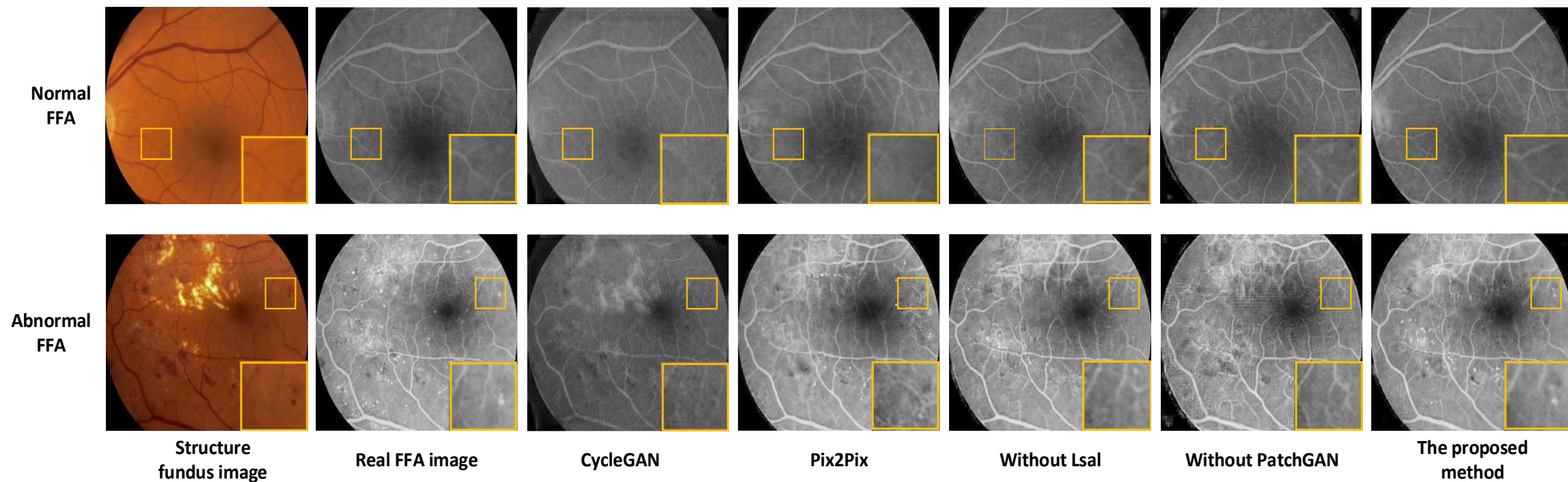


Table 2 Performance comparison with different methods tested on Infahan MISP dataset

Metrics	CycleGAN	Pix2Pix	Without Lsal	Without PatchGAN	The proposed method
PSNR(dB)	19.65	23.43	24.99	23.74	25.16
SSIM	0.5799	0.7438	0.7668	0.7471	0.8268

Conclusion

Spotlight:

- The proposed local saliency loss can ensure the accurate generation of the pathological structures in the synthesis FA image.
- The data used to train and validate the proposed model were all selected according to the characteristics of fundus angiography and clinical demands, which can better demonstrate the medical significance of the proposed method.

Limitation:

- The proposed method performs unsatisfied on the leakage details generation.
- Lack of a suitable and reliable measurement method to evaluate the reliability and value of the proposed method for physicians.

The proposed method has better performance in retinal vascular and fluorescein leakages generation, which has great potential significance for clinical diagnosis.

**Thanks for the MIDL 2020
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