Gaze into the Details: Locality-Sensitive Enhancement for OCTA Retinal Vessel Segmentation

Supplementary Material

A. Ablation Experiments

Comprehensive modules' ablation studies across three datasets are shown in Tab. 1, demonstrating that our model achieves the best performance with the integration of all three proposed modules.

Table 1. Ablation study of the Multiscale Feature Fusion (MFF) module, Patch Information Enhance (PIE) module, and Connectivity Refinement Decoder (CRD) on the OCTA-500, ROSE-1 and ROSSA datasets. (Mean ± SD). **Bold** indicates the best performance, underline indicates the second best.

	MFF	PIE	CRD	Dice% ↑	Sensitivity% ↑	Specificity% ↑	FDR% ↓	Accuracy% ↑	Kappa% ↑
OCTA-500 3mm	×	×	×	91.46 ± 0.15	91.16 ± 0.51	99.41 ± 0.05	8.23 ± 0.60	98.85 ± 0.02	90.84 ± 0.16
	×	✓	×	91.85 ± 0.04	**91.48 ± 0.50**	99.44 ± 0.04	7.77 ± 0.52	98.90 ± 0.01	91.27 ± 0.05
	✓	×	×	91.93 ± 0.12	91.22 ± 0.64	99.48 ± 0.05	7.33 ± 0.60	98.92 ± 0.02	91.35 ± 0.12
	×	×	✓	91.94 ± 0.05	91.37 ± 0.64	99.46 ± 0.05	7.48 ± 0.59	98.92 ± 0.01	91.36 ± 0.05
	✓	×	✓	91.92 ± 0.19	90.78 ± 0.81	**99.51 ± 0.05**	**6.90 ± 0.63**	98.92 ± 0.02	91.34 ± 0.21
	×	✓	✓	91.98 ± 0.10	91.30 ± 0.18	99.48 ± 0.02	7.34 ± 0.27	98.92 ± 0.01	91.40 ± 0.10
	✓	✓	×	91.96 ± 0.09	91.30 ± 0.40	99.47 ± 0.03	7.37 ± 0.32	98.92 ± 0.01	91.38 ± 0.09
	✓	✓	✓	**92.03 ± 0.11**	91.25 ± 0.61	99.49 ± 0.05	7.17 ± 0.62	**98.93 ± 0.02**	**91.45 ± 0.12**
OCTA-500 6mm	×	×	×	88.49 ± 0.10	88.72 ± 0.49	98.77 ± 0.07	11.73 ± 0.54	97.81 ± 0.07	87.28 ± 0.11
	×	✓	×	88.81 ± 0.12	88.73 ± 0.59	98.84 ± 0.10	11.10 ± 0.83	97.88 ± 0.04	87.64 ± 0.14
	✓	×	×	88.89 ± 0.22	89.22 ± 0.91	98.79 ± 0.09	11.43 ± 0.65	97.89 ± 0.03	87.72 ± 0.23
	×	×	✓	88.85 ± 0.08	89.15 ± 0.66	98.80 ± 0.09	11.43 ± 0.67	97.88 ± 0.02	87.68 ± 0.09
	✓	×	✓	89.01 ± 0.12	88.62 ± 0.22	**98.90 ± 0.02**	10.60 ± 0.19	97.93 ± 0.02	87.86 ± 0.13
	×	✓	✓	88.96 ± 0.06	89.38 ± 0.45	98.79 ± 0.07	11.46 ± 0.54	97.90 ± 0.02	87.80 ± 0.07
	✓	✓	×	88.98 ± 0.08	**89.42 ± 0.78**	98.79 ± 0.11	11.44 ± 0.85	97.90 ± 0.03	87.82 ± 0.10
	✓	✓	✓	**89.14 ± 0.06**	88.88 ± 0.52	98.90 ± 0.08	**10.59 ± 0.59**	**97.95 ± 0.02**	**88.01 ± 0.07**
ROSE	×	×	×	87.16 ± 0.19	90.40 ± 0.35	97.28 ± 0.11	15.85 ± 0.50	96.33 ± 0.07	85.02 ± 0.23
	×	✓	×	87.43 ± 0.14	90.59 ± 0.68	97.34 ± 0.18	15.50 ± 0.81	96.41 ± 0.07	85.34 ± 0.18
	✓	×	×	87.68 ± 0.20	**91.31 ± 0.76**	97.29 ± 0.22	15.65 ± 0.94	96.46 ± 0.09	85.62 ± 0.25
	×	×	✓	87.73 ± 0.18	88.91 ± 0.21	**97.80 ± 0.04**	13.42 ± 0.21	96.57 ± 0.05	85.74 ± 0.21
	✓	×	✓	88.18 ± 0.18	89.74 ± 0.25	97.79 ± 0.03	**13.33 ± 0.17**	96.68 ± 0.05	86.25 ± 0.21
	×	✓	✓	87.72 ± 0.08	89.57 ± 0.91	97.66 ± 0.19	14.04 ± 0.86	96.54 ± 0.04	85.71 ± 0.10
	✓	✓	×	87.98 ± 0.47	90.83 ± 0.60	97.49 ± 0.30	14.69 ± 1.38	96.58 ± 0.17	85.98 ± 0.57
	✓	✓	✓	**88.22 ± 0.07**	89.85 ± 0.80	97.79 ± 0.17	13.34 ± 0.82	**96.69 ± 0.04**	**86.30 ± 0.09**
ROSSA	×	×	×	91.06 ± 0.19	90.28 ± 0.43	99.08 ± 0.09	8.14 ± 0.69	98.17 ± 0.05	90.04 ± 0.21
	×	✓	×	91.19 ± 0.16	90.29 ± 0.44	99.11 ± 0.08	7.89 ± 0.62	98.20 ± 0.04	90.19 ± 0.19
	✓	×	×	91.53 ± 0.16	90.70 ± 0.62	99.14 ± 0.07	7.61 ± 0.53	**98.27 ± 0.03**	90.57 ± 0.18
	×	×	✓	91.41 ± 0.28	90.35 ± 0.45	99.15 ± 0.11	7.50 ± 0.88	98.24 ± 0.07	90.43 ± 0.32
	✓	×	✓	91.36 ± 0.25	90.08 ± 0.84	**99.18 ± 0.08**	**7.31 ± 0.58**	98.24 ± 0.04	90.38 ± 0.27
	×	✓	✓	91.39 ± 0.29	90.80 ± 0.38	99.09 ± 0.08	8.01 ± 0.62	98.23 ± 0.06	90.41 ± 0.32
	✓	✓	×	91.33 ± 0.07	90.82 ± 1.05	99.07 ± 0.13	8.14 ± 1.00	98.22 ± 0.02	90.33 ± 0.07
	✓	✓	✓	**91.59 ± 0.15**	**90.89 ± 0.51**	99.13 ± 0.08	7.69 ± 0.62	98.27 ± 0.04	**90.63 ± 0.17**

Table 2. Ablation study of the layers on the OCTA-500 6mm dataset. (Mean ± SD).

Layers	Dice% ↑	Sensitivity% ↑	Specificity% ↑	FDR% ↓	Accuracy% ↑	Kappa% ↑
3	89.06 ± 0.15	**89.15 ± 0.37**	98.84 ± 0.08	11.03 ± 0.65	97.93 ± 0.04	87.91 ± 0.17
4	**89.14 ± 0.06**	88.88 ± 0.52	**98.90 ± 0.08**	10.59 ± 0.59	**97.95 ± 0.02**	**88.01 ± 0.07**
5	89.06 ± 0.08	88.68 ± 0.79	98.90 ± 0.10	**10.55 ± 0.78**	97.94 ± 0.02	87.92 ± 0.08

The layer number n ablation study is shown in Tab. 2. Setting $n = 4$ achieves a favorable balance between performance and efficiency.

B. Qualitative Comparison

The complete qualitative analysis (Fig. 1) demonstrates that our method achieves superior connectivity while simultaneously capturing more vascular details.

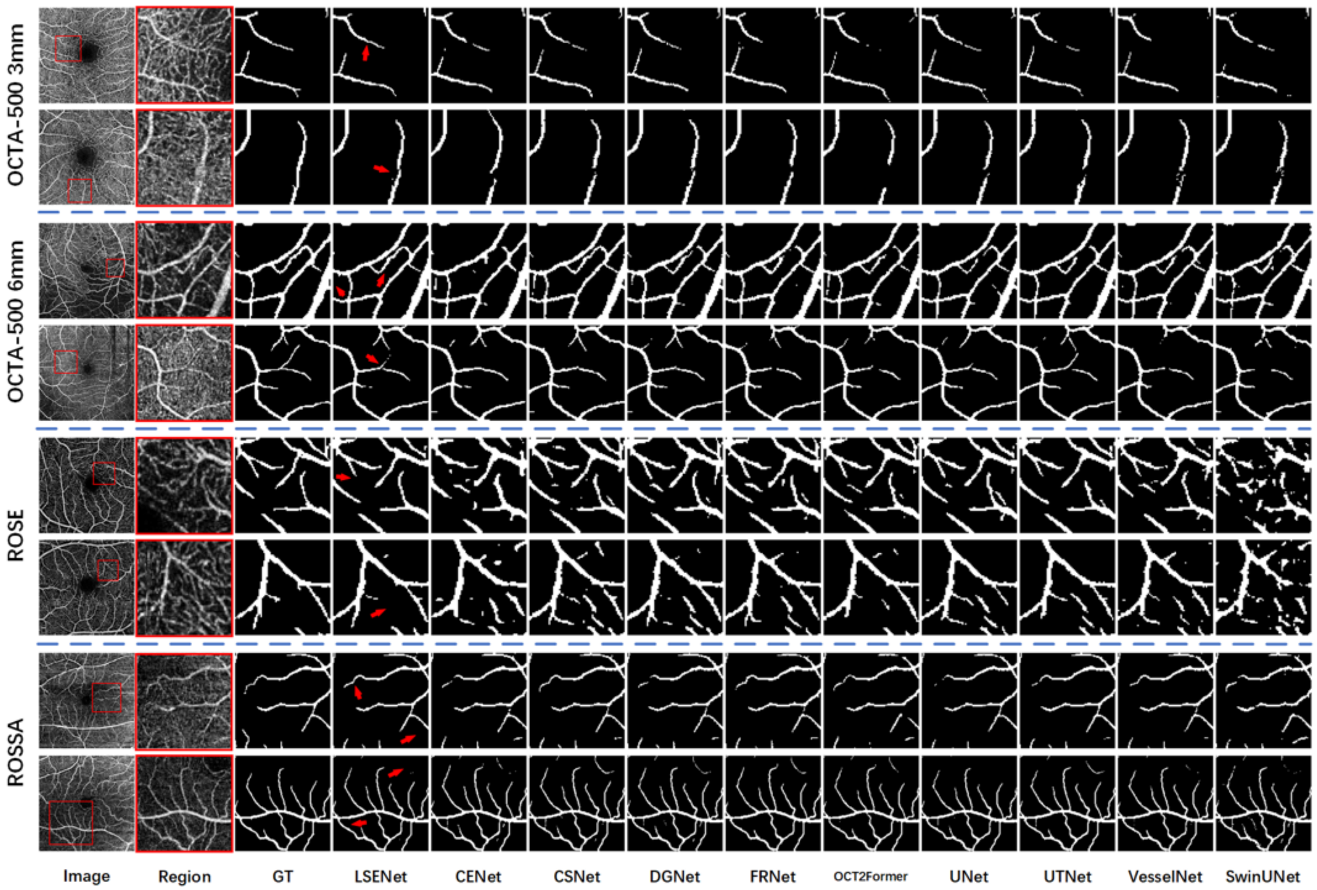


Figure 1. Qualitative comparison on samples from OCTA-500 3mm, OCTA-500 6mm, ROSE-1, and ROSSA. Columns (from left to right) show: Original Image, Magnified Region, Ground Truth (GT), LSENet (Ours), and competing methods.

C. Efficiency Analysis

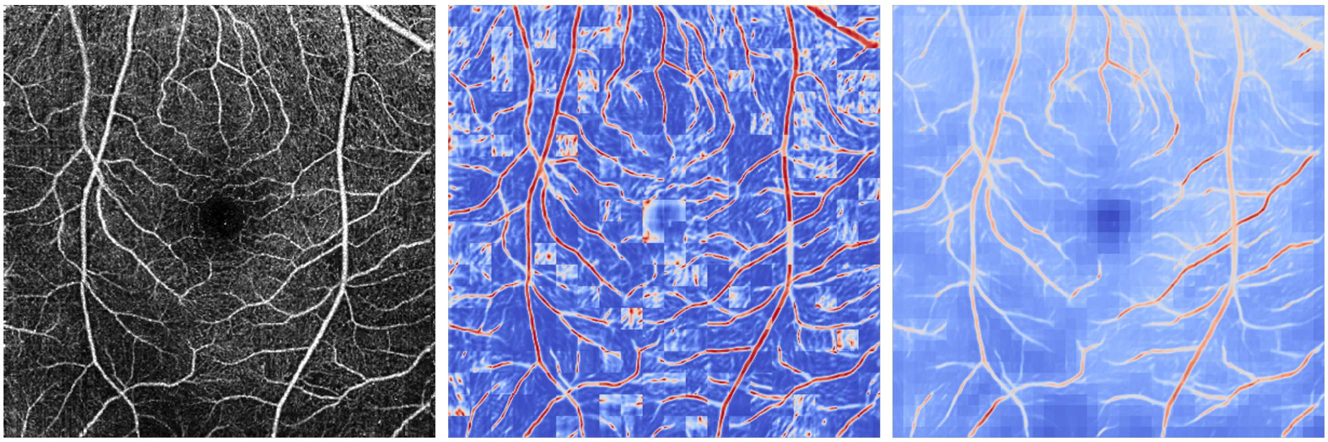
Tab. 3 presents the quantitative analysis of model efficiency, including parameters, FLOPs, and inference time.

Table 3. Comparison of parameters, FLOPs, and time for retinal vessel segmentation under 224×224 input conditions.

	OURS	UNet	CENet	CSNet	UTNet	VesselNet	SwinUNet	OCT2Former	FRNet	DGNet
Params/M	2.082	17.266	29.003	8.4	57.451	1.265	27.143	7.345	0.013	1.043
FLOPs/G	55.49	30.71	6.82	10.69	62.23	13.42	5.901	50.07	18.63	2.74
Time/ms	27.19	4.11	10.07	5.27	12.15	4.14	11.19	26.88	6.92	20.61

D. Patch Attention

The attention weights generated by different patch attention schemes are visualized in Fig. 2. It can be observed that relying solely on the original single-partition strategy causes the model to over-emphasize fine vessels, potentially leading to increased false positives. Additionally, this single-partition approach tends to miss vascular details situated at patch boundaries. In contrast, after integrating the dual intra-patch branches with the inter-patch attention, the resulting attention weights become smoother, and the model's focus aligns more closely with the requirements of our segmentation task.



(a) (b) (c)

Figure 2. Visualization of Patch Attention results. (a) Original input. (b) Patch-wise attention heatmap generated by the single intra-patch branch. (c) Final attention heatmap integrating two intra-patch branches and the inter-patch attention.