Highlight Removal Network based on an Improved Dichromatic Reflection Model

Tsinghua University

Kun Hu, Zhaoyangfan Huang, Xingjun Wang

Tsinghua Shenzhen International Graduate School, Tsinghua University, China

清华大学深圳国际研究生院 Tsinghua Shenzhen International Graduate School

Background Introduction& Contributions

- ### Background Introduction

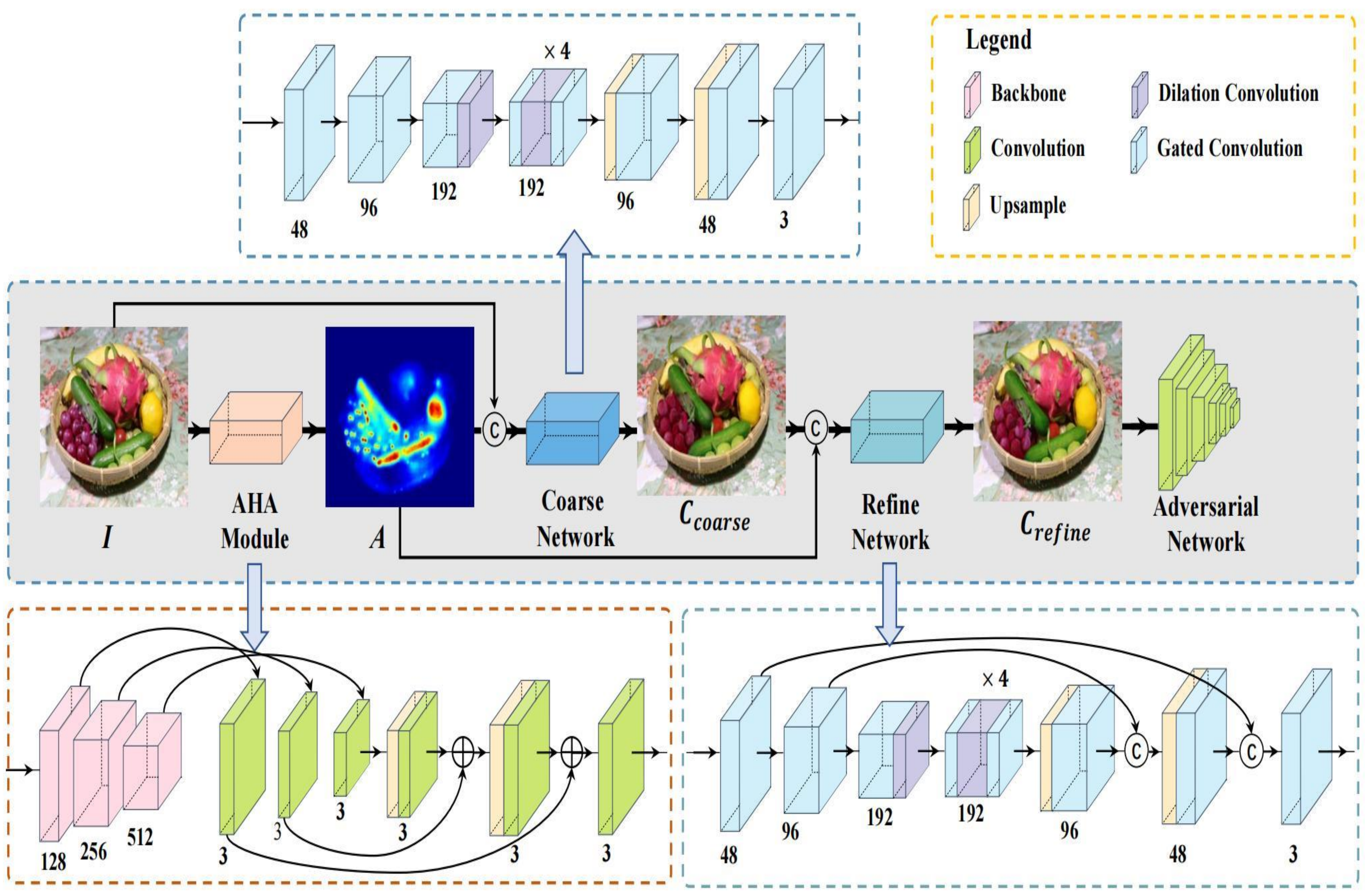
Specular highlights are prevalent in real-world images and are a difficult problem in many computer vision tasks, which degrade the performance of various tasks. Therefore, highlight removal plays a crucial role in facilitating multimedia and computer vision tasks. State-of-the-art highlight removal methods still face the problems of color inconsistencies between highlight region and background, and content unreality in highlight areas.

- ### Contributions

✓ We adopt a novel highlight removal model that improves the **dichromatic reflection model** and obtains better performance from extensive experiments.

✓ We propose an **adaptive highlight-aware** module for identifying highlight information based on position and scale, coupled with a coarse-fine network structure. This structure first creates broadly highlight-removed images, and then refines them for greater detail and accuracy.

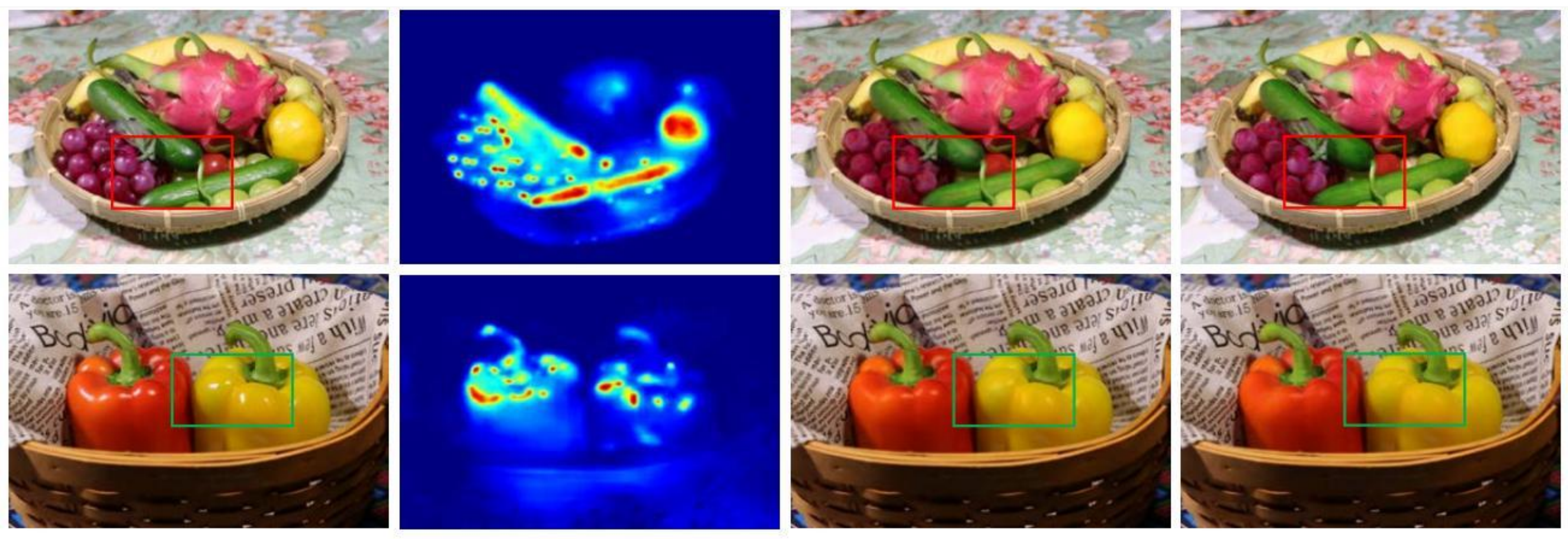
Our Pipeline



Experiment Results

Table 1. Results of quantitative evaluation on PSD [9] and SHIQ [8] datasets. The best and second best results are marked in red and blue, respectively.

Methods	PSD (Test Data) [9]			PSD (Validation Data) [9]			SHIQ [8]		
	PSNR↑	SSIM↑	LPIPS↓	PSNR↑	SSIM↑	LPIPS↓	PSNR↑	SSIM↑	LPIPS↓
Wu et al. [9]	31.6330	0.9131	0.0468	34.7159	0.9257	0.0428	32.4717	0.9357	0.0246
JSHDR [8]	29.4829	0.9086	0.0439	32.3545	0.9268	0.0414	34.8917	0.9404	0.0184
Multi-class GAN [10]	29.1470	0.9180	0.0360	32.4846	0.9366	0.0249	26.5272	0.9319	0.0609
Spec-CGAN [11]	26.4217	0.9026	0.0454	23.5784	0.8618	0.0846	26.6309	0.8817	0.0822
Unet-Transformer [14]	30.1693	0.9251	0.0382	32.7438	0.9288	0.0360	32.6419	0.9239	0.0394
Ours	33.1860	0.9614	0.0160	36.0755	0.9643	0.0166	35.7239	0.9587	0.0235



(a) Input (b) Highlight-Aware (c) Coarse Result (d) Refine Result

(c) and (d) show the results of coarse highlight removal and refine highlight removal. Coarse removal has the effect of removing highlight areas mainly on the substrate, and there is an unnatural highlight-filling outcome. Whereas, with the refine removal network, the highlight-filled pixels match the surrounding pixels more realistically.

Ablation Study

Table 2. Ablation studies of the proposed modules (AHA, coarse and refine network) and three loss functions on PSD (Test Data) dataset [9].

Alation	PSNR↑	SSIM↑	LPIPS↓
w/o AHA	30.6255	0.9130	0.0309
Only Coarse Network	31.8459	0.9324	0.0294
Only Refine Network	32.6234	0.9528	0.0276
Ours	33.1860	0.9614	0.0160
w/o Adversarial Loss	32.2767	0.9553	0.0226
w/o Perceptual Loss	32.1503	0.9536	0.0260
w/o Content Loss	32.2550	0.9529	0.0225
Only Content Loss	32.7975	0.9521	0.0256
Full Loss	33.1860	0.9614	0.0160

Acknowledgement

This work was supported in part by the Science, Technology and Innovation Commission of Shenzhen Municipality under Grant WDZC20200818121348001, Grant KCXFZ202002011010487, and Grant SGDX2019091810120169.

Paper Codes