Rendering Nighttime Image Via Cascaded Color and Brightness Compensation

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Background

- Most of NN based lSP are designed to render daytime images.
- The lack of sufficient nighttime image dataset.
- Nighttime light sources are more complex.

Solutions

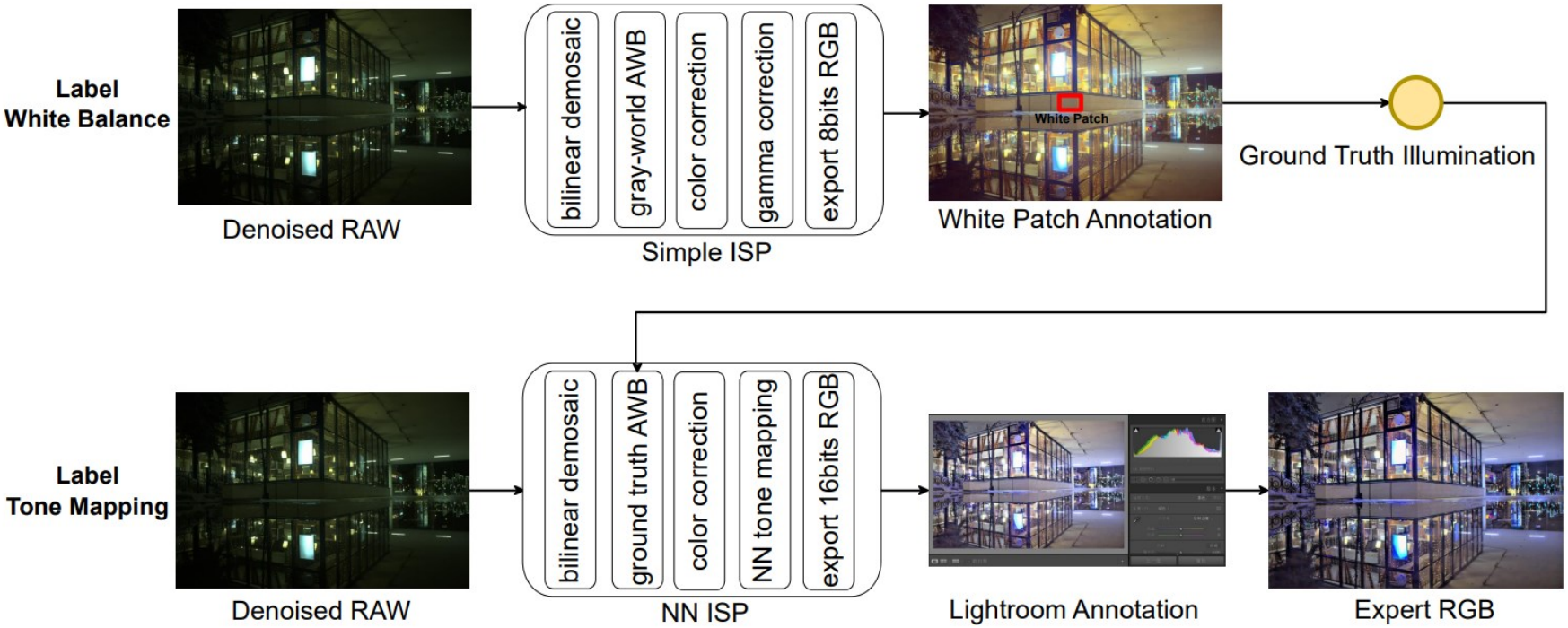
- **NR2R Dataset**

  - We labeled a high-resolution nighttime RAW to RGB dataset to address the lack of paired RAW and RGB data.

- **CBUnet**

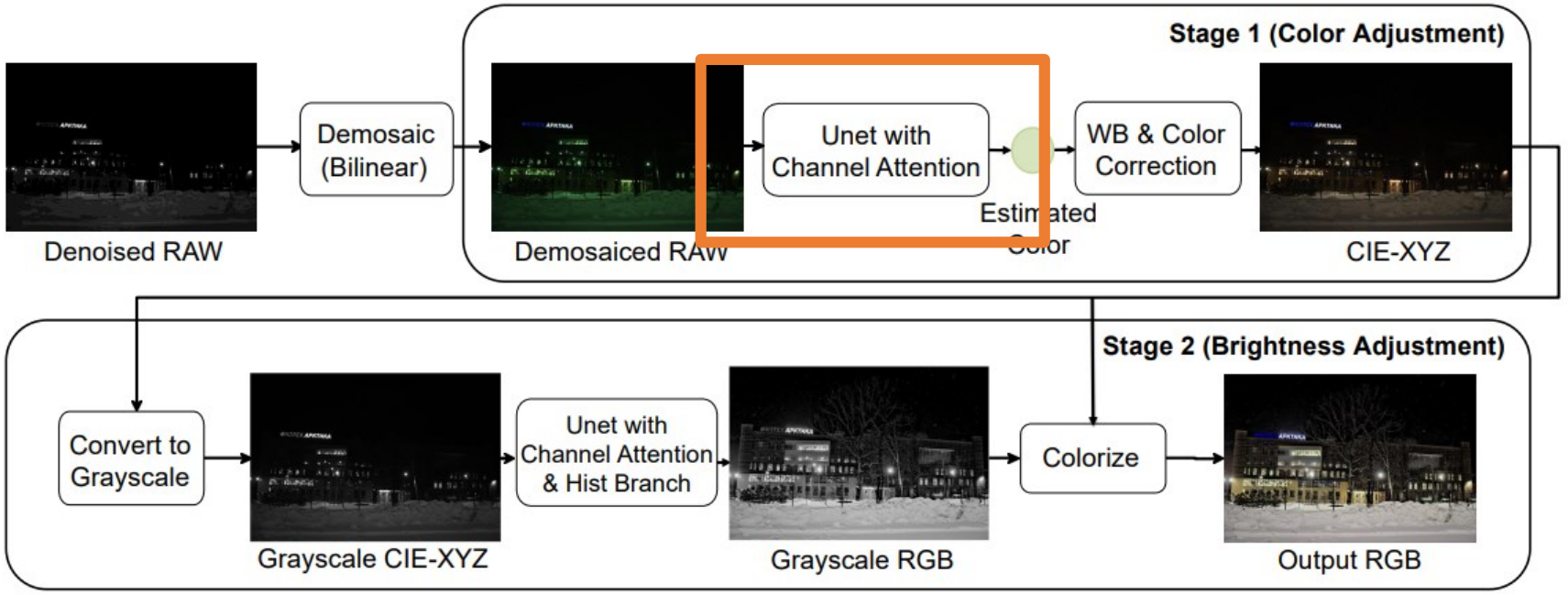
  - A two-stage CBUnet is proposed to compensate color and brightness attributes consecutively.

Method - NR2R Dataset



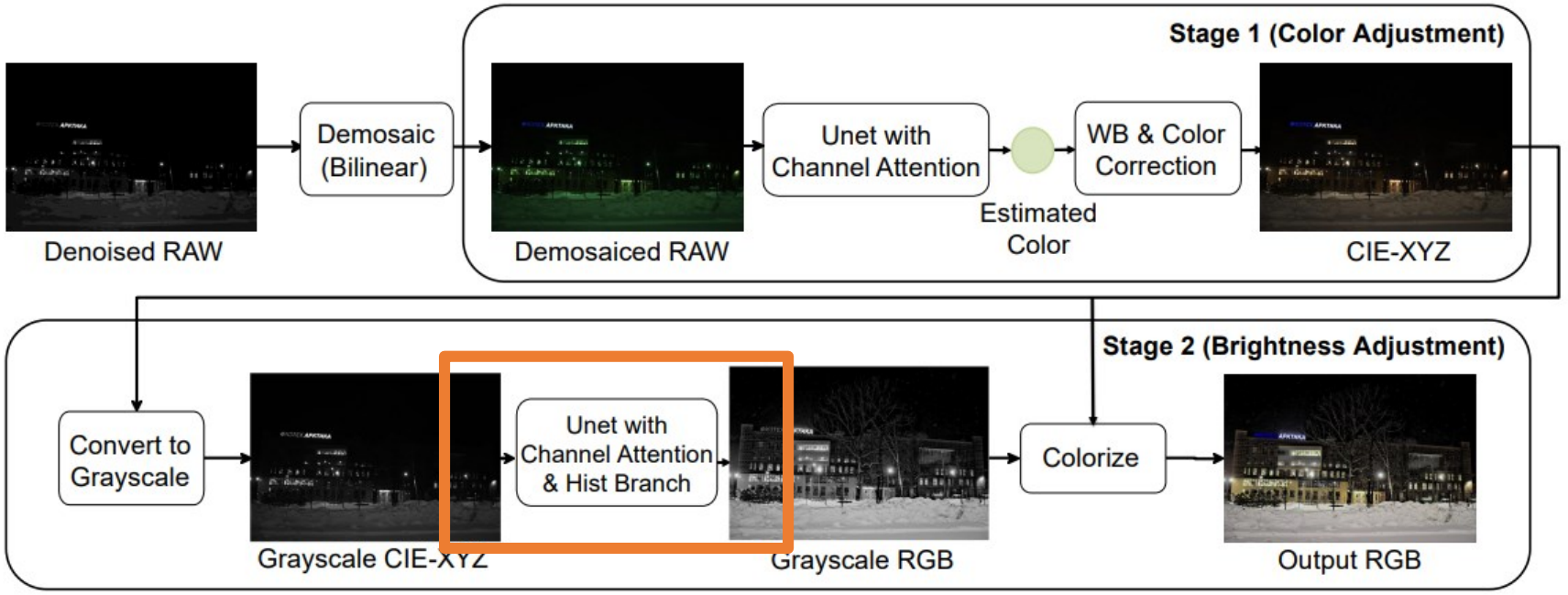
Labeling pipeline: White balance annotation → Input denoised RAW with estimated ground truth illumination into the NN ISP module → Use Lightroom to adjust global exposure, brightness, shadows and contrasts.

Method - CBUnet Stage #1



The architecture of the CBUnet: Correct the color → Adjusts the brightness for a high-quality output.

Method - CBUnet Stage #2



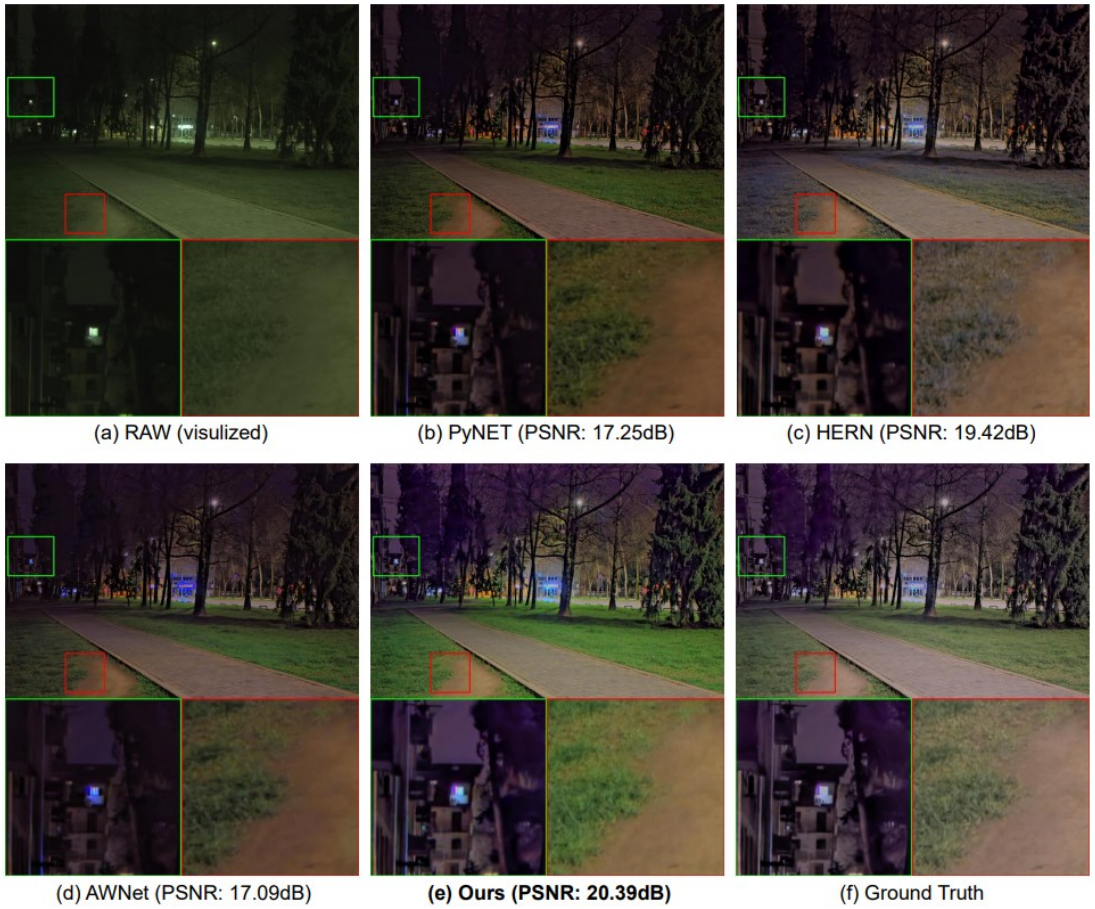
The architecture of the CBUnet: Correct the color → Adjusts the brightness for a high-quality output.

Result - Comparative studies

Method	PSNR	Parameter (M)	FLOPs (G)
PyNET	20.67	47.55	1370.79
HERN	19.57	56.18	466.74
AWNet	21.16	46.99	1532.46
Ours	**22.29**	**23.64**	**391.58**

Comparative studies of reconstruction PSNR, parameter size and FLOPs, where FLOPs is calculated when the input size is 1024 × 1024.

Result - Comparative studies



Visual comparison of reconstructions from four different methods including PyNET, HERN, AWNet and our proposed CBUnet.

Our method have demonstrated the superior performance to other solution in synthesizing the **local details, color saturation and contrast**.

Result - Ablation Study

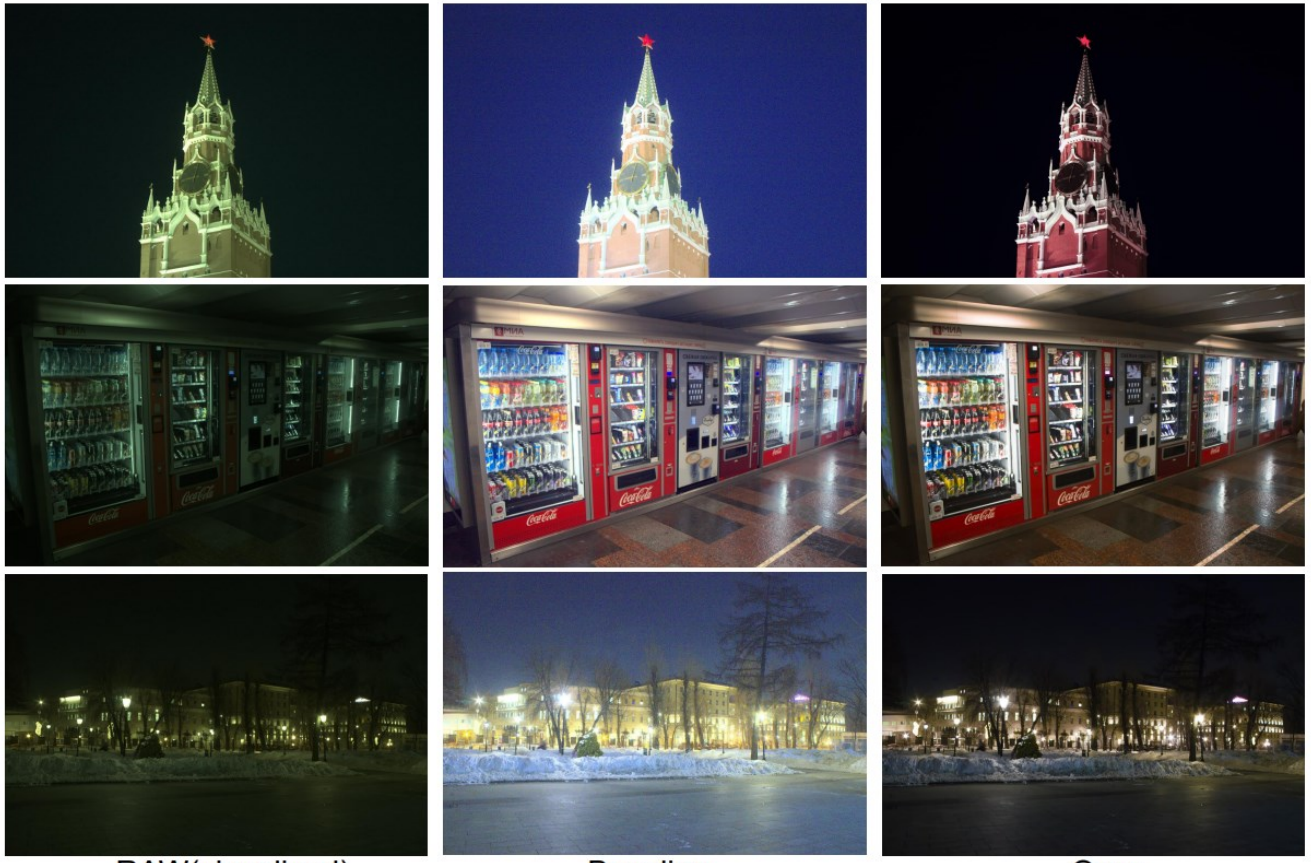
CA	Two Stage	Hist Branch	PSNR
			19.85
√			20.53
√	√		22.01
√	√	√	22.29

Ablation studies on network architectures, where CA and Hist Branch mean channel attention and histogram branch, respectively.

L_1	$L_{angular}$	L_{hist}	PSNR
√			21.98
√	√		22.14
√	√	√	22.29

Ablation studies loss functions.

Result – Challenge Results

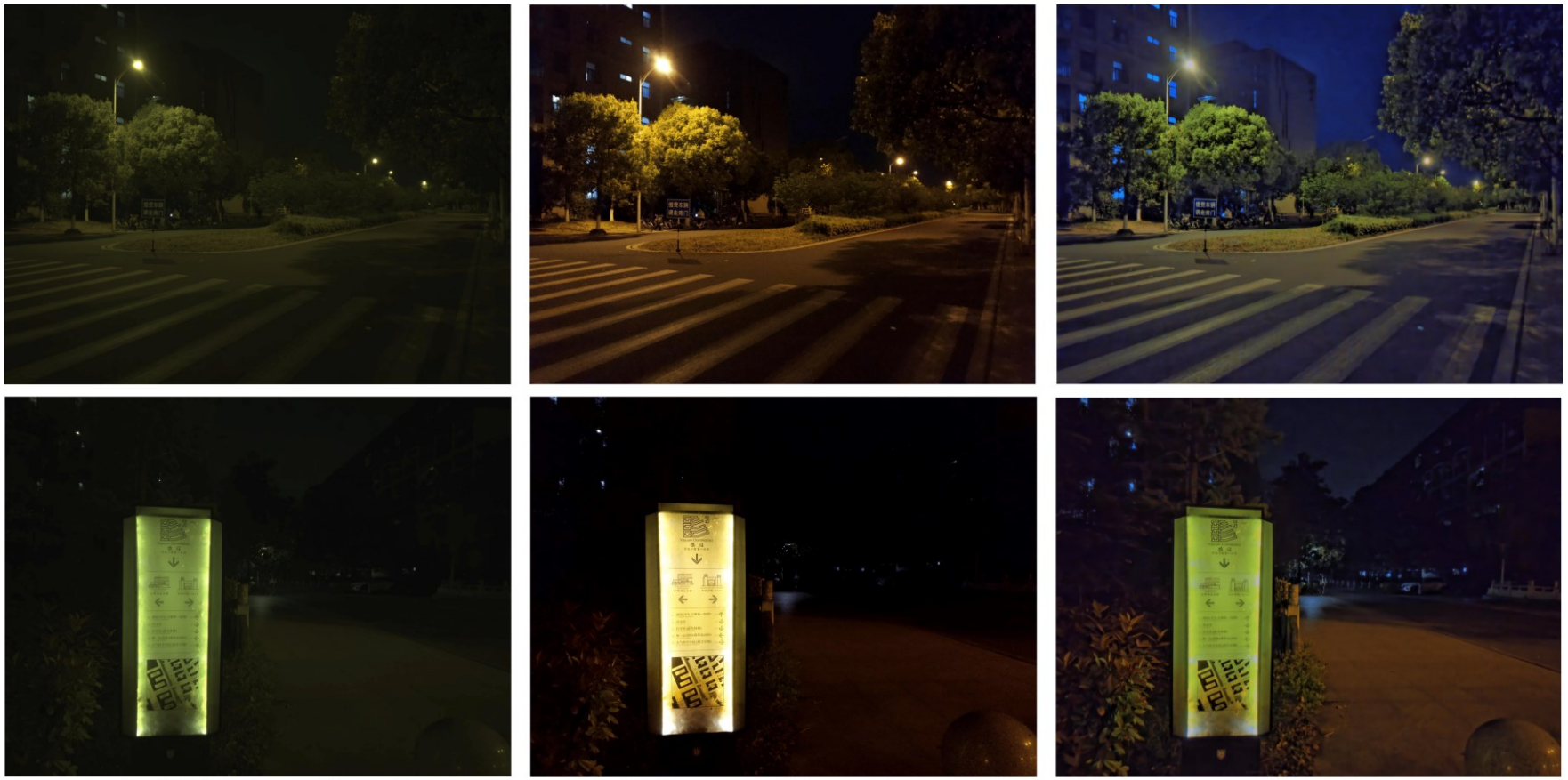


RAW(visualized) Baseline Ours

Rendering Results of our CBUnet in the NTIRE 2022 Photography Rendering Challenge.

Our renderings have a more **accurate white balance** and a **more consistent brightness distribution** with nighttime scene characteristics.

Result – Cross Camera



RAW (visualized) iPhone 8 Plus ISP Ours

Rendering Results of our CBUnet within RAW image captured by **iPhone 8 Plus**

Thanks

- Homepage: https://njuvision.github.io/CBUnet/
- Github: https://github.com/NJUVISION/CBUnet
- E-mail: lizhihao6_at_outlook.com