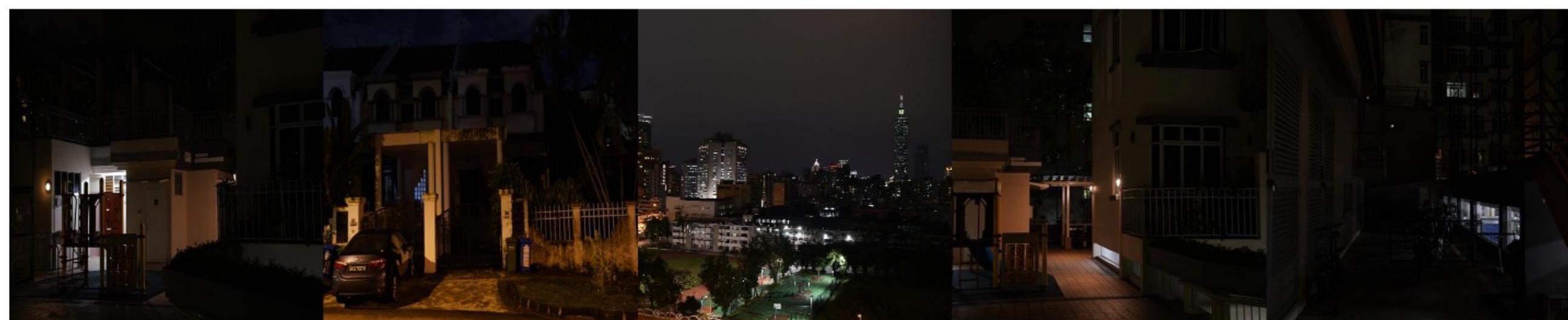


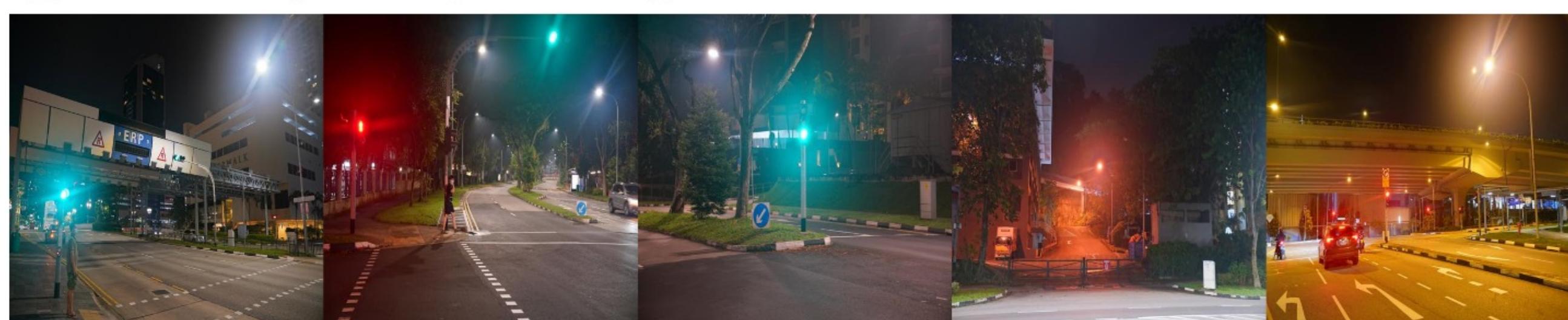
Introduction

Problem of Night Image

➤ Low Light:

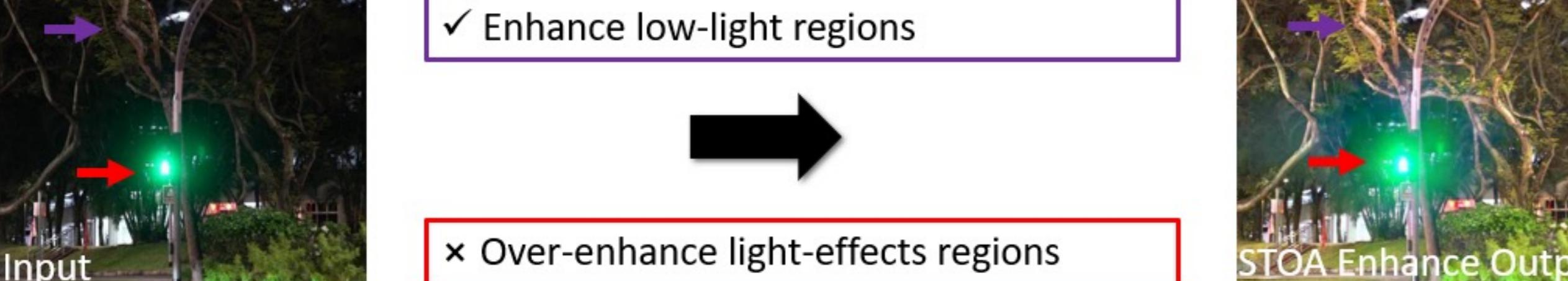


➤ Light-Effects/Glare/Floodlight:



Motivation

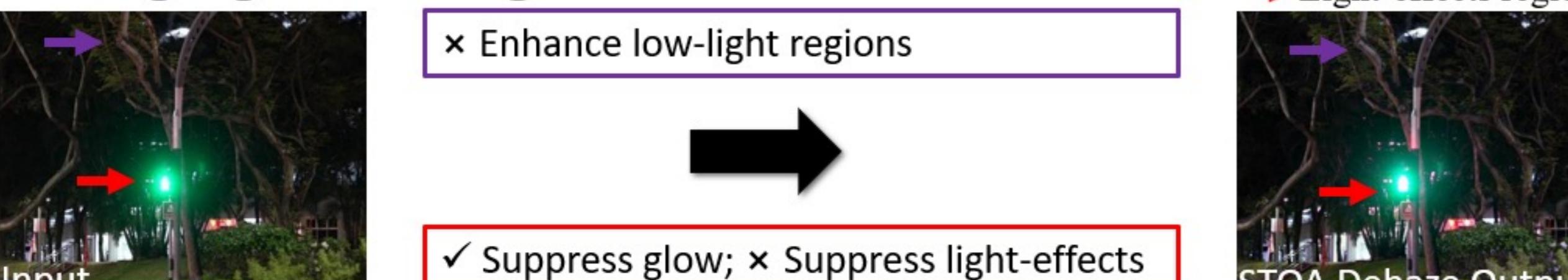
➤ Existing low-light enhancement methods:



✓ Enhance low-light regions

✗ Over-enhance light-effects regions

➤ Existing night dehazing methods:

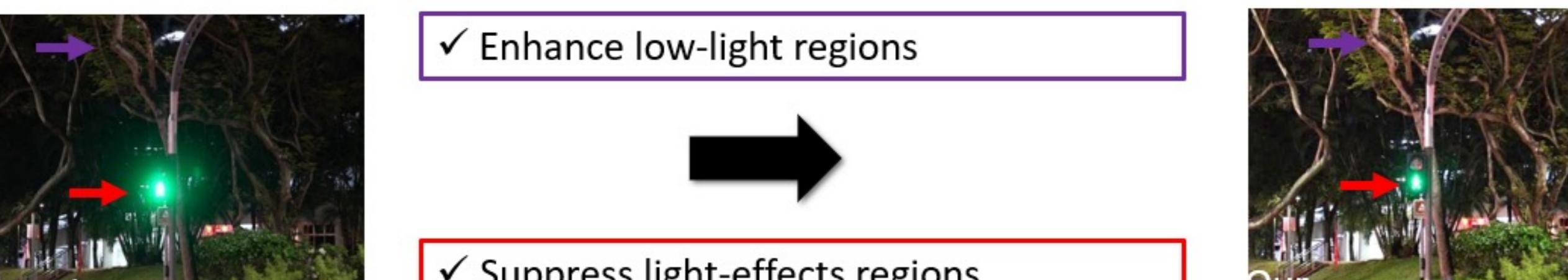


✗ Enhance low-light regions

✓ Suppress glow; ✗ Suppress light-effects

Main task: Boost dark regions, at the same time, suppress light-effects.

➤ Our:



✓ Enhance low-light regions

✓ Suppress light-effects regions

Challenge 1. Lack of paired training data, hard to collect ground truth

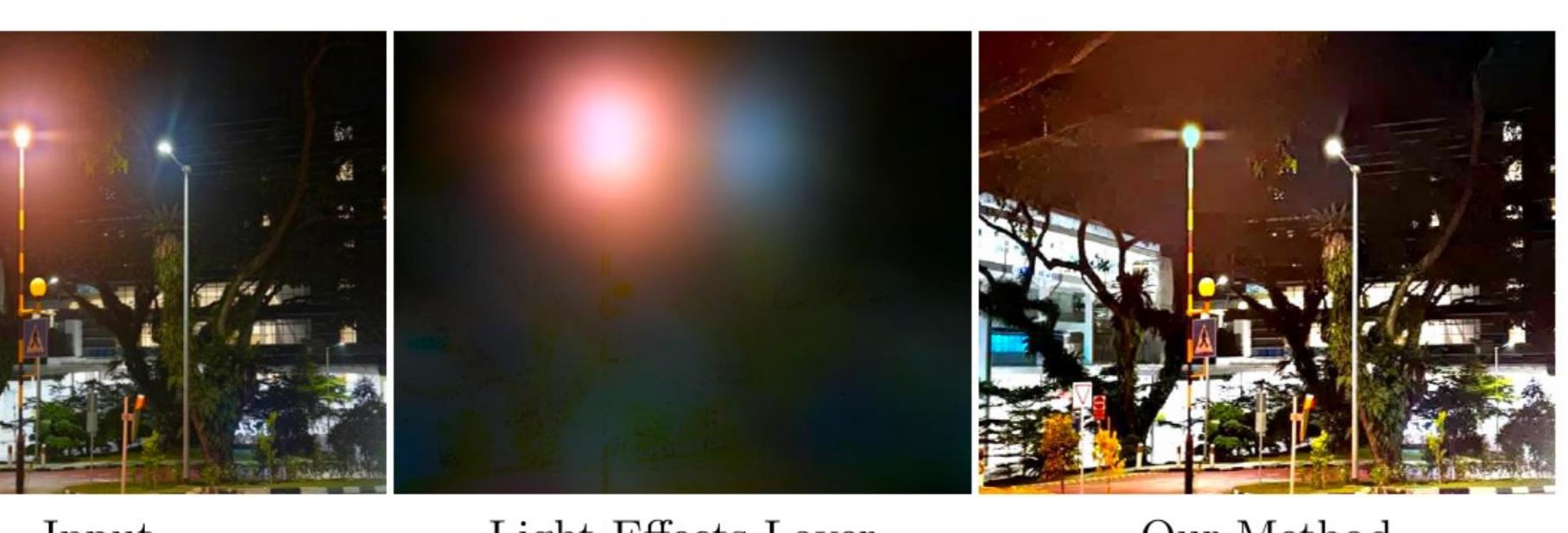
2. Rendering physically correct night light-effects images is challenging

Key Idea Model-Based Layer Decomposition + Unpaired Light-Effects Suppression

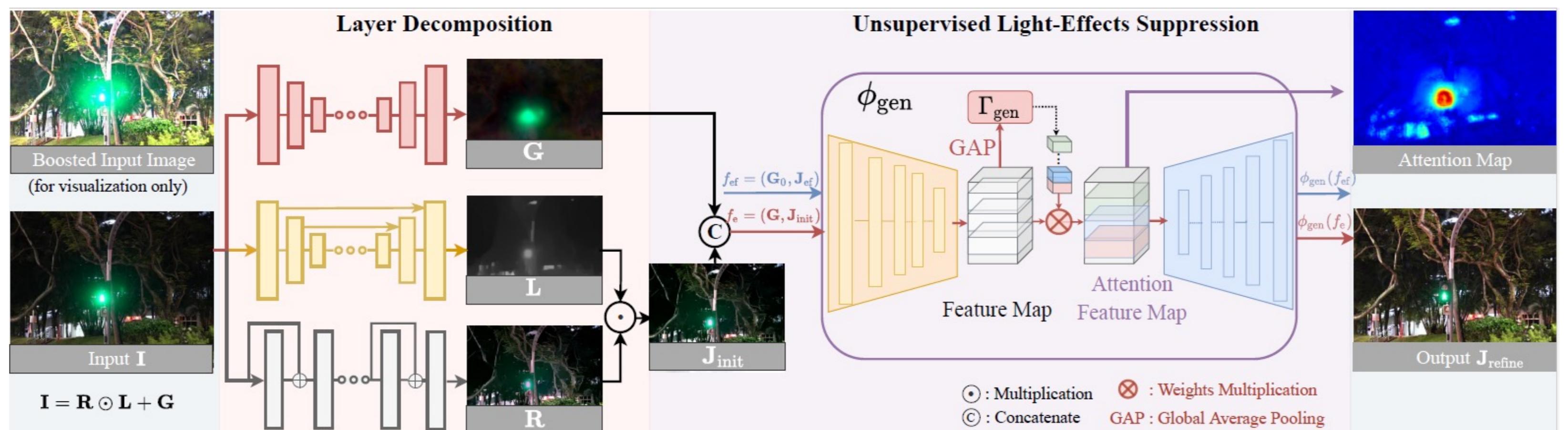
Main Contributions

To boost dark regions, at the same time, suppress light-effects.

1. We introduce an **unsupervised learning network**, that integrates layer decomposition and light-effects suppression.
2. We propose utilizing the **light-effects layer** as guidance, to distinguish light-effects from background regions, e.g., **white/multi-colored light-effects**.
3. We introduce **unsupervised losses** based on the structure and HF-features consistency, to **restore the background details**.



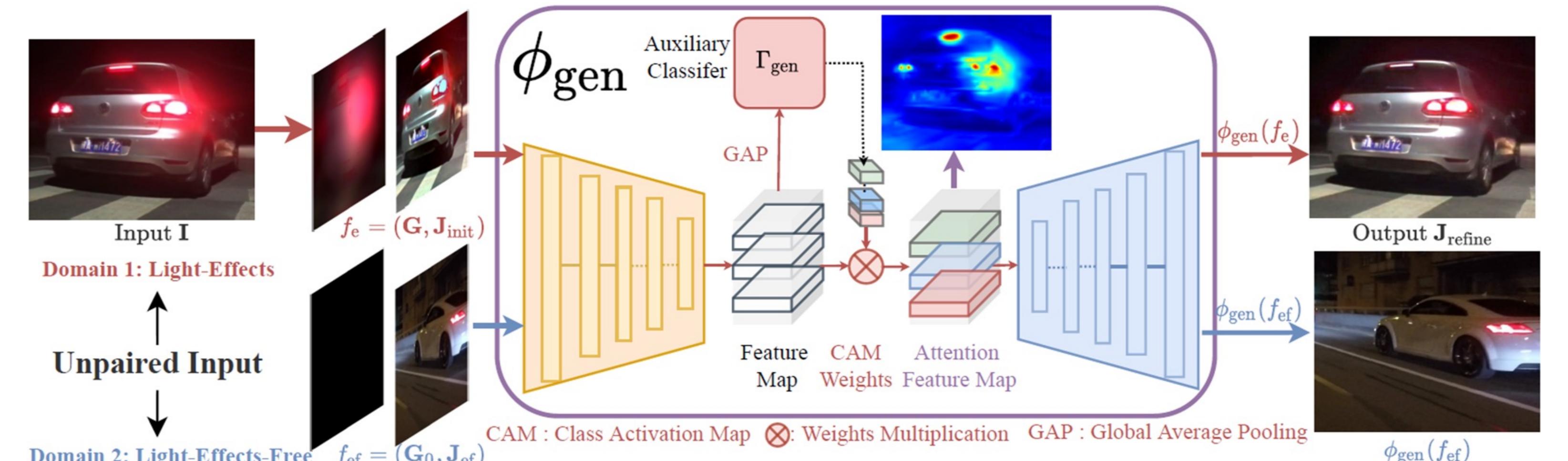
Method



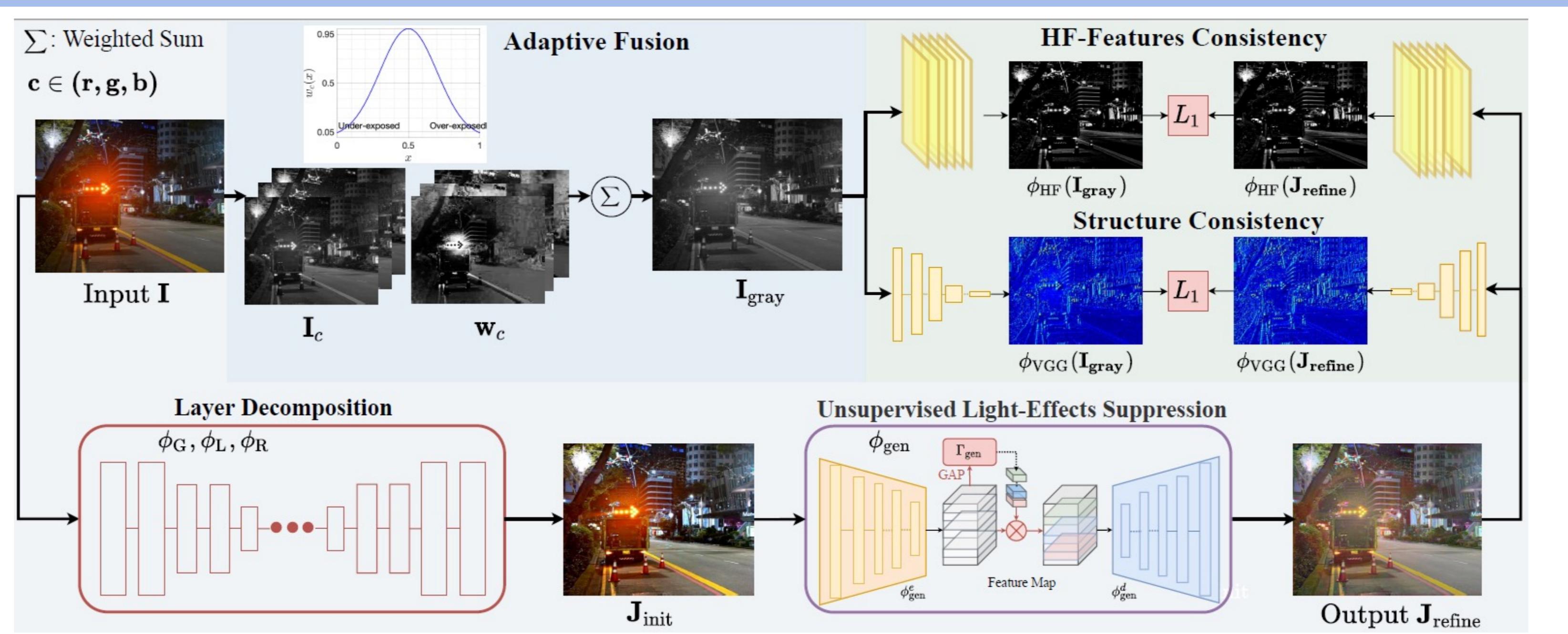
Layer Decomposition



Light-effects Suppression



Structure and HF-features Losses



Quantitative Results

Light-effects Suppression

User study evaluation on the real night data, our method obtained the highest mean (the max score is 7) and lowest standard deviation.

Three Aspects	EG [15]	Affifi [1]	Yan [38]	Zhang [44]	Li [23]	Sharma [32]	Ours
1. Realism↑	3.3 ± 1.5	5.5 ± 1.3	3.7 ± 2.0	3.5 ± 1.6	3.1 ± 1.8	2.8 ± 1.5	6.1 ± 0.8
2. L.E. Supp.↑	1.7 ± 0.8	3.1 ± 1.3	4.6 ± 1.4	3.9 ± 1.1	5.2 ± 1.2	3.0 ± 1.5	6.6 ± 0.7
3. Visibility↑	3.1 ± 1.6	4.2 ± 1.5	4.7 ± 1.5	3.7 ± 1.1	3.8 ± 1.5	3.0 ± 1.4	6.4 ± 0.7

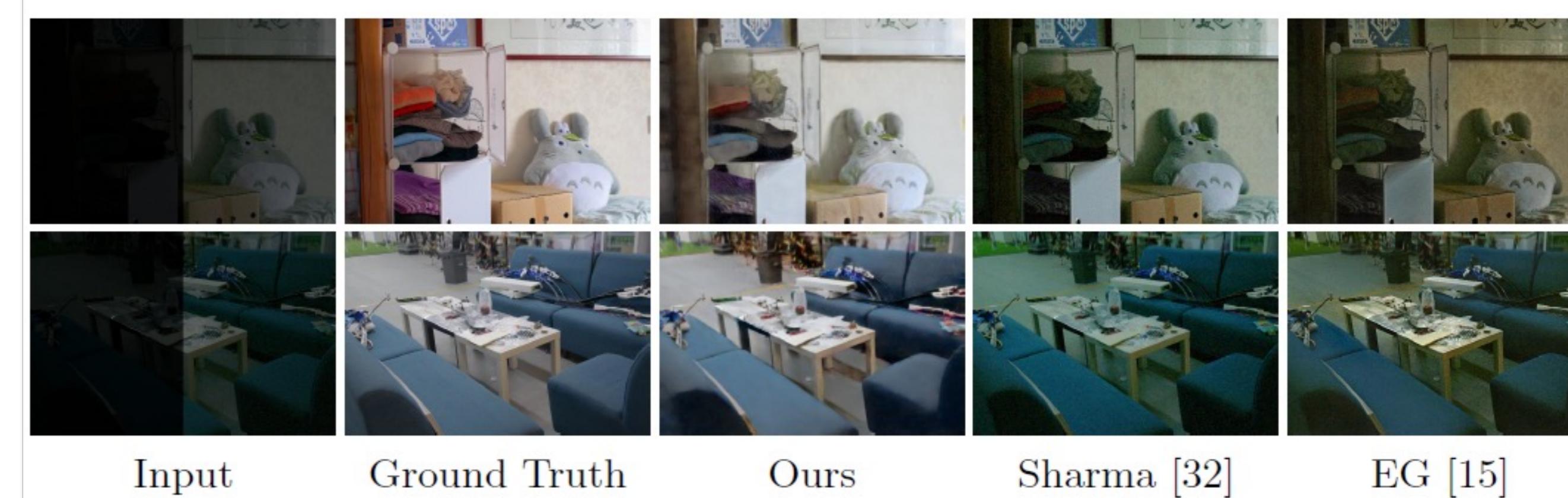
Low Light Enhancement

Quantitative comparisons on the *LOL-Real* dataset.

Learning Method	NA Input	Opti JED [29]	Opti RRM [21]	Opti SRIE [9]	ZSL RDIP [48]	ZSL MIRNet [43]	ZSL RRDNet [50]	ZSL ZD [13]	ZSL RUAS [24]
PSNR↑	9.72	17.33	17.34	17.34	11.43	12.67	14.85	20.54	15.33
SSIM↑	0.18	0.66	0.68	0.68	0.36	0.41	0.56	0.78	0.52
Learning Method	SL SL	SL SL	SL SL	SL SL	SSL SSL	UL UL	SSL SSL	UL UL	
PSNR↑	LLNet [25]	RN [7]	DUPE [34]	SICE [6]	Affifi [1]	DRBN [41]	EG [15]	Sharma [32]	Ours
SSIM↑	17.56	15.47	13.27	19.40	16.38	19.66	18.23	18.34	25.53

Visual Results

Low Light Enhancement



Light-effects Suppression

