

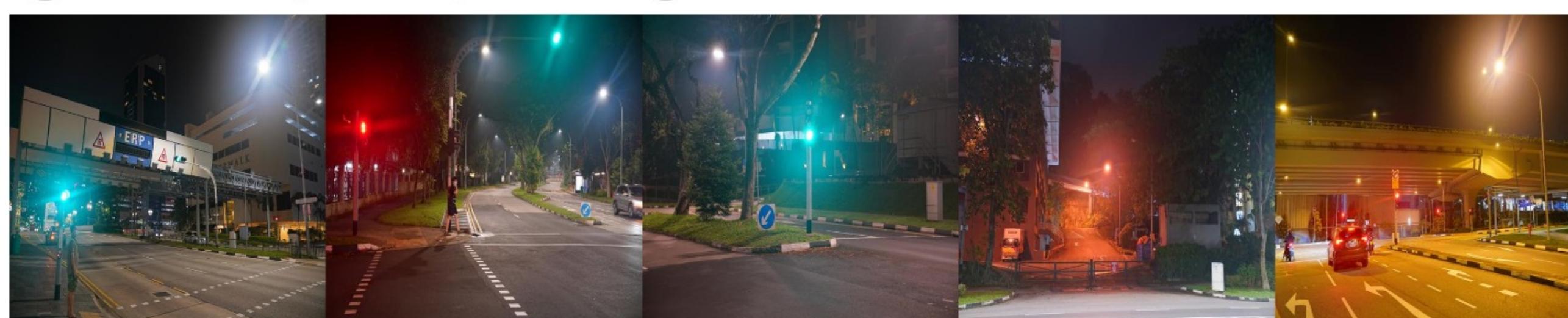
Introduction

Problem of Night Image

➤ Low Light:

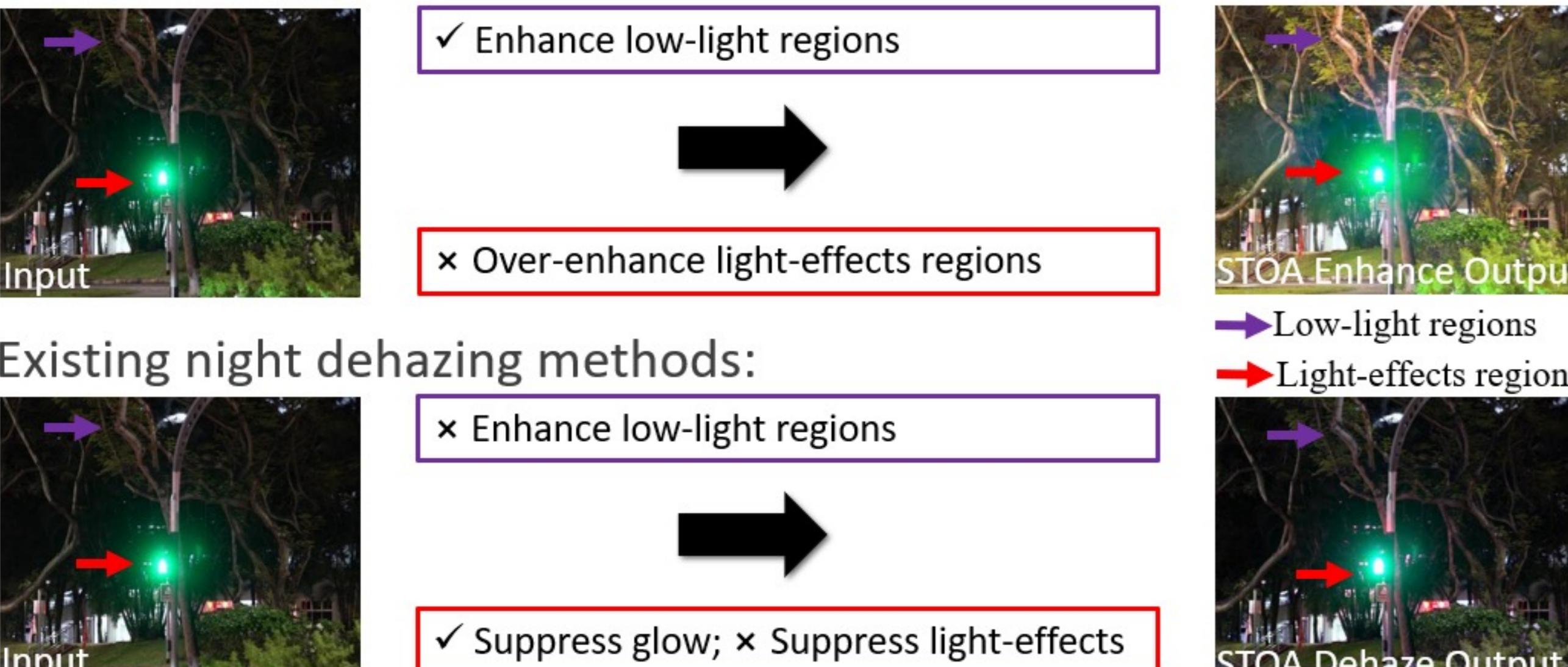


➤ Light-Effects/Glare/Floodlight:



Motivation

➤ Existing low-light enhancement methods:



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

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

Rendering physically correct night light-effects images is challenging

Unsupervised Night image Enhancement

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



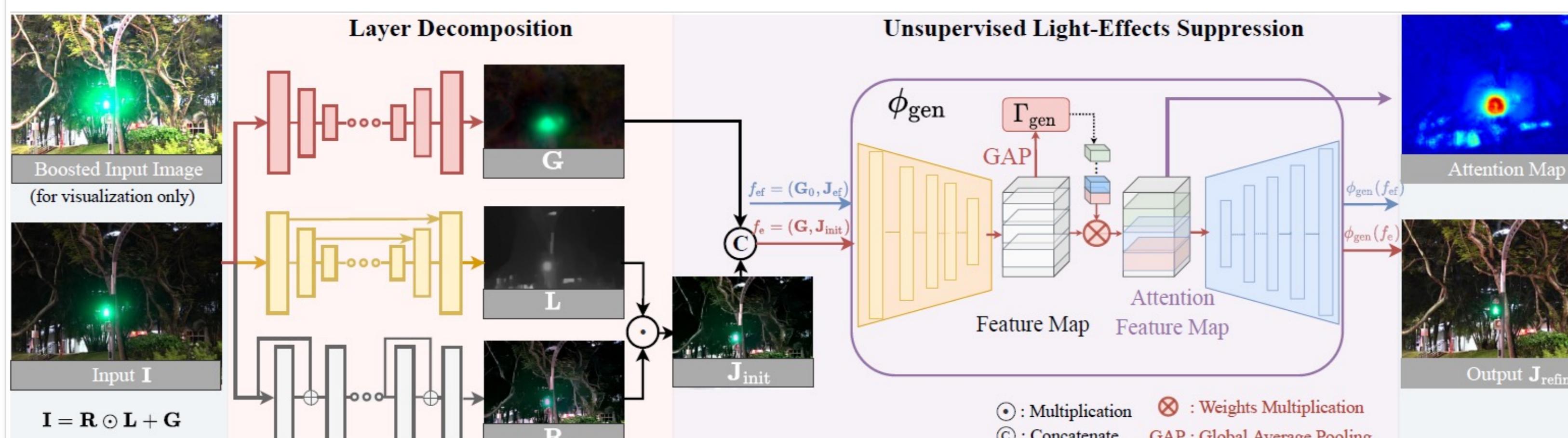
Main Contributions

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**.



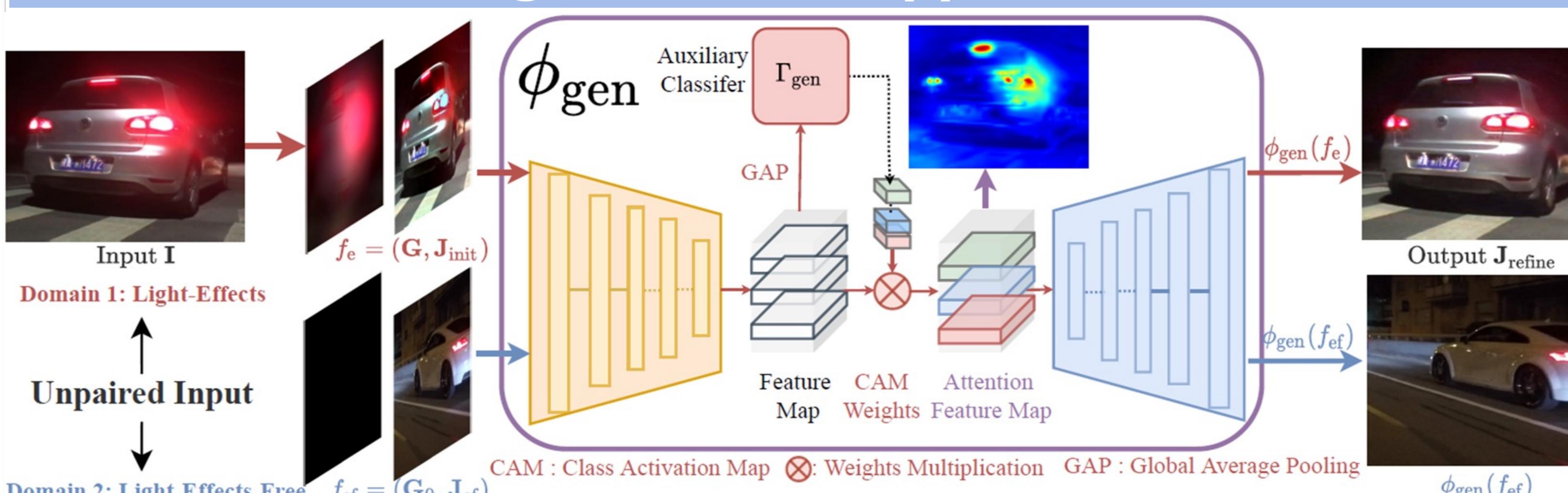
Method



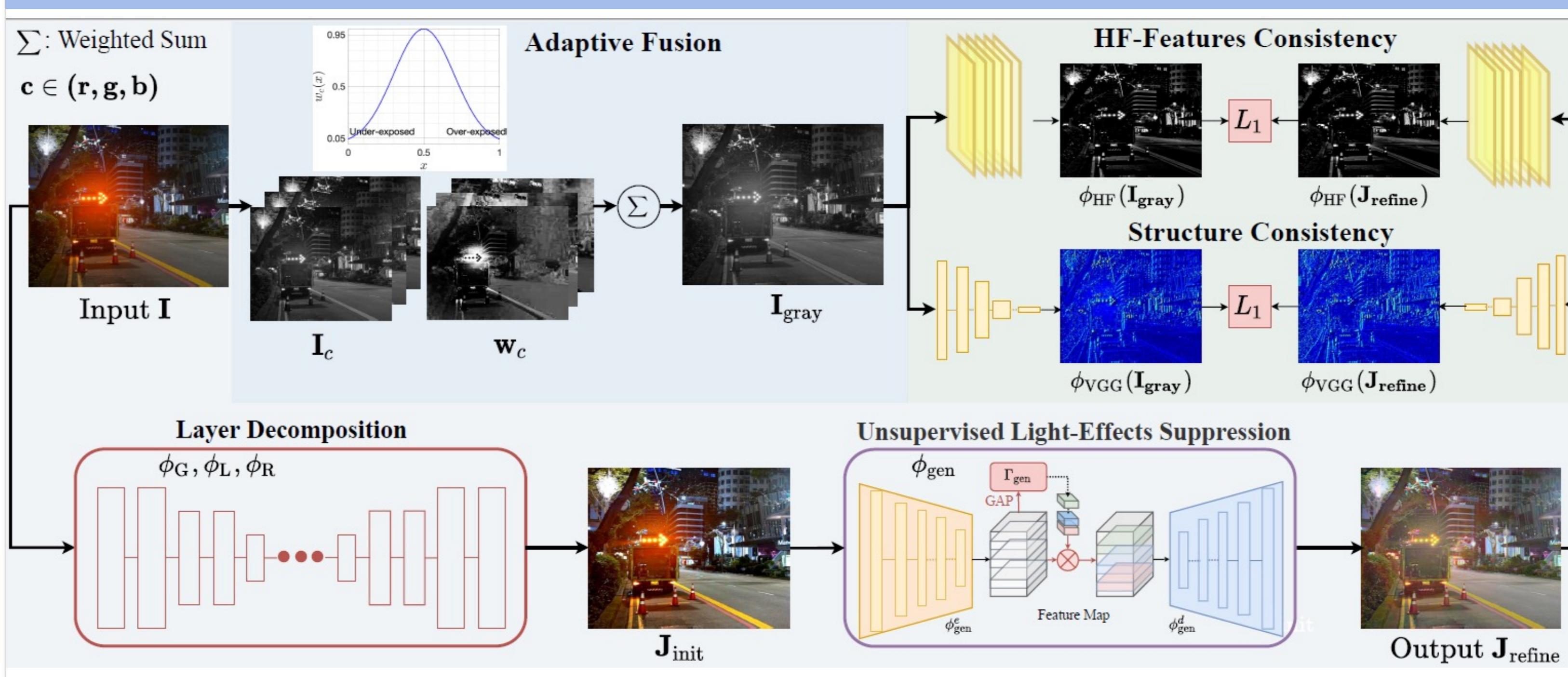
Layer Decomposition



Light-effects Suppression



Structure and HF-feature Loss



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]	Afifi [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

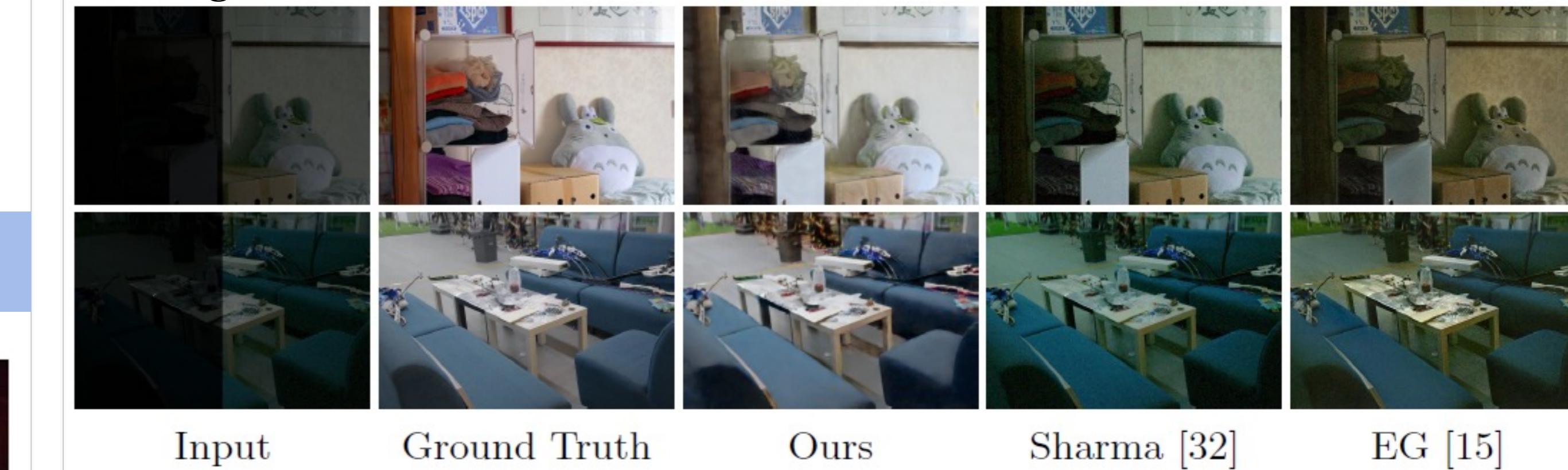
Low Light Enhancement

Quantitative comparisons on the LOL-Real dataset.

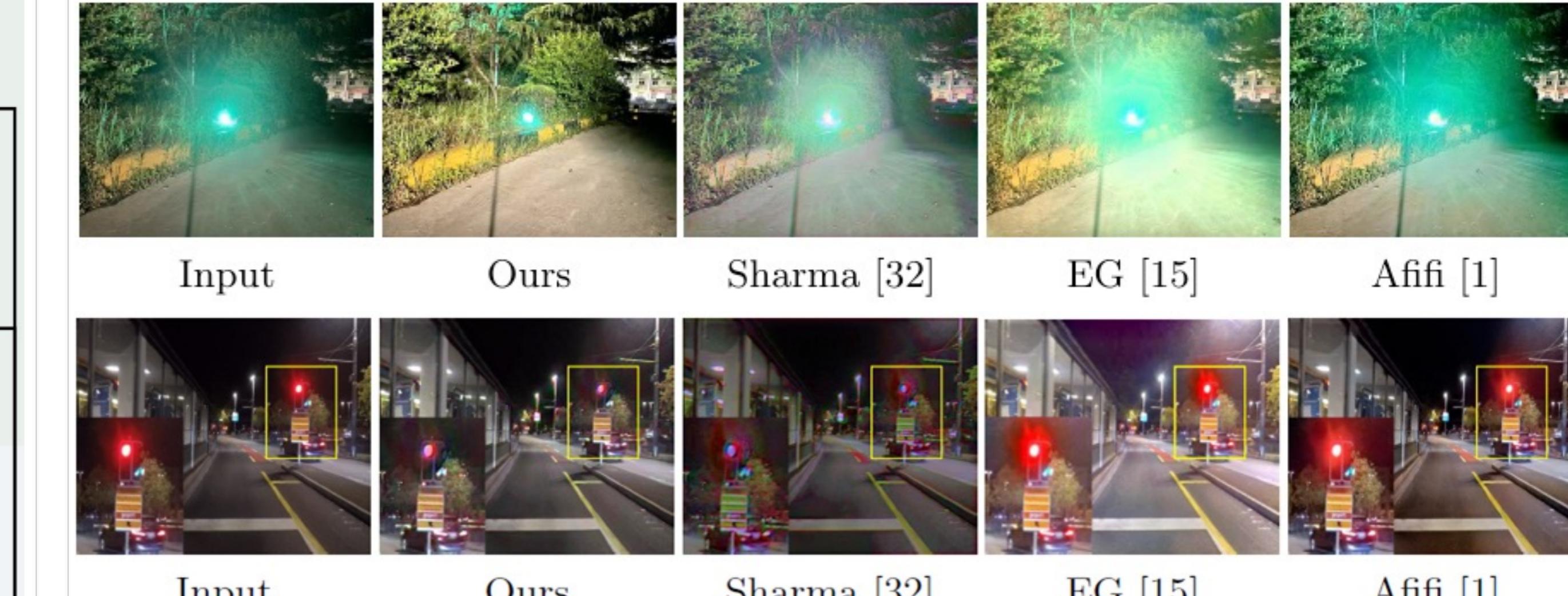
Learning Method	NA Input	Opti Input	Opti JED [29]	Opti RRM [21]	Opti SRIE [9]	ZSL RDIP [48]	ZSL MIRNet [43]	ZSL RRDNet [50]	ZSL ZD [13]	ZSL RUAS [24]
PSNR↑	9.72	17.33	17.34	17.34	11.43	12.67	14.85	20.54	15.33	
SSIM↑	0.18	0.66	0.68	0.68	0.36	0.41	0.56	0.78	0.52	
Learning Method	SL LLNet [25]	SL RN [7]	SL DUPE [34]	SL SICE [6]	SL Affifi [1]	SL DRBN [41]	SL EG [15]	SL Sharma [32]	SL Ours	SL RUAS
PSNR↑	17.56	15.47	13.27	19.40	16.38	19.66	18.23	18.34	25.53	
SSIM↑	0.54	0.56	0.45	0.69	0.53	0.76	0.61	0.64	0.88	

Visual Results

Low Light Enhancement



Light-effects Suppression



Feature Loss

