Joint Low-light Enhancement and Super Resolution with Image Underexposure Level Guidance

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Introduction

Joint Low-light Enhancement (LLE) and Super Resolution (SR)

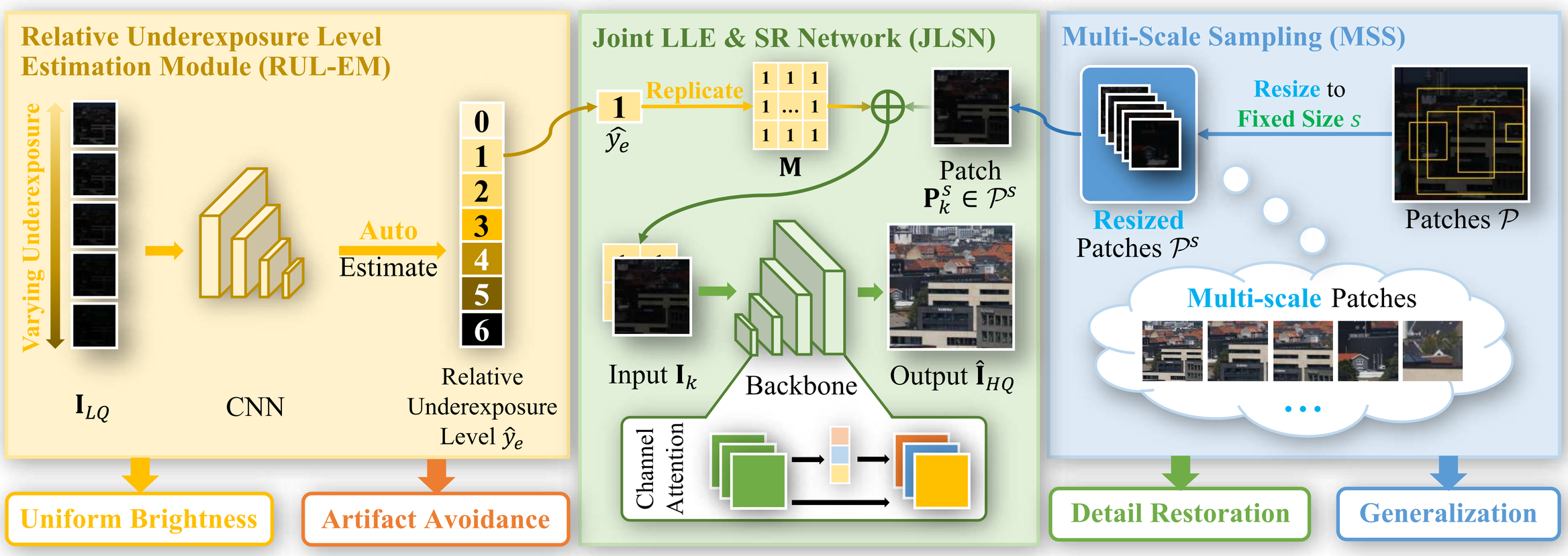
Problems in Joint LLE & SR

- **Non-uniform brightness** when inputting images of varying brightness.
- **Loss of details.**
- **Significant performance degradation on unseen datasets**, *i.e.*, cross-dataset problem.

Contributions

- A novel **joint LLE & SR solution** which can address the above-mentioned problems.
- Three novel modules are proposed or introduced, including Relative Underexposure Level Estimation Module (RUL-EM), Multi-Scale Sampling (MSS) and Joint LLE & SR Network (JLSN).
- **State-of-the-art performance** on **joint LLE & SR task in both within-dataset and cross-dataset settings.**

Method



Relative Underexposure Level Estimation Module (RUL-EM)

- Designing RUL-EM as **a classification module** based on ResNet-50 with Squeeze-and-Excitation module.
- Using the ground truth **relative underexposure levels** provided by the RELLISUR dataset as labels.
- **Pre-training** before subsequent modules.
- Can help for **uniform brightness** and **artifact avoidance**.

Multi-Scale Sampling (MSS)

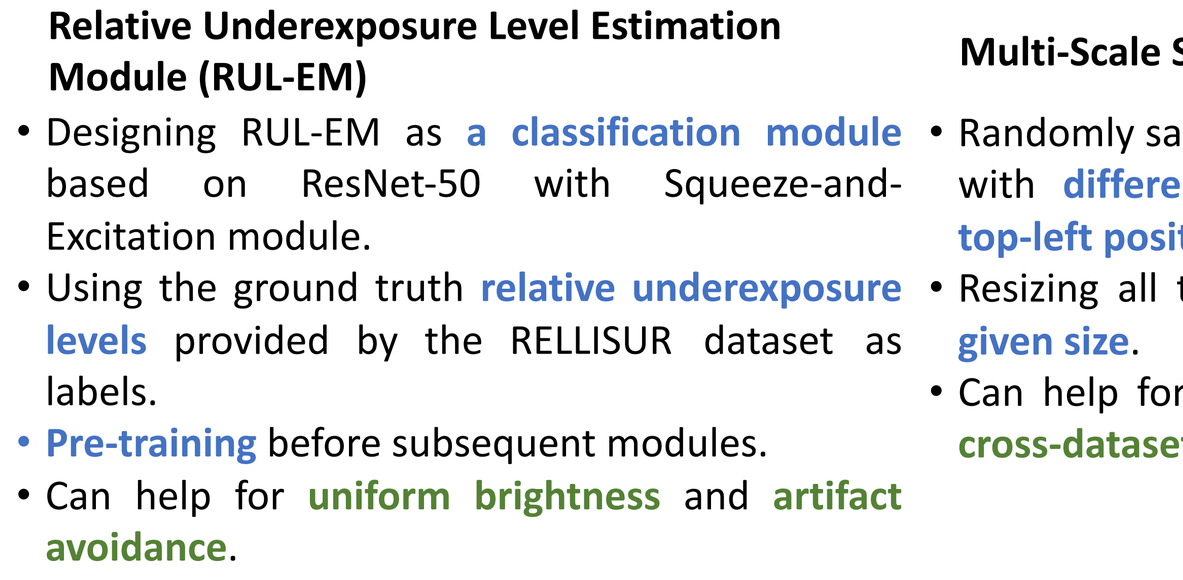
- Randomly sampling multiple patches with **different sizes and different top-left positions**.
- Resizing all the patches in into **the given size**.
- Can help for **detail restoration** and **cross-dataset generalization**.

Joint LLE & SR Network (JLSN)

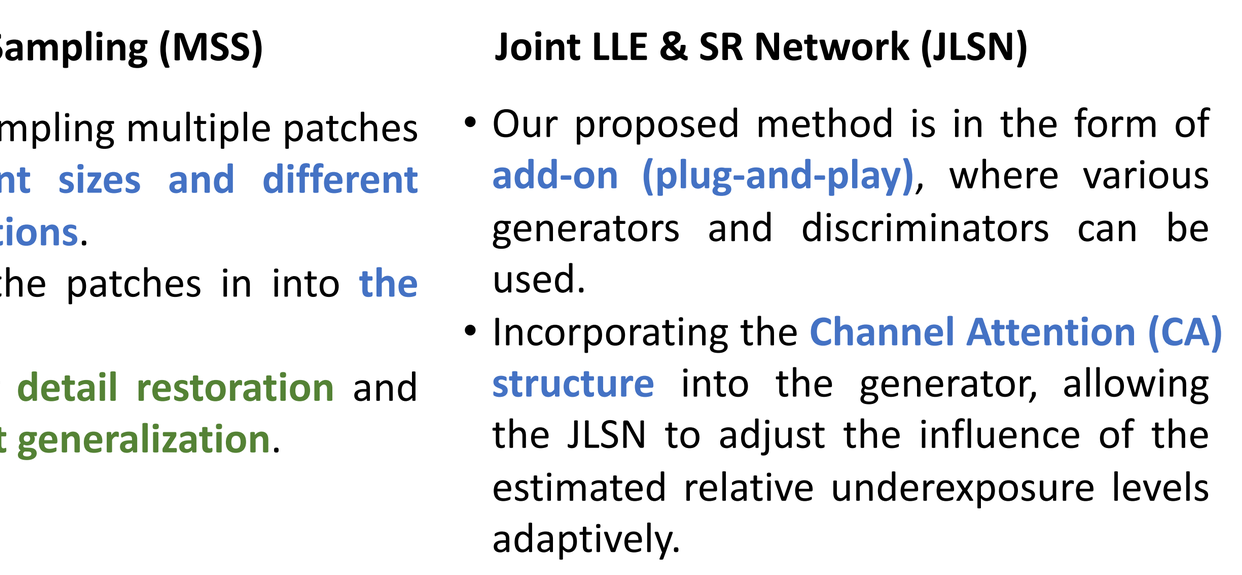
- Our proposed method is in the form of **add-on (plug-and-play)**, where various generators and discriminators can be used.
- Incorporating the **Channel Attention (CA) structure** into the generator, allowing the JLSN to adjust the influence of the estimated relative underexposure levels adaptively.

Experimental Results

Within-dataset Visual Results

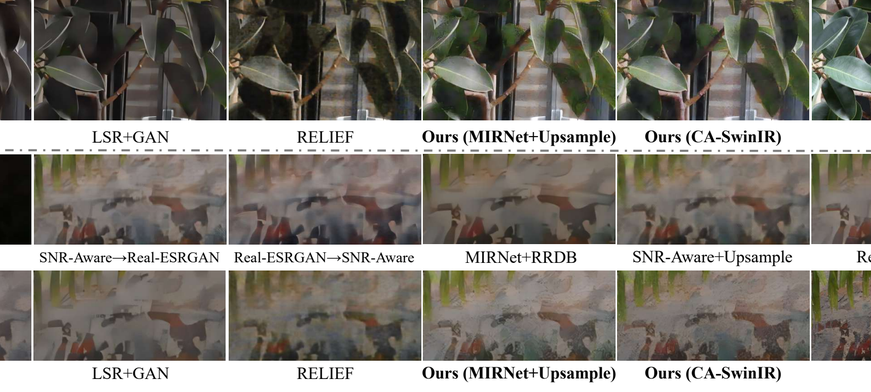


Cross-dataset Visual Results



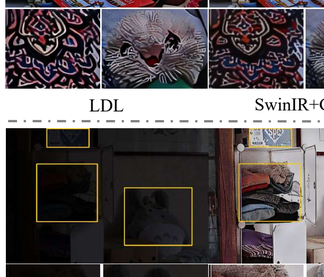
Visual Results of Ablation Study

(a) Comparisons of different strategies on **adjustment brightness to a uniform level**



(b) Comparisons of different strategies on **detail recovery** and **artifact avoidance**

(a) Confusion Matrix of RUL-EM; (b) Ablation Study Results



(a)

Strategy	PSNR↑	SSIM↑	LPIPS↓	NIQE↓
Vanilla	18.59	0.76	0.40	8.32
RUL-EM	20.97	0.78	0.40	8.18
RUL-EM + MSS	20.76	0.76	0.42	5.85
RUL-EM + CA	21.66	0.79	0.39	8.62
RUL-EM + MSS + CA	21.52	0.77	0.39	6.77

(b)

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