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

Mingjie Xu, Chaoran Zhang, Feifan Li*, Feng Li* 1
1State Key Laboratory of VR Technology and Systems, School of CSE, Beihang University, Beijing, China
2Huawei Consumer BG Consumer Cloud Service Dept, Nanjing, China

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

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

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