Low light photography based on L3 approach

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1 Motivation

Imaging in low light environment is challenging, yet opening question. The main difficulty is the low photon count and the low SNR. Recently, a novel machine-learning based image processing pipeline, called L3(learned, linear, local) has been proposed. It is a new way of thinking image processing pipeline as a large collection of filters, and try to combine the machine learning and image system simulations to automate the pipeline design. Inspired by this idea, we proposed to use the L3 to develop a low light photography.

2 Method

To do this, the process will be divided into two parts: learning and rendering. In the learning section, we will crop the image into small patches. We will generate the simulated scene by adjusting the illumination with ISETcam toolbox. The ground truth image will be generated also with ISETcam. For ground truth, we will use the image captured by the noise-free ideal sensor, which gives us the brighter image. With the training data and the ground truth, we will apply classification on the training database (e.g. based on the illumination level). In the rendering section, we will crop the new sample image into small patches with the same dimension of the patches used in the learning step. By using our learned transformation kernel, we will be able to convert the raw sensor data into RGB value images. Lastly, we need to select a standard approach to evaluate the quality of our rendered image.

3 Intended experiments

There are two challenges to achieve this method. a) we need to experiment with different loss functions to select a best one for the learning section and b) we need to play with the parameters (e.g. size of the patches) to achieve best learning result. Based on those two challenges, our experiment will contain these steps. First, we will implement the commercial available sensor parameter to modify the sensor performance. In the next step, we'll first experiment with the current default set (e.g. the patch size, the cutpoint for the classification) to set the benchmark. In the next step, we will tune these parameters. If time permits, we will also try to implement different loss functions to optimize the learning result.