EFFECTIVE COLOR CORRECTION PIPELINE FOR A NOISY IMAGE

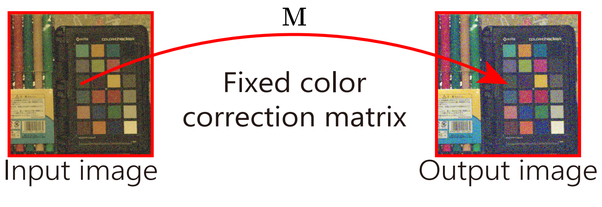
Kenta Takahashi, Yusuke Monno, Masayuki Tanaka, and Masatoshi Okutomi
Tokyo Institute of Technology

Source code is available on our project page !!
http://www.ok.ctrl.titech.ac.jp/res/CC/CC.html

Introduction

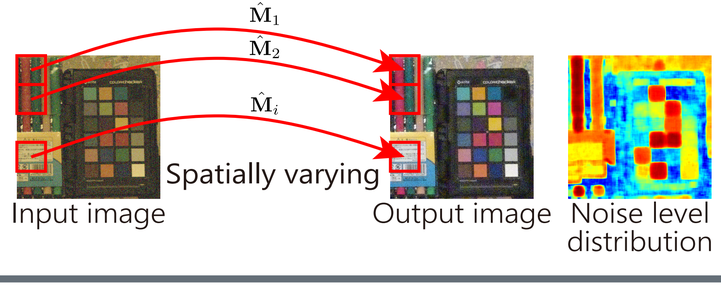
Standard Color Correction

- Usually do not consider the noise.
- Often amplifies the image noise.



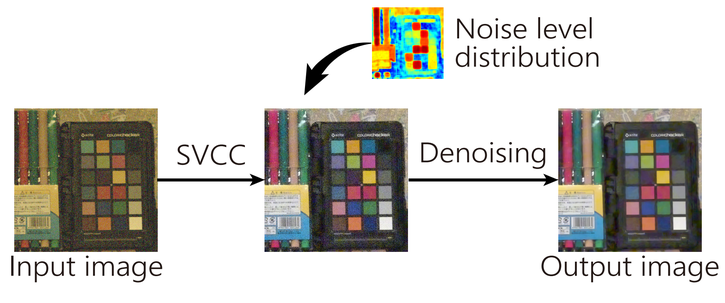
SVCC: Spatially Varying Color Correction [1]

- Can effectively suppress the noise.
- Adaptively calculates the matrix for each local block.
  ➢The noise levels spatially vary.

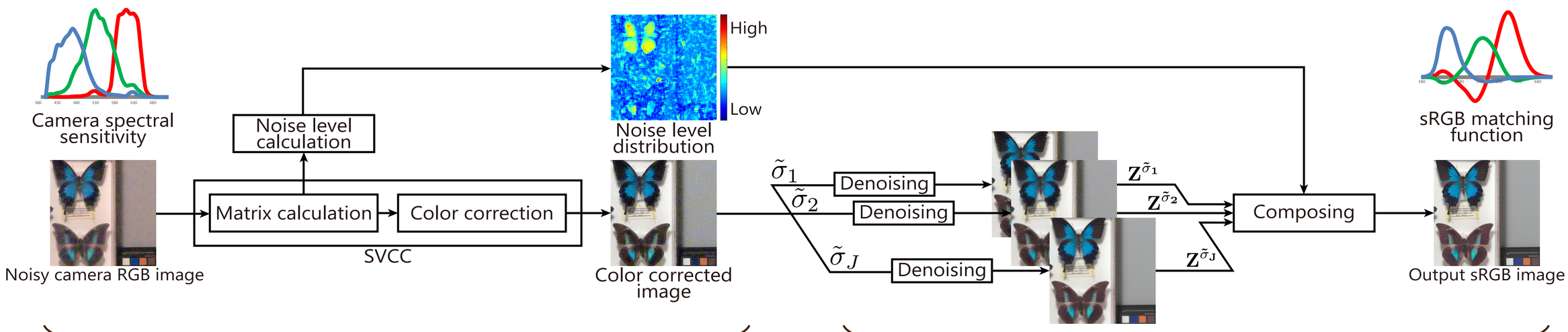


Proposed Algorithm

- Color correction + Denoising
- Denoising framework for spatially varying noise levels.



Proposed Algorithm



1. Color correction and noise level calculation

- Utilize SVCC to achieve a better trade-off between color fidelity and noise amplification.

$$\hat{\mathbf{M}}_i = \arg\min_{\mathbf{M}_i} \mathrm{E}[||\underbrace{\mathbf{M}\mathbf{x}}_{\text{noise free case}} - \underbrace{\mathbf{M}_i\mathbf{x}_n}_{\text{real case (noisy)}}||^2]$$

- Calculate the noise level for each local block.

$$[\hat{\sigma}_r^2\ \hat{\sigma}_g^2\ \hat{\sigma}_b^2]^T = \hat{\mathbf{M}}_i \circ \hat{\mathbf{M}}_i[\sigma_r^2\ \sigma_g^2\ \sigma_b^2]^T$$

2. Denoise images with spatially varying noise level

- Apply a denoising algorithm, BM3D [2], using preset assumed noise levels $[\tilde{\sigma}_1, \tilde{\sigma}_2, \cdots, \tilde{\sigma}_J]$
- Final output is obtained by weighted average of de-noised images based on the noise level distribution.

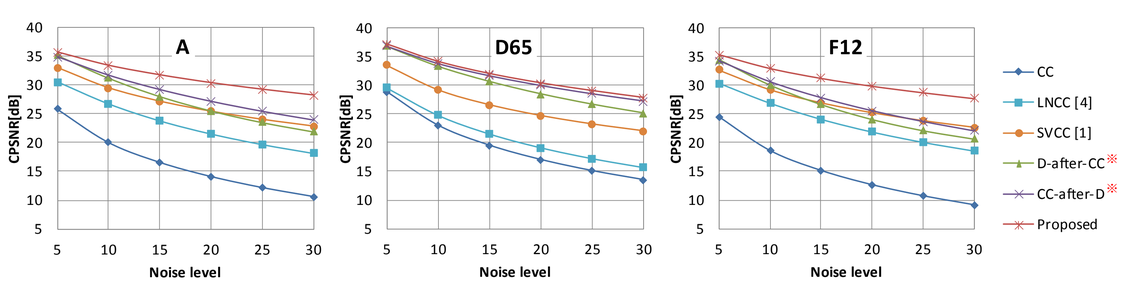
Experimental Results

Dataset

Synthesized images using hyperspectral images.

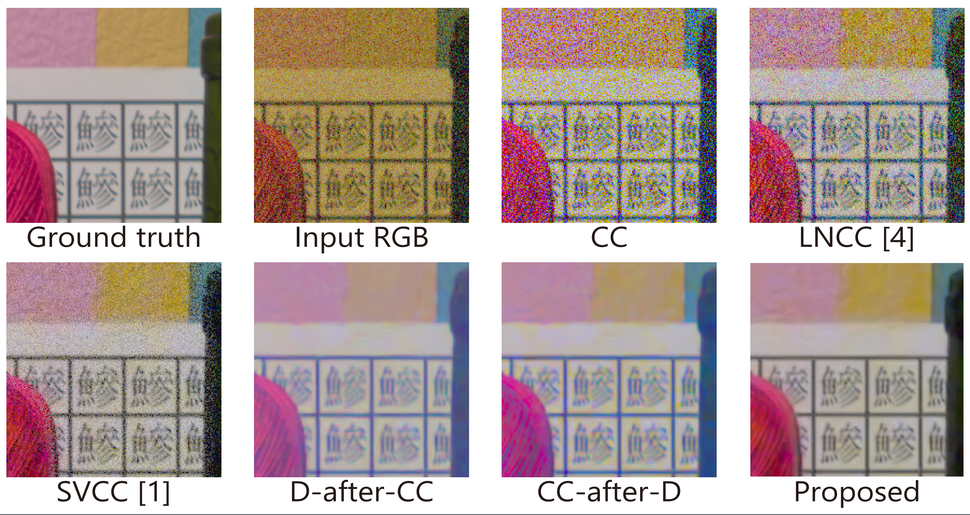
- 20 scenes
- Illuminations: CIE A, CIE D65, CIE F12
- Camera sensitivity: Olympus E-PL2 [3]

Numerical Comparison | Average CPSNR of 20 images



※ D:Denoising CC:Color Correction

Visual Comparison | CIE F12 σ=30



References

[1] S. Lim and A. Silverstein, "Spatially varying color correction (SVCC) matrices for reduced noise," CIC 2004.
[2] K. Dabov, et. al., "Image denoising by sparse 3-d transform-domain collaborative filtering," TIP 2007.
[3] J. Jiang, et. al, "What is the space of spectral sensitivity functions for digital color cameras?," WACV 2013.
[4] L. Kharitonenko, et. al., "Suppression of noise amplification during colour correction," TCE 2002.