

Superresolution Imaging Pipeline

PURPOSE

Implement existing single-image superresolution algorithm with an ISP pipeline. The pipeline takes raw binary input and processes the image to JPEG image. Study the image quality of single-image superresolution algorithm, compare to pipeline output without the algorithm.

DESCRIPTION

The goal for this project is to implement an image processing pipeline in MATLAB with the addition of a superresolution algorithm from literature (Daniel Glasner).

The pipeline begins with a defective pixel correction module based on median filtering. Followed by black-level subtraction, lens shading correction (LSC), and white balance (WB) modules. The LSC module applies gain LUT on the input image. The LUT is for the same illuminant as the input image (for better color shading correction), applied per Bayer color channel. WB is implemented using the shades-of-gray algorithm.

The next block to be implemented is Bayer denoising (Dmitriy Paliya). This method proposes joint denoising and demosaicing and, according to the authors, “performs, at a lower computational cost, better or comparable than combination of successive state-of-the-art techniques targeted denoising and demosaicing techniques known to the authors.”

After demosaicing, a color correction matrix (CCM) is applied followed by gamma-correction (GMC), sharpening (Johns Hopkins University, 2005; Stanford University) and finally, superresolution. The CCM is a pre-computed 3x3 transformation matrix for the specific illuminant in the scene. GMC is a simple LUT of values.

At this stage, the superresolution algorithm is implemented and images from various scenes are simulated in the pipeline. The output is going to be analyzed and adjustments in the pipeline will be made accordingly.

The proposed pipe is shown in Figure 1 below.

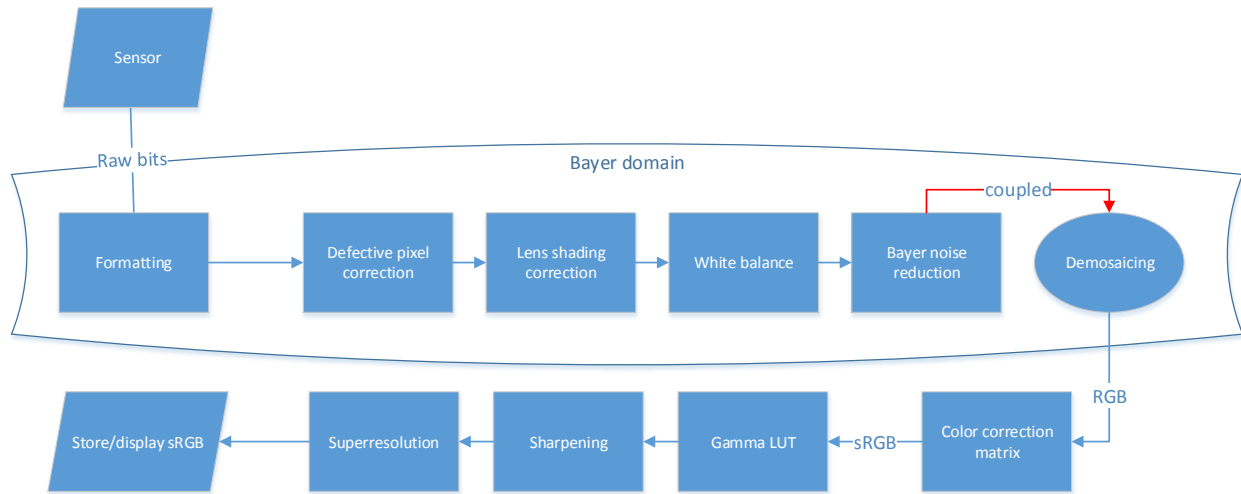


Figure 1: Proposed ISP pipeline implementation

Figure 2 shows a scene from Image Engineering Light Studio. A raw database which includes this scene as well as others captured from a 13Mp Sony sensor will be used in the simulations.



Figure 2: Image Engineering Light Studio iPhone 5s

BIBLIOGRAPHY

Daniel Glasner, S. B. (n.d.). Super-Resolution from a Single Image. The Weizmann Institute of Science, Israel.

Dmitriy Paliya, A. F. (n.d.). Denoising and Interpolation of Noisy Bayer Data with Adaptive Cross-Color Filters. Nokia Research Center, Tampere, Finland.

Johns Hopkins University. (2005, August 2). *The Principles Behind Digital Image Sharpening*. Retrieved from <http://gene.bio.jhu.edu>: <http://gene.bio.jhu.edu/sharpening/sharpen2.html>

Stanford University. (n.d.). *Image Processing For Photography and Vision: Sharpening*. Retrieved from <http://web.stanford.edu/class/cs448f/lectures/2.1/Sharpening.pdf>