Spencer McDonough
6341617166
shmcdono@usc.edu

EE569 Homework #1
January 22, 2019

Part 1: Image Demosaicing and Histogram Manipulation

1. Abstract and Motivation

Digital camera sensors are limited in their capacity to capture light continuously due to the fact that you cannot place red, green, and blue sensors in the exact same location. This limitation led to the development of the color filter array (CFA for short) where red, green, and blue sensors are arranged in what is known as a Bayer pattern. In this pattern, there are 2 green sensors for every red and blue sensor (due to the fact that the human eye is most sensitive to wavelengths closest to the color green). When the image is captured, we are left with a mosaic of red, green, and blue pixels to look at, which is almost nonsensical to the human eye. Consequently, we must demosaic this pattern and create a more viewable image using the mosaic we are given. The approach and procedure to solve this is discussed below.

2. Approach and Procedures

There are two approaches that we explore to demosaic an image in this assignment. The first approach is what is known as bilinear interpolation. In this approach, we take the average of the nearest pixels of different color to estimate the missing two values at any one pixel location. This is described in the equations below:

$$\hat{R}_{3,3} = \frac{1}{2}(R_{3,2} + R_{3,4}) \qquad \hat{B}_{3,4} = \frac{1}{4}(B_{2,3} + B_{2,5} + B_{4,3} + B_{4,5})$$

$$\hat{B}_{3,3} = \frac{1}{2}(B_{2,3} + B_{4,3}) \qquad \hat{G}_{3,4} = \frac{1}{4}(G_{3,3} + G_{2,4} + G_{3,5} + G_{4,4})$$

The results for this approach are laid out and discussed henceforth.

The second approach for demosaicing is known as Malvar-He-Cutler C) demosaicing, where we take 5 and 9 point discrete Laplacians of surrounding pixels to estimate missing colors at any given pixel location.

3. Results

Input image: cat.raw

Demosaicing by Uniform Bilinear Interpolation

Output image: cat_demosaicedUniform.raw

Demosaicing by Gaussian Bilinear Interpolation

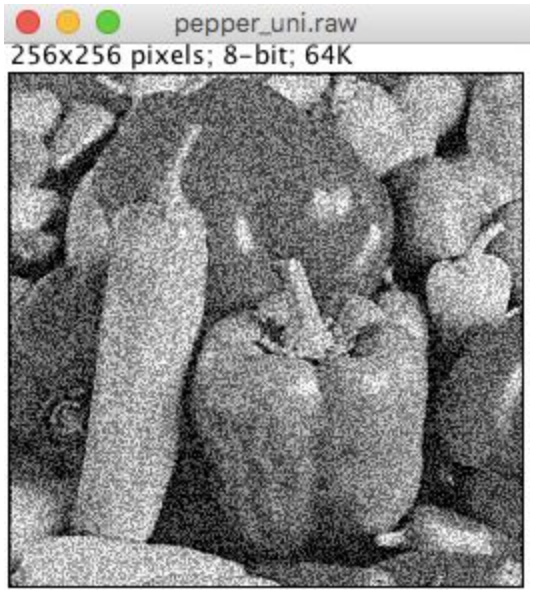
Demosaicing by MHC Demosaicing

Output image: cat_demosaicedMHC.raw

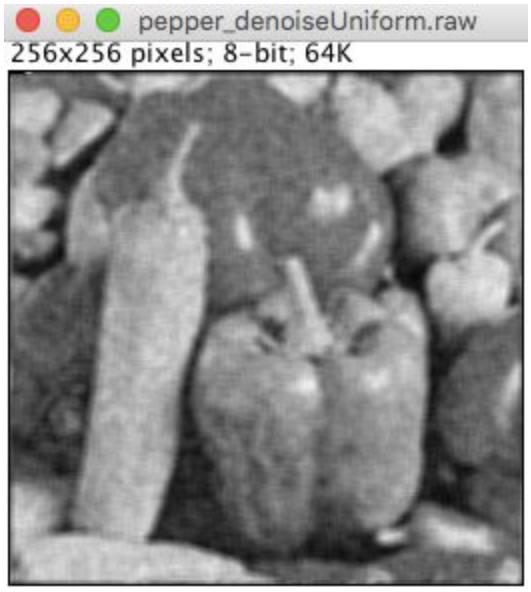
4. **Discussion**
   more to come after deadline
5. **Question Answers**
   more to come after deadline

Part 2: Image Denoising

6. **Abstract and Motivation**
   more to come after deadline
7. **Approach and Procedures**
   more to come after deadline
8. **Results**
   Input image: pepper_uni.raw



Uniform Denoising with N = 5



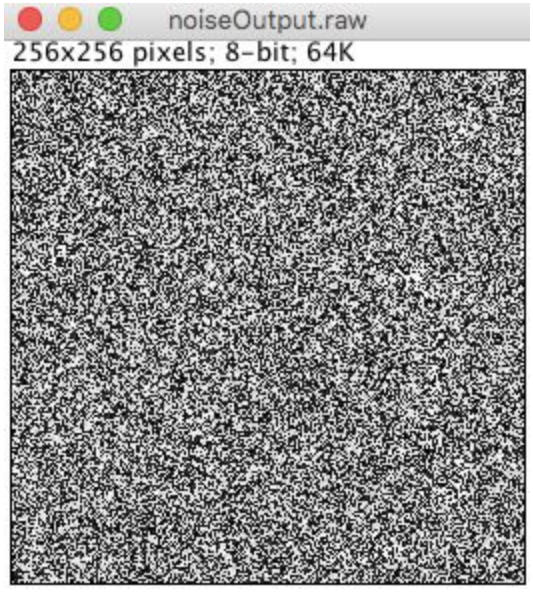
more to come after deadline

9. Discussion

more to come after deadline

10. Question Answers

1) noise is uniform as seen below (image created by subtracting clean image from noisy image)



more to come after deadline

References

Gaussian Filter: https://homepages.inf.ed.ac.uk/rbf/HIPR2/gsmooth.htm
Passing 3D Array by Reference:
https://www.geeksforgeeks.org/pass-2d-array-parameter-c/