

Improving the Two Color Prior Bayesian Demosaicing Algorithm

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Introduction

RGB images are made up of pixels, each of which contains three color channels: Red, Green and Blue.

Most digital cameras record only one channel per pixel. Image demosaicing is the process of reconstructing truecolor images from such partial data.

Better demosaicing algorithms improve image quality at the capture level, making digital images more accurate representation of the real world.

Objectives

1. To implement and compare four previously published demosaicing algorithms
2. To investigate the effect of η , a configurable parameter in the two color prior method
3. To improve the two color prior Bayesian demosaicing algorithm

Methods

24 scaled-down images from the Kodak PhotoCD are used as the sample set. Sample images filtered by the Bayer filter are used as simulated inputs to the algorithms.

A Java experimental framework is developed to facilitate the research.

Background

Bayer Pattern (US Patent 3971065)



Peak Signal-to-Noise-Ratio (PSNR)

$$PSNR = 20 \log_{10} \left(\frac{255}{MSE} \right)$$

Algorithms

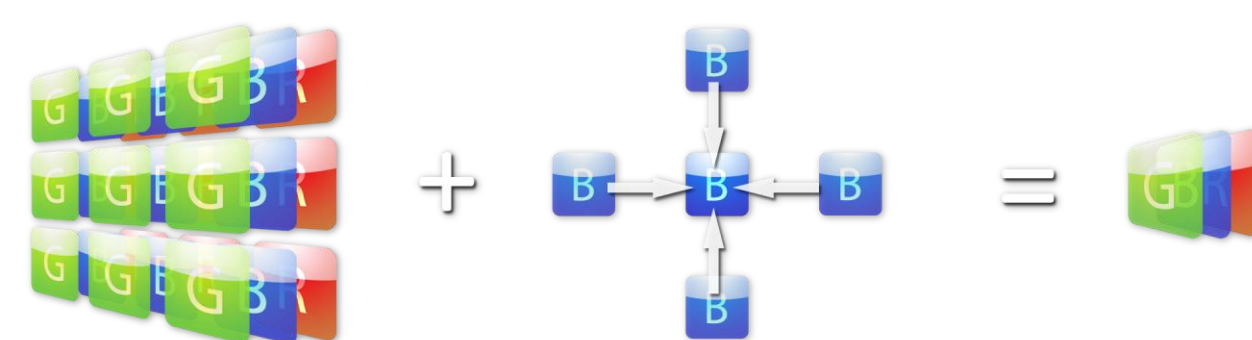
Bilinear Interpolation



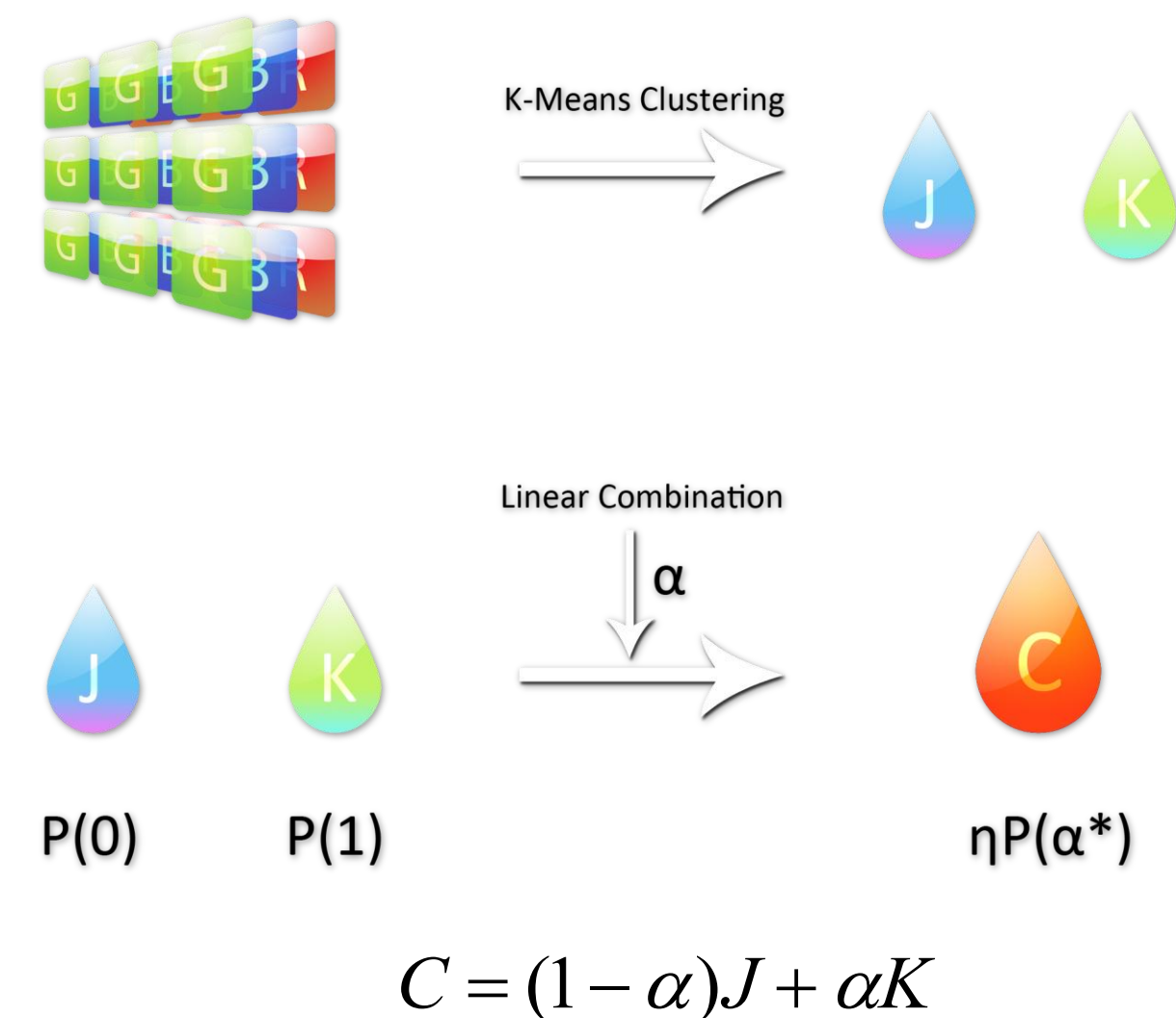
Vector Median



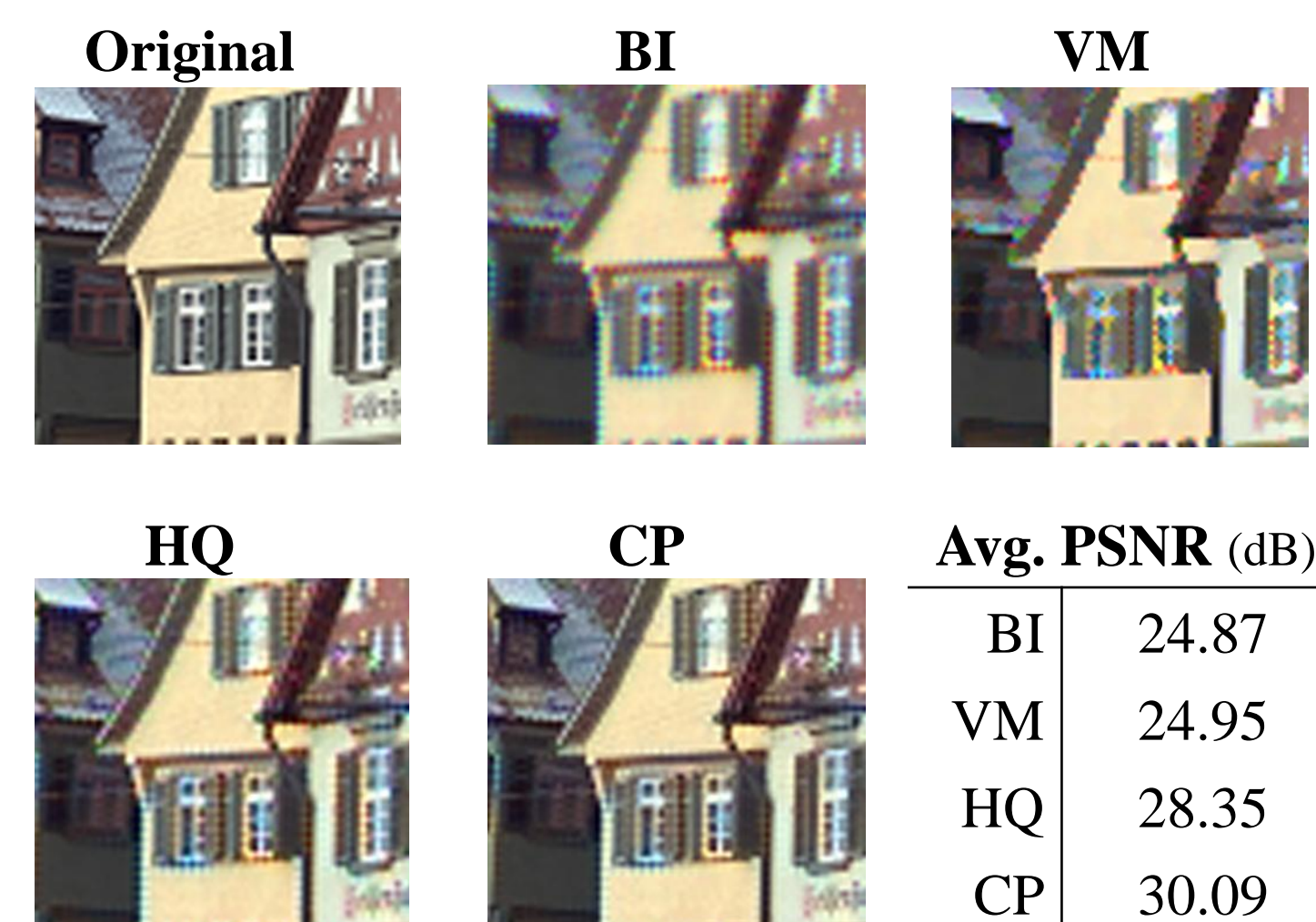
High-Quality Linear Interpolation



The Two Color Image Prior Demosaicing

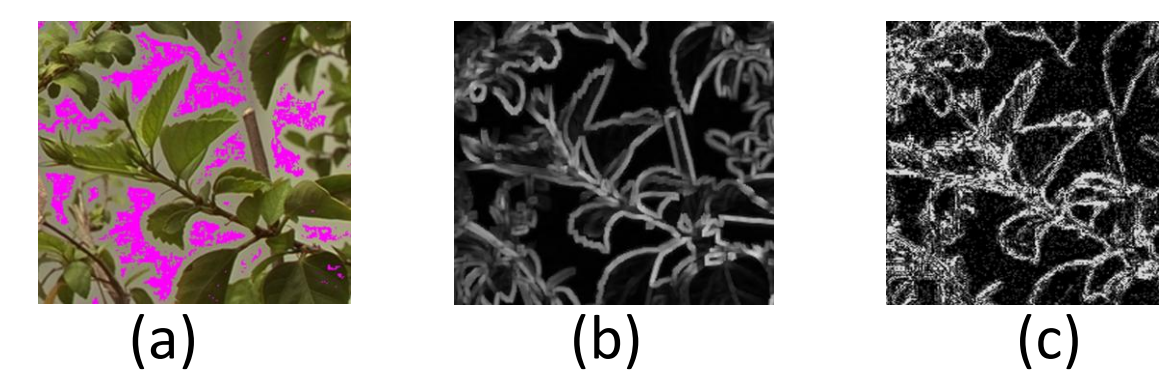


Comparison



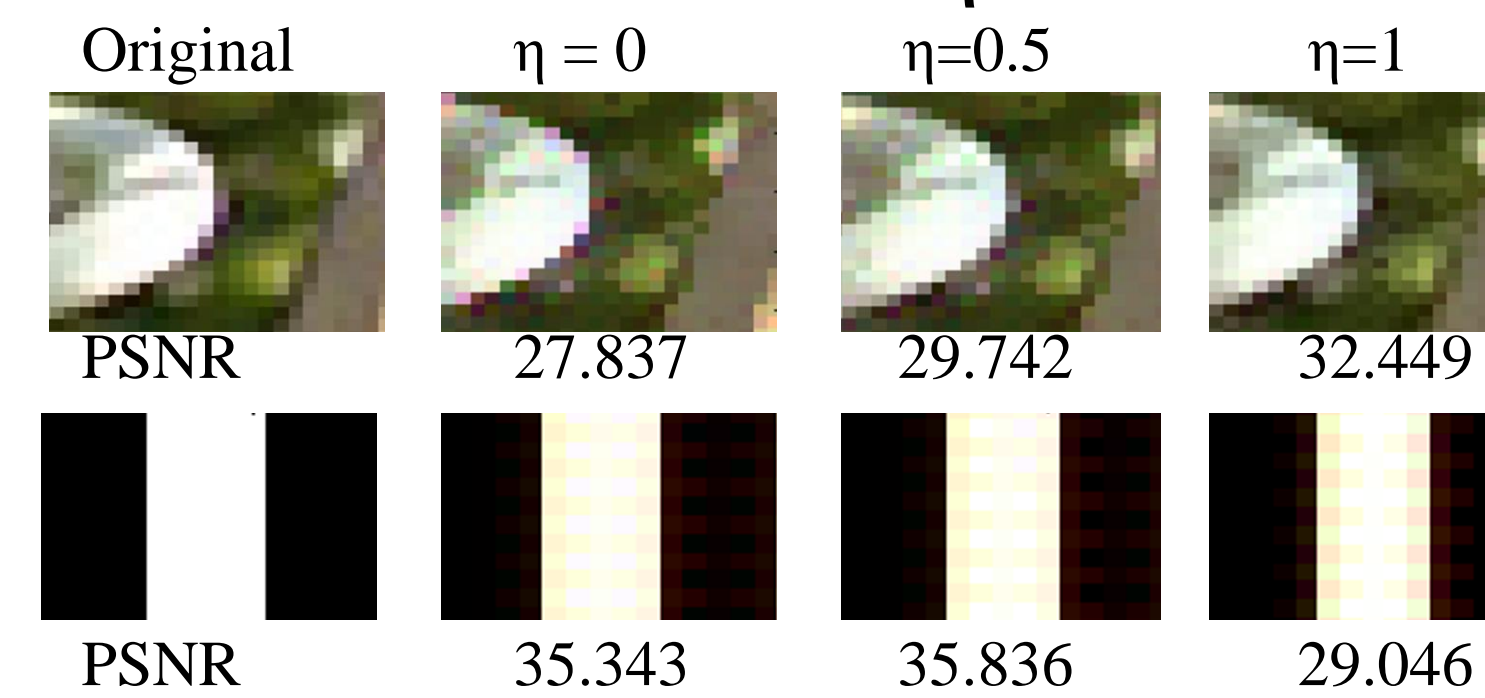
Analysis

Two Color Prior Method Failure Mode



A marked pixel in Figure (a) chooses one of the representative colors. Figure (b) shows the distance between the representative colors at each pixel. Figure (c) measures demosaicing error.

The Effect of η



Proposed Adjustments

The Dynamic η Adjustment

This adjustment assumes that a certain level of linear combination suppression along edges can lead to better performance.

The value of η will be set to a lower value when the algorithm detects that the pixel being processed is on a strong edge. The Sobel method is used to detect edges.

The Post-Combination Correction Adjustment

This adjustment assumes that the color of an edge pixel is much closer to one of the representative colors than to the other. If a pixel meets an "edges pixel profile", the adjustment will apply a correction that tries to compensate for the linear combination error at the pixel.

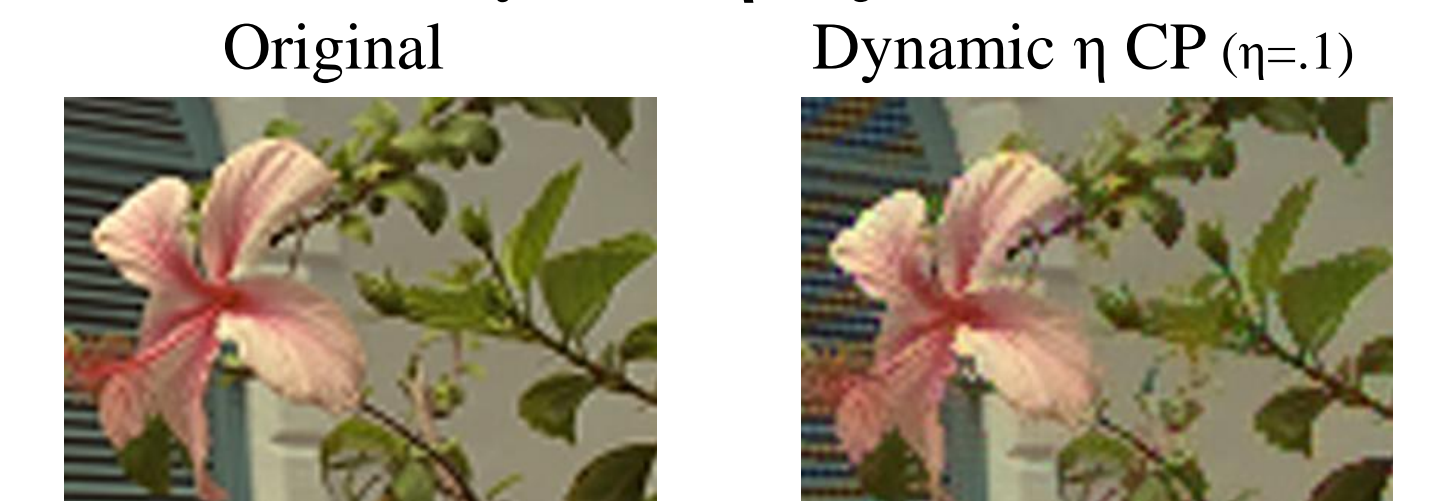
$$\theta = \frac{P(\alpha^*) - P(M)}{P(\alpha^*)}$$

$$\zeta = \frac{MEAN - P(N)}{MEAN}$$

$$MEAN = \frac{P(\alpha^*) + P(M)}{2}$$

Results

The Dynamic η Adjustment

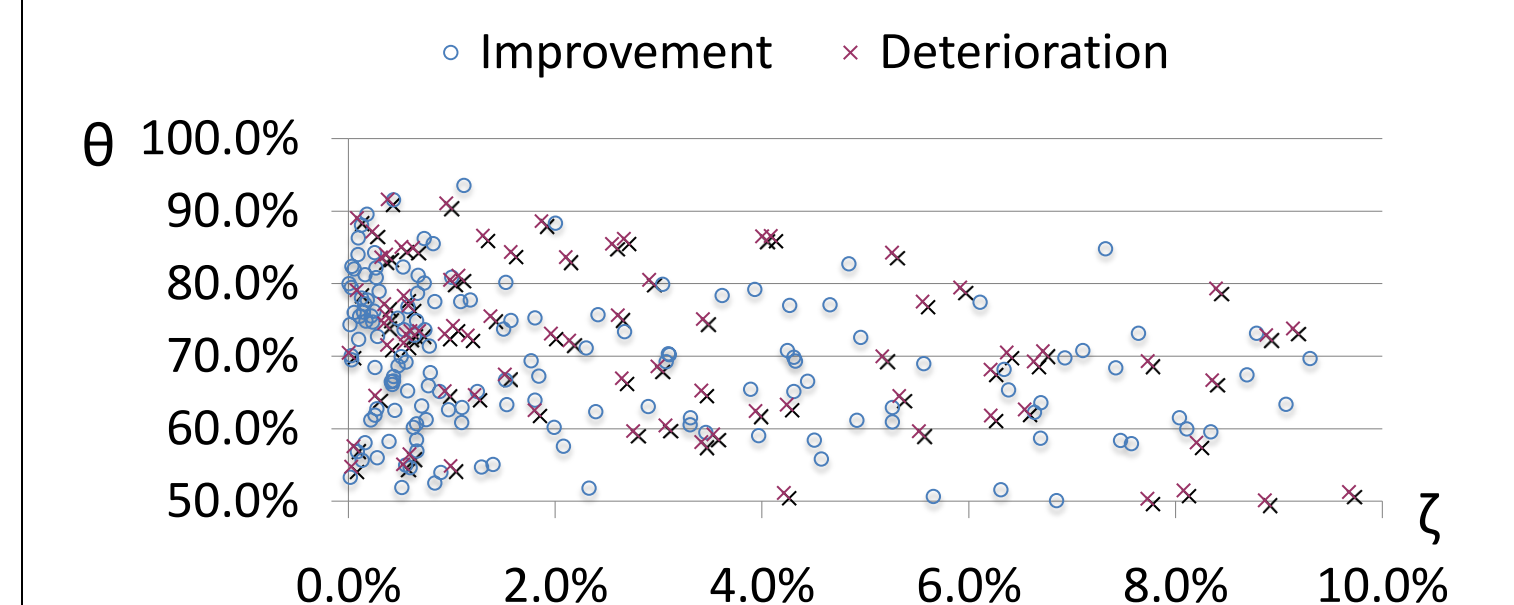
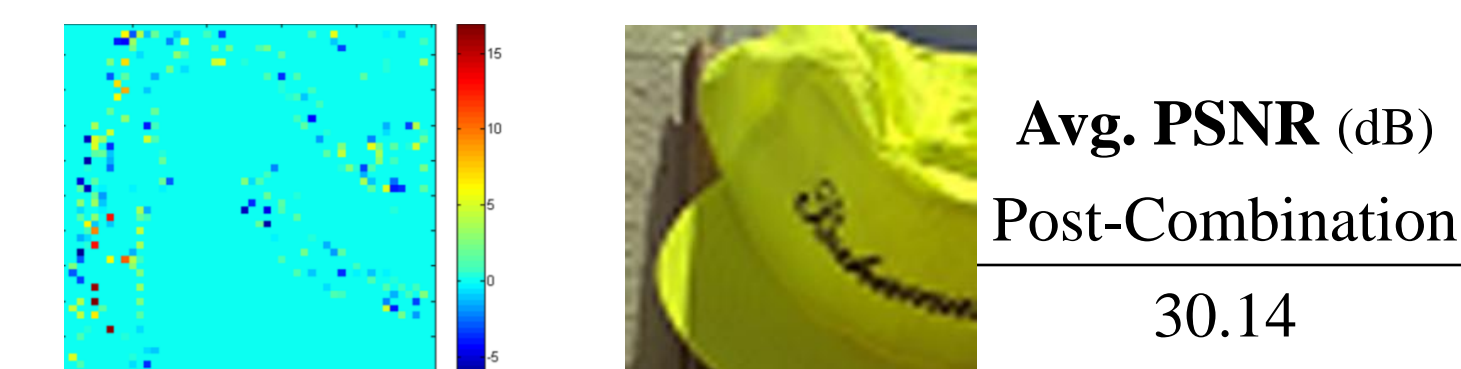


Avg. PSNR (dB)

CP	Dynamic η CP
30.19	29.92

Edges are oversharpened.

The Post-Combination Correction Adjustment



Conclusions

The dynamic η adjustment improves the two color prior method on some artificial images with strong edges, but does not provide improvement to real world images, because even their strongest edges are gradients. The setting appears to give the best performance.

The post-combination correction adjustment achieved a modest improvement to the two color prior model in experiments, but further work is required to confirm the statistical significance of the improvement.

References

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