

Applications of Flash / No-Flash Image Pairs in Mobile Phone Photography

Xi Luo

Department of Electrical Engineering, Stanford University

EE367

Winter '16

Motivation

Rapid advances in semiconductor technology significantly improves mobile phone imaging sensor capability and hardware processing resources, however image quality is still limited under low lighting environment.



Photo from cell phone

This project utilizes the integrated flash to capture the flash and no-flash image pair and reconstruct the original image through denoising and white balancing. [1][2][3] Additional processing techniques will also be explored that could help users to manipulate images for intended effects.[4]



Photo from Canon 550D

Technique

Denoising and Image Reconstruction

- Joint bilateral filter, utilize edge-stopping function from the Flash image.
- Combine detail layer from Flash image

White Balancing

- Estimate the albedo by taking mean value from each pixel from the entire image.

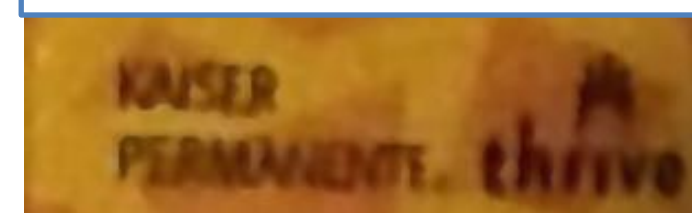
Dynamic Edge Preservation Filtering for Special Effects

- Create mask layer with per pixel intensity gradient which weight the filter parameters for each pixel.

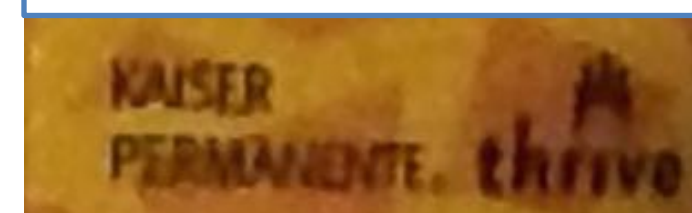
Experimental Results

Denoised and Combined Image

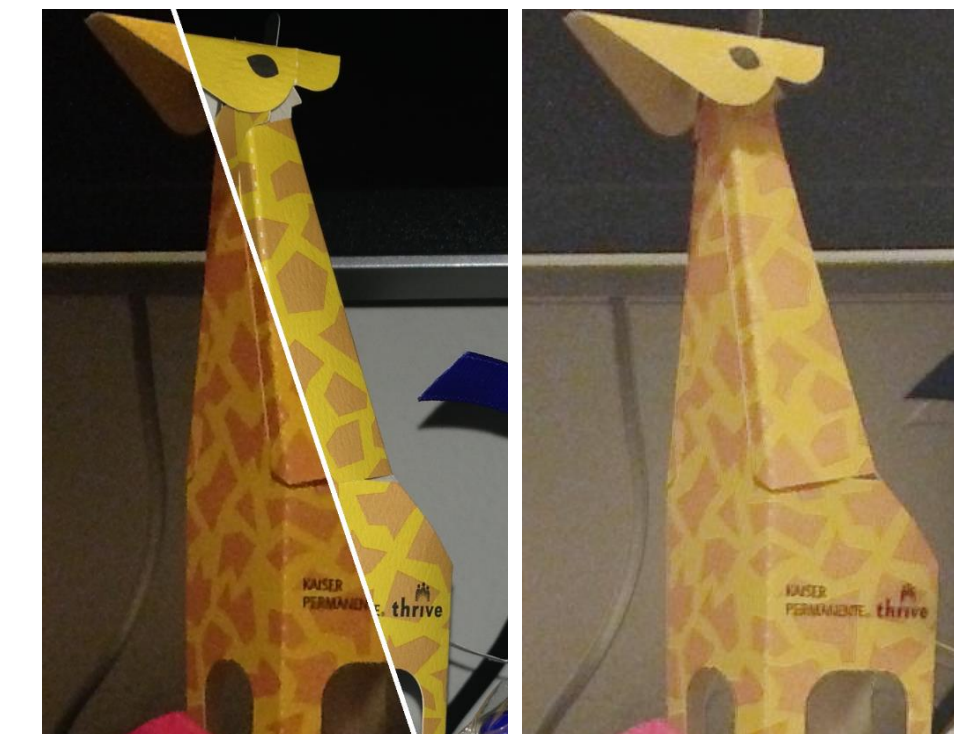
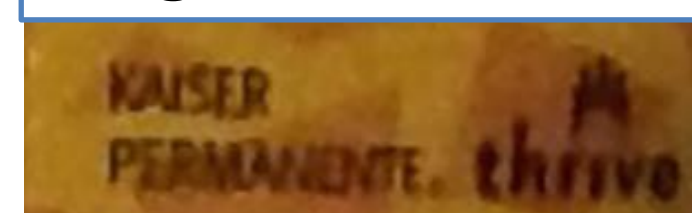
Bilateral Filtered



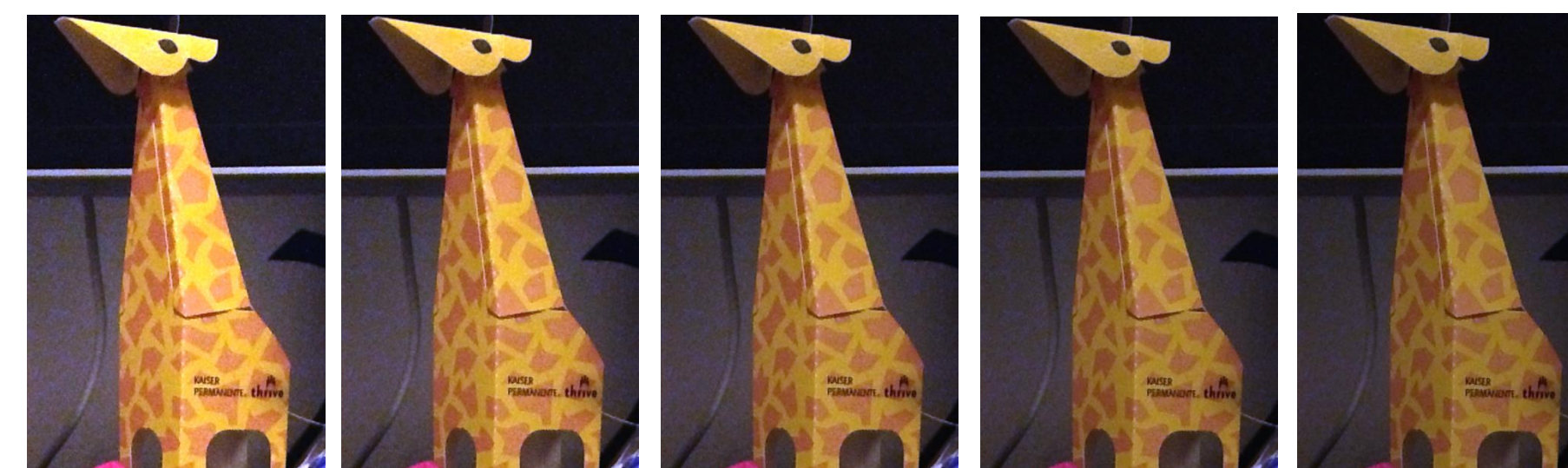
Joint Bilateral Filtered



Original No-Flash Image



White Balancing



White balance can be tuned, such a lookup table for light sources for most pleasing image.

Final image retained high frequency information as expected but the misalignment between the image pair can cause an misalignment between the detail layer and the base image layer.

Dynamic Edge Preservation Filtering

Original



Special Effect



Related Work

The denoising and white balancing techniques were a re-implementation guided by Petschnigg *et al.* [1] and where the original work used a more powerful digital camera.

[1] G. Petschnigg, M. Agrawala, H. Hoppe, R. Szeliski, M. Cohen, and K. Toyama, 2004. Digital Photography with Flash and No-Flash Image Pairs. ACM SIGGRAPH

[2] J. M. Dicarolo, F. Xiao, and B. A. Wandell, 2001. Illuminating Illumination. Ninth Color Imaging Conference, pp. 27-34.

[3] A. Shashua and T. Riklin-Raviv, 2001. The quotient image: class based re-rendering and recognition with varying illuminations. IEEE Transactions on Pattern Analysis and Machine Intelligence, 23(2), pp. 129-139.

[4] F. Durand and J. Dorsey, 2002. Fast bilateral filtering for the display of high-dynamic-range images. ACM Transactions on Graphics, 21(3), pp. 257-266.