EE367 Revised Project Proposal: Glare Reduction in Light Field Photographs

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1 Motivation

Glare in photographs is typically caused by multiple reflections in both the camera body and in camera lenses. Typically, glare reduces the overall contrast in an image thereby reducing overall image quality and the ability to make out objects in a scene. There are numerous techniques for reducing glare in images, both with standard photographs taken by a conventional camera and those captured using masks or a light field camera [2, 1]. With this project, the hope is to explore that space and recreate, compare, and improve upon established methods.

2 Related Work

This topic was originally inspired by in-class lecture 8 and the paper by Raskar et al. at SIGGRAPH in 2008 [1]. While a majority of the paper is dedicated to a discussion of masks for the purposes of reducing glare using ray tracing in 4D, the benefits of a light field camera are also mentioned and some of the same techniques could be brought to bear on the problem. Additionally, traditional techniques for removing glare from 2D images, like standard deconvolution, have been explored and used in the past [2]. Glare has been characterized via numerous methods, and this characterization can help with both understanding the impact of glare on an image and removing it [3]. Numerous papers have been written on the subject of reducing glare over the years, with some of the newer work looking at alternative hardware-based solutions, though that will be beyond the scope of this project [4, 5].

3 Project Overview

The primary focus of this project will be to reduce glare in a set of photographs taken with a light-field camera (Lytro). The primary method used will be the one described in [1], though further research will be done and if there are additional or better techniques to explore, those will be considered. Deconvolution and other widely used glare-reduction techniques will also be performed on 2D versions of the light-field images for comparison. During the course of the project, if there are opportunities for increased performance or efficiency with these techniques, they will be incorporated if possible.

3.1 Test Data

As mentioned briefly above, the dataset for this project will be a set of pictures captured using a Lytro camera. These photographs will be taken in a way that exaggerates the glare effect to partially obscure the primary focus of the photograph. The source of the glare will either be the sun or a camera flash, typically in the background of the image.

4 Milestones

1. **[3 Mar (Fri)]:**
   (a) Have taken new photographs with the Lytro and imported them.
   (b) Begin implementing the algorithms on the new photographs.
2. **[6 Mar (Mon)]:**
   (a) Assess current status.
   (b) Possible discussion with advisor about feasibility and options.
3. **[12 Mar (Sun)]:**
   (a) All code completed and results computed.
   (b) Begin work on poster presentation.
4. **[15 Mar (Wed)]:** Project Poster Presentation
5. **[17 Mar (Fri)]:** Submit Project Final Report and Code NLT

References

[1] Raskar, R.; Agrawal, A.; Wilson, C.; Veeraraghavan, A, "Glare Aware Photography". *ACM SIGGRAPH 2008*

[2] REINHARD, E., WARD, G., PATTANAIK, S., AND DEBEVEC, P., 2006. *High Dynamic Range Imaging - Acquisition, Display and Image-based Lighting* . Morgan Kaufman Publishers, San Francisco, CA, 2006.

[3] Bitlis, B., Jansson, P., Allebach, J., Parametric point spread function modeling and reduction of stray light effects in digital still cameras. *Proc. SPIE 6498, Computational Imaging V*, (February 28, 2007).

[4] A. Daniel, L. Lieberman, Y. Silberberg, "Wavefront shaping for glare reduction," Optica, 3, 10, 1107 (2016). DOI: 10.1364/OPTICA.3.001104.

[5] E.H. Zhou, A. Shibukawa, J. Brake, H. Ruan, C. Yang, "Glare suppression by coherence gated negation," Optica, 3, 10, 1104 (2016). DOI: 10.1364/OPTICA.3.001107.

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[7] G. Wetzstein, I. Ihrke, W. Heidrich "On Plenoptic Multiplexing and Reconstruction", IJCV 2013