EE 367 Project Proposal
Reflection Removal in Images

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1 Motivation

When an image is taken through a window or piece of glass, there is often a reflection that obstructs the view of the desired image. These less than optimal conditions not always easily avoided. Occasionally, the photographer may need to take an image through their window or take a photo of a painting with a plane of glass protecting it. In both scenarios, the resulting image will often contain a reflection on the glass plane which obscures the quality of the actual image. The image will be composed of the desired scene combined with the unwanted reflection on the glass. Polarized lenses are sometimes used to mitigate this effect, but such equipment is not always readily available to the user, and it is useful to be able to use computational techniques to eliminate, or at least mitigate, the effects caused by reflections. This project will seek to explore different methods to mitigate the artifacts caused by image reflections and demonstrate their effectiveness.

2 Related Work

A paper by Tianfan Xue attempts to remove both reflections and small obstructions by taking advantage of motion parallax. In their setup, they make the assumption that both the scene and the obstruction are static and that the obstruction is much closer to the viewer than the scene is. The removal of reflections/obstructions is accomplished by first taking a series of shifted photos of the same scene. The difference in motion between the scene and the obstruction is then used to separate the two layers. Information from the other images is then used to fill in information lost by removing the obstruction. Therefore given a sequence of photos, the algorithm attempts to estimate the actual scene I_B along with the obstruction image I_O. This paper utilizes convex optimization in order to minimize the objective function. An alternating gradient descent method is utilized in order to fix the motion field of the camera in order to

solve for I_B, I_O, and A, where A is the alpha-blending mask to implement on the initial image. First, I_B, I_O, and A are estimated while keeping the motion fields V_O and V_B constant. With the resulting I_B, I_O, and A, you solve for the new motion fields V_O and V_B. You repeat this process multiple times in order to get the proper I_B scene. [4].

3 Project Overview

For this project, I will be evaluating various methods on mitigating these artifacts caused by reflections. I will first be examining the method implemented by Xue, but there are a many other algorithms/methods that attempt to accomplish the same task [1] [2] [3]. After further research into many of these algorithms, I will then attempt to implement one of these algorithms in Matlab and evaluate its effectiveness at removing reflections in different types of conditions.

4 Milestone, timeline, and goals

2/8 - 2/18: I will first spend the first 1.5 weeks researching various methods of removing reflections in an image and select out the top 3 algorithms.

2/18 - 2/30: I will spend 1.5 weeks reviewing some of the basic convex optimization algorithms

2/30 - 3/14: I will then spend the last two weeks implementing one of the algorithms listed and evaluate its performance on different images.

References

[1] Xiaojie Guo, Xiaochun Cao, and Yi Ma. Robust separation of reflection from multiple images. In *Computer Vision and Pattern Recognition (CVPR), 2014 IEEE Conference on*, pages 2195–2202, June 2014.

[2] YiChang Shih, D. Krishnan, F. Durand, and W.T. Freeman. Reflection removal using ghosting cues. In *Computer Vision and Pattern Recognition (CVPR), 2015 IEEE Conference on*, pages 3193–3201, June 2015.

[3] Sudipta N. Sinha, Johannes Kopf, Michael Goesele, Daniel Scharstein, and Richard Szeliski. Image-based rendering for scenes with reflections. In *ACM Trans. Graph. (August 2012)*. ACM SIGGRAPH, August 2012.

[4] Tianfan Xue, Michael Rubinstein, Ce Liu, and William T. Freeman. A computational approach for obstruction-free photography. *ACM Trans. Graph.*, 34(4):79:1–79:11, July 2015.