CS 583: INTRODUCTION TO COMPUTER VISION

FALL 2013

PROJECT 3: PHOTOMETRIC STEREO

In this project, I had to implement photometric stereo which is a method to recover the 3D geometry of an object from multiple images taken under varying illumination. The program first computes light directions and then, for each pixel, estimate surface normals and recover depth information from the surface normals. For this project, I was supplied with test images and a sample solution executable that I can use to compare with my program.

The requirements of the assignment are:

1. Estimate the light source direction for each image from the chrome sphere images.
2. Compute the surface normals.
3. Compute albedos.
4. Estimate depth from surface normals.
5. Relight the object.

There are two parts for this program. One is the PhotometricStereo.pde which does the main testing and output for the project development and the other is Relight.pde which helps me to visualize my results.

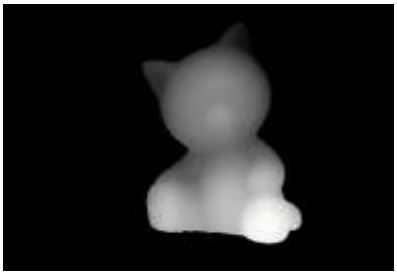
IMAGE 1: BUDDHA

RELIT BUDDHA

NORMAL ALBEDO DEPTH

IMAGE 2: CAT

RELIT CAT



NORMAL ALBEDO DEPTH

IMAGE 3: GRAY SPHERE

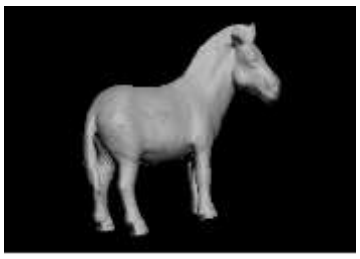


RELIT GRAY SPHERE

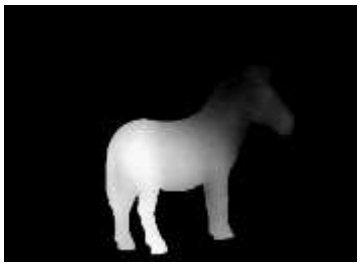


NORMAL ALBEDO DEPTH

IMAGE 4: HORSE



RELIT HORSE

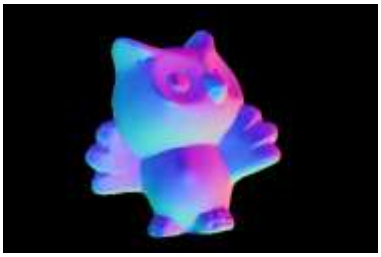


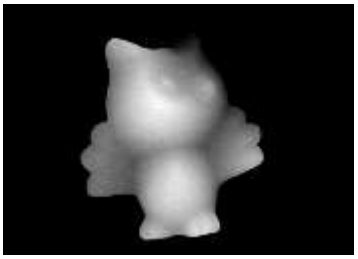


NORMAL ALBEDO DEPTH

IMAGE 5: OWL

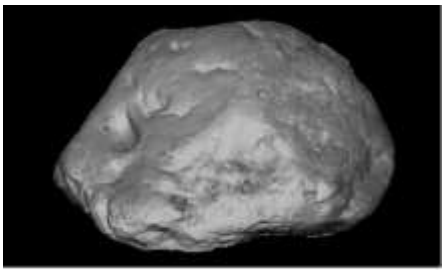
RELIT OWL



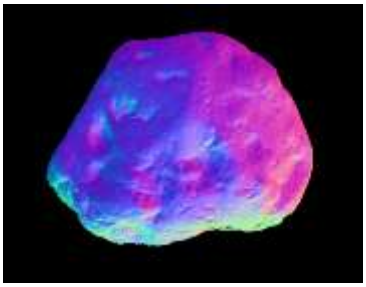


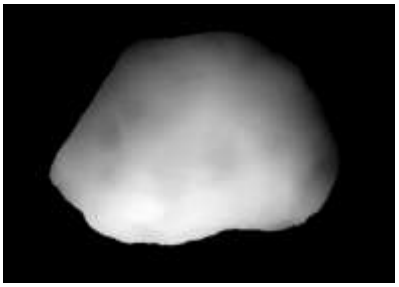
NORMAL ALBEDO DEPTH

IMAGE 6: ROCK



RELIT ROCK





NORMAL ALBEDO DEPTH

This project was interesting towards the end, especially after I figured how the output would be like. The mouse pointer works like a torch, wherever the mouse pointer moved, the light was shown on the opposite direction. It was amazing!

There were a lot of problems which I faced.

First of all the sample executable did not work in my computer for some reason which I do not know still. I am just getting a blank screen. The major problem was while finding the pseudo inverse, I was getting the matrix singular exception. I had to use the try and catch technique.

The brightness() method did not produce the correct light source directions. I had to normalize the red, green and blue values of the color. I am not able to see the output from the photometric stereo.pde.

In relight.pde, to find out that there was a normalization(norm.TwoRobust) in the matrix toolkit documentation took a lot of time. Only after using that I was able to get a proper result. It would have been a lot simpler if it was specified in the code.

Also to find the brightness I had to multiply the dotproduct of surfacenormal and lightdirection by 255 as they are unit vectors! I took a lot of time figuring out what the error must be!

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