Homework 4

Guixiang Zhang

Describe:

Using the algorithm given by professor in the lecture, my code can construct the illumination cone of my object.

1. I took 5 photos of an up-side-down bowl in a dark room. The only light source is the smart phone's flashlight.

2. Load the images, change them to grayscale and create the sample images matrix T.

3. Get the SVD of the matrix T*T'. Thus, in my opinion, B = T' * V is the approximation.
   Because, the s is composed of the magnitude matrix Sc and the direction vector of the light source s. So, T' = B * (Sc*s), where T' is N×5, B is N×3, Sc is 3×3 and s is 3×5.
   B is the product of the albedo and normal. T*T'=s' * (Sc'*B'*B*Sc) * s.
   If we do SVD of T*T'=VDV' in this equation V is 5×5 and the norm of each row equals 1. We need to choose the first 3 largest singular value and their corresponding matrix V. We can approximate s'=V which is 5×3.
   This time the norm of each row of V does not equal 1 but we need V'*V = s*s' = 1,
   B * Sc=T' * V.
   I think the D^(-0.5) in the algorithm given by professor may be another kind of approximation, but I don't fully understand.
4. Another approximation, we can use any other s whose norm equals 1, to get synthetic images.

5. I think it is better to display all the images in a video. So, I make a video of all the images.

Note: In my code, the theta is the angle between Z axis and the direction of illumination vector S in the illumination sphere. And the angle phi is between the X axis and the projection of S in XY plane. Because it is a sphere in 3D, theta is from 0 to π and phi is from 0 to 2π. These notations are a little different from the professor's in the lecture. But it makes sense and is easy for me to understand.

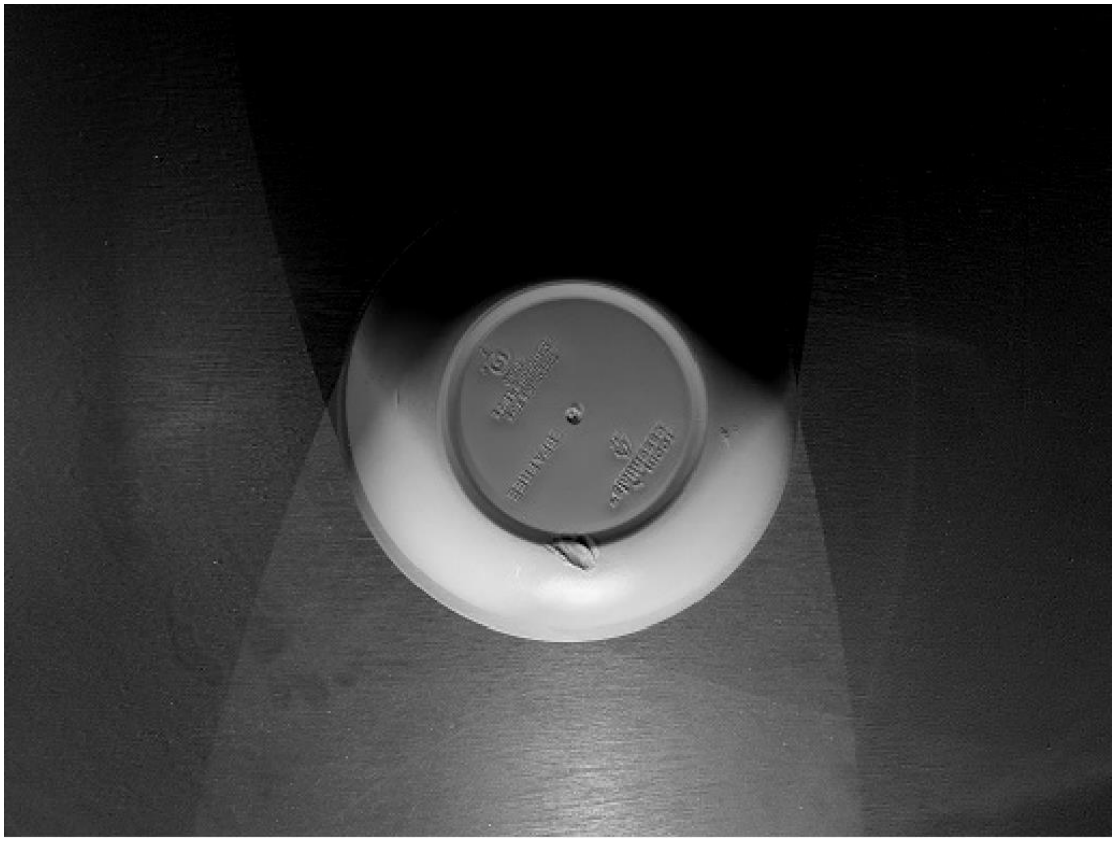
Here are the 5 samples:





Here are two synthetic images picked up from the video.

Theta=0.4 phi=1.4



Theta=0.9 phi=1.1