COMP70058 Computer Vision

Tutorial 6 - Photometric Stereo

1. The light intensity reflected from a point on a perfectly Lambertian object is given by:

$$R(p,q) = \rho(n \cdot s)/(\|n\|\|s\|)$$

Where $n = (p, q, -1)$ is the outward surface normal vector ($p = dz/dx$ and $q = dz/dy$), s is the vector from the point on the object to the light source, and ρ is a constant called the albedo.

In an experiment three distant light sources are used to illuminate a Lambertian object in an otherwise darkened room. They have directions:

$$s_0 = (0, -1, 0)$$
$$s_1 = (1, 0, 0)$$
$$s_2 = (0, 0, 1)$$

At a particular pixel (x_i, y_i), the measured intensities from these three light sources are 65 from s_0, 52 from s_1, and 26 from s_2. Calculate the normal vector of the object at that point.

2. We have some objects with non-Lambertian reflectance and we do not know the light source locations.

We do have a reference object with known geometry (e.g. a sphere) that has the same material reflectance properties of the test objects. You can take multiple images of the objects and reference object from the same viewpoint and with the same set of illuminants.

Outline how you would solve this variation of the photometric stereo problem to find the surface shape of the test objects.