3D Computer Vision Project3

Bodong Zhang

Practical Problems

Introduction:

In practical Problems, the main goal is that we derive the normal vector of surface and then get the depth of each location in image by integration of gradient. The resources that we have are images taken at the same place with different light vector, the vectors are also given. The assumption is that the surface is Lambertian surface, so the surface reflects light equally to all directions. But the albedo is not always the same, which means that some parts of surface reflect light strongly while others do not.

Algorithm:

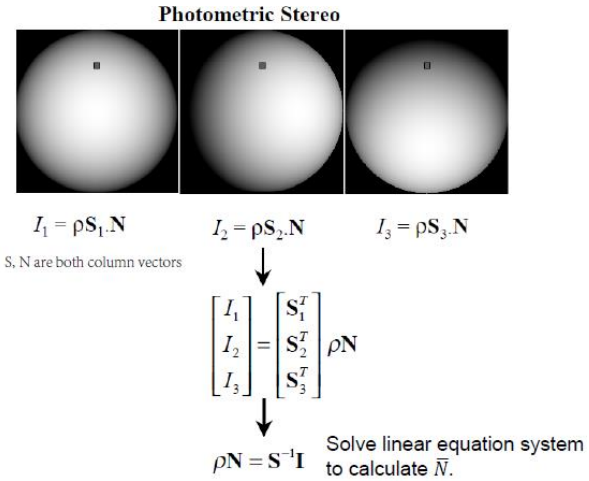
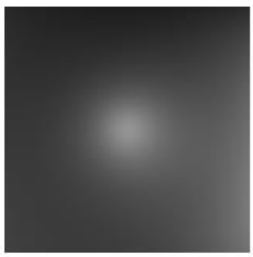


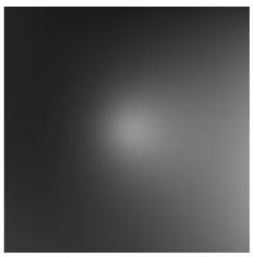
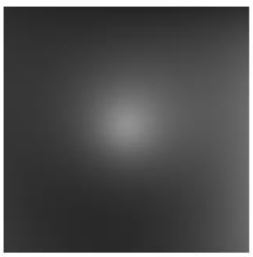
Figure 1 algorithm of calculation

Figure 1 shows that for Lambertian surface, the intensity of light is only dependent with BRDF and the angle between normal vector and light vector. There are three variables in pN, so we could use three images with different vectors of light to get N.

2.1 Shape from shading

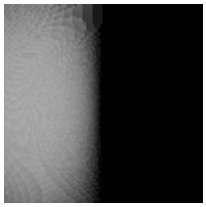
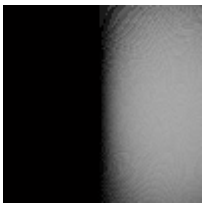
First we have three images of same object under different light sources.



im1.png $\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ im2.png $\begin{bmatrix} 0.2 \\ 0 \\ 1 \end{bmatrix}$ im3.png $\begin{bmatrix} -0.2 \\ 0 \\ 1 \end{bmatrix}$ im4.png $\begin{bmatrix} 0 \\ 0.2 \\ 1 \end{bmatrix}$

We choose image 1,2 and 4 for this task. And use format $pN=S^{-1}I$ to calculate.
Then the coordinates of normal are provided below.

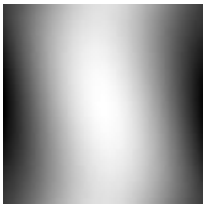




Nx Ny Nz

There are large black areas which means that those data are negative.

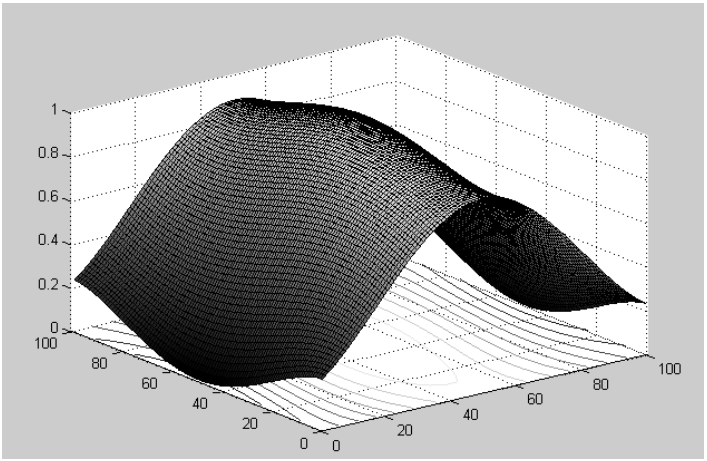
Albedo map

We can see the albedo is different in different areas.
(1)The depth map is shown below.



Depth show by intensity

(2)3D graph

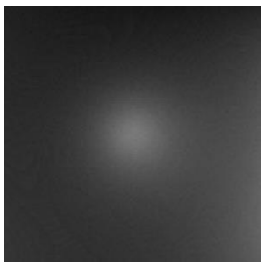


3D graph

We can see that the above two images are rational and have same structure.

(3)another image if

light vector is (0.5 0.5 1)

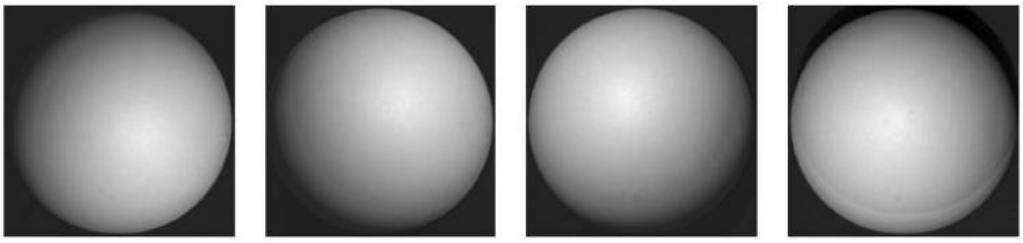


(0.5 0.5 1)

2.2 Shape from shading from real images

First we have three images of same object under different light sources.

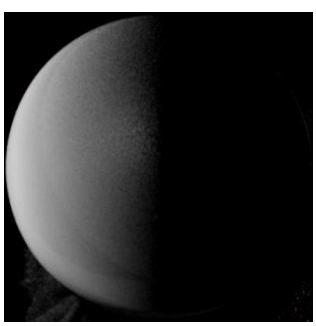
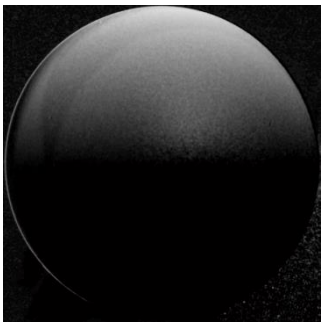
Sphere Images:



real1.bmp	real2.bmp	real3.bmp	real4.bmp
$\begin{bmatrix} -0.38359 \\ -0.236647 \\ 0.892668 \end{bmatrix}$	$\begin{bmatrix} -0.372825 \\ 0.303914 \\ 0.87672 \end{bmatrix}$	$\begin{bmatrix} 0.250814 \\ 0.34752 \\ 0.903505 \end{bmatrix}$	$\begin{bmatrix} 0.203844 \\ -0.096308 \\ 0.974255 \end{bmatrix}$

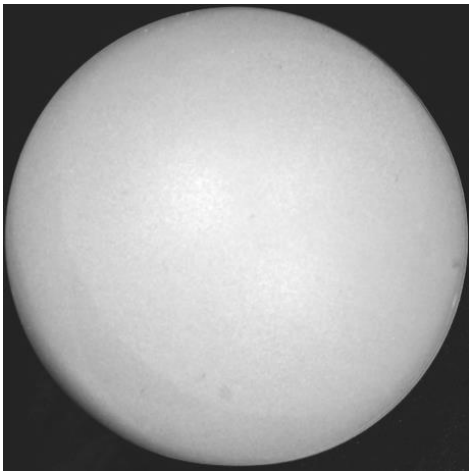
We choose image 1,2 and 3 for this task. And use format $pN=S^{-1}I$ to calculate.

Then the coordinates of normal are provided below.


Nx Ny Nz

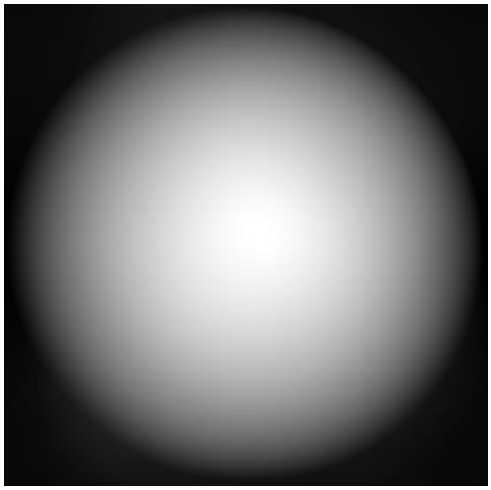
There are large black areas which means that those data are negative.



Albedo map

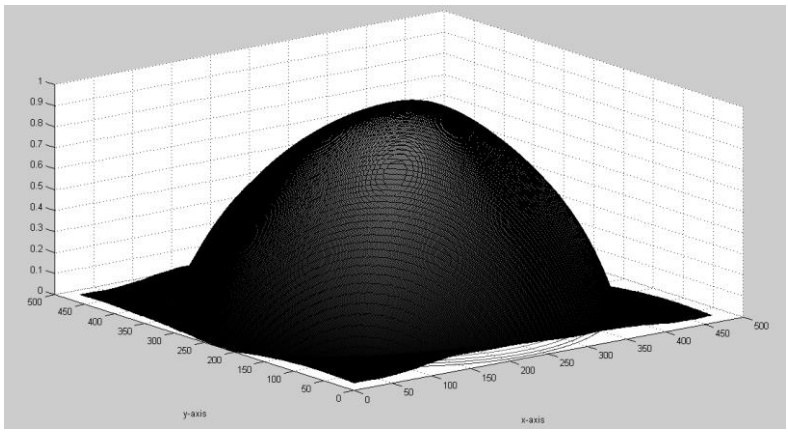
We can see the albedo is different in different areas but much similar.

(1)The depth map is shown below.



Depth show by intensity

(2)3D graph

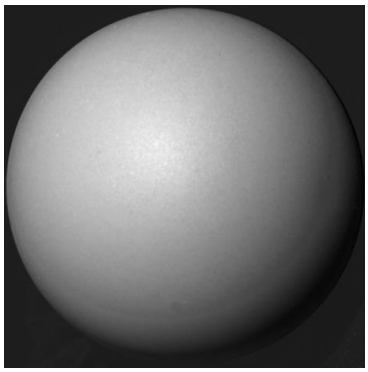


3D graph

We can see that the above two images are rational and have same structure.

(3)another image if

light vector is (0.5 0.5 1)

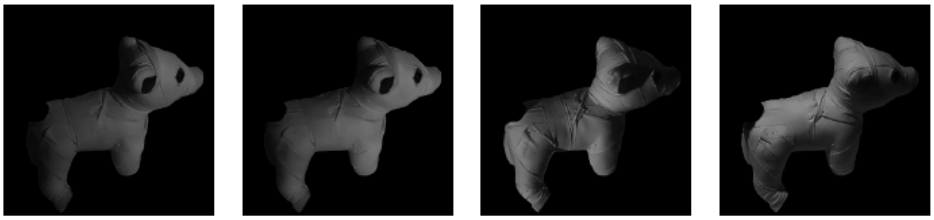


(0.5 0.5 1)

2.3 Shape from shading from real images

First we have three images of same object under different light sources.

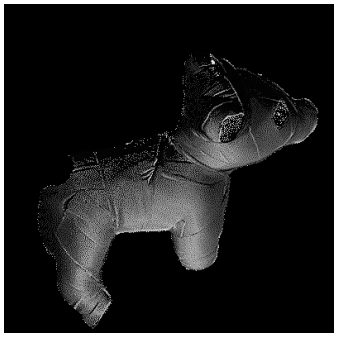
Dog Images:



dog1.tif $\begin{bmatrix}16\\19\\30\end{bmatrix}$ dog2.tif $\begin{bmatrix}13\\16\\30\end{bmatrix}$ dog3.tif $\begin{bmatrix}-17\\10.5\\26.5\end{bmatrix}$ dog4.tif $\begin{bmatrix}-9\\25\\4\end{bmatrix}$

We choose image 1,2 and 3 for this task. And use format $pN=S^{-1}I$ to calculate.

Then the coordinates of normal are provided below.


Nx Ny Nz

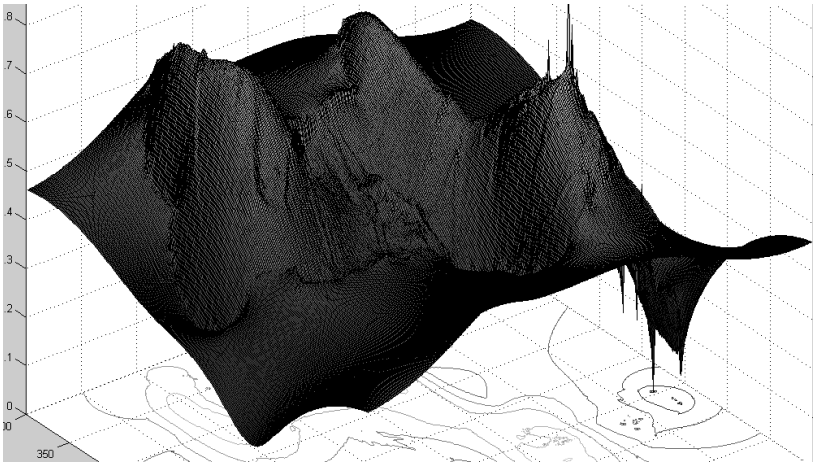
Albedo map

We can see the albedo is different in different areas but much similar.

(1)The depth map is shown below.

Depth show by intensity

(2)3D graph



3D graph

We can see that the above two images are rational and have same structure.

(3)another image if

light vector is (0.5 0.5 1)

(0.5 0.5 1)

Conclusion:

From this homework, we can experience the wonderful magic of light, maybe a satellite could use this method for topography. The satellite could take different pictures of same object at same location while at different time of a day. So the direction of sun is different. Thus the altitude will be derived.