COS429 HW3: Photometric Stereo

Due: 11:59pm, Thursday, October 18, 2007

This is a Matlab programming assignment. You are asked to implement photometric stereo, including:

(a) the recovery of the G field,

(b) the recovery of the albedo and normal field,

(c) the integration of the normal field to recover the surface.

The data include five images of the same scene under illumination from different angles, available at

http://www.cs.princeton.edu/courses/archive/fall07/cos429/hw/hw3data

Ignore the linear constraints corresponding to images where a point is in shadow. Do not worry about integrability.

Write a function *[G, albedo, normal, surface] = pstereo( ).* *G* and *normal* are H*W*3 matrices; *albedo* and *surface* are H*W matrices, where H and W are the image height and width. Assume all the images are in your working directory.

Visualize the albedo field, the normal field and the surface. For the normal field, you may either display it as a color image with (x,y,z) as the r,g,b components, or draw it in 3D as vectors. Some relevant visualization functions are *quiver3, mesh* and *surf* . Also you might want to check out the 3D visualization section of the Matlab help document.

The vectors V_i corresponding to the five images are

V1=[0,0,1];
V2=[0.5774,0.5774,0.5774];
V3=[0.5774,-0.5774,0.5774];
V4=[-0.5774,0.5774,0.5774];
V5=[-0.5774,-0.5774,0.5774];

where the x y z coordinates are set up so that x=r-1 and y=c-1, where r is the row number and y is the column number, so x goes from 0 to 511 with zero at the top of the image and 511 at the bottom, and y goes from 0 to 511 with y=0 at the left border of the image and 511 at its right border. The z coordinate is the height above the image plane.

Submission: please submit the following items to moodle (http://moodle.cs.princeton.edu) :

1. Images showing the albedo field, the normal field and the surface.

2. Matlab code

    a. pstereo.m

    b. (if any) other source files needed by pstereo.m, i.e. subroutines called by *pstereo*. (You don't need to turn in your visualization code.)