Robotic Vision - Assignment 1

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Q 1) a)

Matlab code:

% Asgn 1 - Question(1)

% Author:Raghavendra Sriram

% Date : 09/16/2013

clc;

clear all; % Clear and close command window, variables, figures

close all;

imtool close all;

f = 1; %Focal length = 10mm = 1 cm

D = 9; %Depth = 9cm

Ku = 1; %intrinsic parameter

Kv = Ku; %Initialize the parameters (cm)

U0 = 0;

V0 = U0;

K = [f\*Ku 0 U0;0 f\*Kv V0;0 0 1];% defining the intrinsic camera calibration matrix

xL = input('Projection - left camera(xL) in cm:');%user input for projection from left pinhole camera

xR = input('Projection - right camera(xR) in cm:');%user input for projection from left pinhole camera

f\_2Dstereo(xL,xR,f,D,Ku); %Calling function to calculate depth of plot

Xc = 9;

Yc = 0;

Zc = 100;

C\_X = [Xc;Yc;Zc]; %defining the location of image

figure(1);

xlabel('x');

ylabel('y');

zlabel('z');

title('Projection of imagine on a stereo camera');

axis equal;

axis([-1 10 -1 120 -1 10]);

view(48,42);

figure(2);

title('Image Plane');

grid on; hold on;

% Placement of Camera and plot of points

figure(1);

hold on;

w\_x = rotox(-pi/2)\*C\_X;

plot3(w\_x(1), w\_x(2), w\_x(3), 'r+');

%% Left Camera position parameters

R = eye(3);

t = [0,0,0]';

H = f\_Rt2H(R,t);

scale = 1/2;

f\_3Dframe(H,'b',scale\*3,'\_');

f\_3Dcamera(H,'b',scale/2);

%% Perspective Projection for Left Camera

u\_l = f\_perspproj(w\_x,H,K,2);

figure(2);

hold on;

plot(u\_l(1), u\_l(2), 'O');

%% Right Camera position parameters

figure(1);

hold on;

t = [Xc,0,0]';

H = f\_Rt2H(R,t);

scale = 1/2;

f\_3Dframe(H,'b',scale\*3,'\_');

f\_3Dcamera(H,'b',scale/2);

%% Perspective Projection for Right Camera

U\_R = f\_perspproj(w\_x,H,K,2);

figure(2);

hold on;

plot(U\_R(1), U\_R(2), 'rO');

% The following MATLAB code simulates a stereo pair camera using functions from the Epipolar Geometry Toolbox provided.

% It displays the pixel projection on the image planes for the left & right cameras. The function f\_2Dstereo which is

% present in the toolbox is called by the main program to calculate the

% depth of the 3D point.

Result :

Projection - left camera(xL) in cm:0

Projection - right camera(xR) in cm:-0.09

Depth = 1.000000



Q 2) a)

Matab Code:

% Asgn 1 - Question(2)

% Author: Raghavendra Sriram

% Date : 09/15/2013

%% Clear command window, all previous variables and close all figures

clc;

clear all;

close all;

imtool close all;

Yc = 0.3;

%% Obtain image

[fn,pn] = uigetfile('\*.jpg','Select the image file');

loc = strcat(pn,fn);

image = importdata(loc);

%% optical center co-ordinates ( hint : draw parallel lines on all lines in

%% image with as much accuracy as

%% possible and point of intersection

%% is best possible result of optical

%% center )

figure(1);

imshow(image);

disp('Select the optical center \n');

[u0,v0] = ginput(1);

fprintf('Selected Optical Center co-ordinates: [ %f , %f ] \n ',u0,v0);

%% Convert and display the co-ordinates from pixels to meters

u0 = u0 \* 4.4\*10^(-6);

v0 = v0 \* 4.4\*10^(-6);

fprintf('Selected Optical Center co-ordinates(meters): [ %f , %f ] \n',u0,v0);

%% User selects the point P

disp('Select the point P which is the base of the pedestrian ');

[x\_p,y\_p] = ginput(1);

fprintf('P co-ordinates(pixels): [ %f , %f ] \n',x\_p,y\_p);

%% Convert and display the co-ordinates from pixels to meters

x\_p = x\_p \* 4.4\*10^(-6);

y\_p = y\_p \* 4.4\*10^(-6);

fprintf('Point P co-ordinates(meters): [ %f , %f ] \n',x\_p,y\_p);

%% Calculate the distance between the camera and point P

distance = sqrt((x\_p-u0)^2 + (y\_p-v0)^2);

%%

f\_kv = 1039\*4.4\*10^(-6);%% Calculate & display D of point P in the image in meters

D = abs(f\_kv\*Yc/(y\_p-v0));

fprintf('Depth of selected point is : %f meters \n',D);

% The above MATLAB code calculates the distance of any point from the

% optical center of the camera and displays the distance in "meters".

% The image selected in obtained by the code and the user defines the

% optical center and the desired Point on the image.

% The Y-component, i.e. height of the camera from the ground, pixel value

% of the focal length and the pixel size are known parameters.

Result :

Warning: Image is too big to fit on screen; displaying at 67%

> In imuitools\private\initSize at 73

In imshow at 262

In Question2 at 22

Select the optical center \n

Selected Optical Center co-ordinates: [ 584.500000 , 361.250000 ]

Selected Optical Center co-ordinates(meters): [ 0.002572 , 0.001590 ]

Select the point P which is the base of the pedestrian

P co-ordinates(pixels): [ 700.000000 , 371.750000 ]

Point P co-ordinates(meters): [ 0.003080 , 0.001636 ]

Depth of selected point is : 29.685714 meters.

Images: (Parallel lines Drawn in order to obtain best possible location of optical center of image. )



Q2) b)

Matlab Code :

function f\_2Dstereo(xL,xR,f,d,ku)

% This MATLAB function calculates the depth of the 3D point.

% xL = Left camera horizontal Projection

% xR = Right camera horizontal Projection

% f = Focal length in cm

% d = baseline distance

% Z = Depth (div by 100 to convert to mts

Z = d\*f\*ku/(xL-xR);

fprintf('Depth = %f m',Z/100);

end