Homework 4
CSE 527
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1.

a)

f = 8mm

$\alpha = f*u_x = 8*800/4 = 1600$

$\beta = f*u_y = 8*600/3 = 1600$

$u_0 = 400$, $v_0 = 300$

Intrinsic Matrix = $\begin{matrix} 1600 & 0 & 400 \\ 0 & 1600 & 300 \\ 0 & 0 & 1 \end{matrix}$

b)

Quaternion = $\cos\left(\frac{\theta}{2}\right) + \left(u_x i + u_y j + u_z k\right)\sin(\frac{\theta}{2})$

= 0.8660 + 1.5i + 2j + 0.5k

4x4 rotation matrix was calculated using *makehgtform* with option as '*axisrotate'*

0.6731	0.4006	0.6217	0
0.0609	0.8077	-0.5864	0
-0.7371	0.4326	0.5192	10
0	0	0	1

c)

Cube Coordinates:

[1 1 1 1; 1 1 -1 1; 1 -1 1 1; 1 -1 -1 1; -1 1 1 1; -1 1 -1 1; -1 -1 1 1; -1 -1 -1 1]

Pixel Coordinates = Intrinsic Matrix*Identity(3x4)*Rotation Matrix*Cube Coordinates'

Pixel Coordinates in homogenous form:

665.5544	478.8140	553.0149	332.7728	447.8003	265.6745	333.1815	122.7884
344.1983	553.7085	71.8462	269.1368	321.9445	500.2867	84.9062	253.8615
1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Cube plot location: 1/cube.jpg

d)

Inf PointX = [2^100 1 1 1]

PixelCoordinate in homogenous form:

1.0e+03 *

-1.0611

0.1677

0.0010

Inf PointY = [1 2^100 1 1]

PixelCoordinate in homogenous form:

1.0e+03 *

1.8817

3.2873

0.0010

Inf PointZ = [1 1 2^100 1]

PixelCoordinate in homogenous form:

1.0e+03 *

2.3157

-1.5071

0.0010

Inf PointXYZ = [2^100 2^100 2^100 1]

PixelCoordinate in homogenous form:

1.0e+04 *

1.3030

0.2402

0.0001

2.

a)

a) Perspective Camera Model:

$$\text{Intrinsic Matrix} = \begin{matrix} \alpha & s & u_0 \\ 0 & \beta & v_0 \\ 0 & 0 & 1 \end{matrix}$$

$$\text{Extrinsic Matrix} = \begin{matrix} r_{11} & r_{12} & r_{13} & t_x \\ r_{21} & r_{22} & r_{23} & t_y \\ r_{31} & r_{32} & r_{33} & t_z \end{matrix}$$

b) Projective Camera Model: A 3X4 Matrix as a result of Intrinsic X Extrinsic

$$\begin{matrix} a & b & c & d \\ e & f & g & h \\ i & j & k & l \end{matrix}$$

In the given problem, Light is travelling in 1 dimension. So we can set Y and Z to 0. (Assuming light is travelling in X direction). Now the Projective matrix is 3x2.

$$\begin{matrix} a & b \\ c & d \\ e & f \end{matrix}$$

b) There are 5 degrees of freedom.

c)

C = Calibration parameters

[100 140 200; 250 340 450; 1 1 1] = C*[50 100 200; 1 1 1]

C = 0.6571 70.0000

1.3000 195.0000

0.0000 1.0000

d)

(130, 310)

pinv(C)*[130; 310; 1] = [98.2551; 0.9347]

height = 105.1194 mm

(170, 380)

pinv(C)*[170; 380; 1] = [176.2970; 0.7734]

height = 227.9506 mm

(190, 300)

pinv(C)*[190; 300; 1] = [431.6077; 1.3387]

height = 322.4081 mm

3.

a)

Images used 'humanity01.JPG' and 'humanity02.JPG'
Points in image 1 chosen:
points1 = [439 837 1;
763 979 1;
369 1173 1;
583 731 1;
123 1153 1;
567 833 1;
442 816 1];
points2 = [419 215 1;
743 361 1;
357 545 1;
570 100 1 ;
127 531 1;
551 209 1;
423 192 1];

b)

a)

Linear equation is of the form $Ax = Y$

where A is a 3x3 matrix of the form $\begin{matrix} a & b & c \\ d & e & f \\ 0 & 0 & 1 \end{matrix}$

Now A*points1 = points2
i.e a*439 + b*837 + c*1 = 419
d*439 + e*837 + f*1 = 215

a*763 + b*979 + c*1 = 743
d*763 + e*979 + f*1 = 361 and so on…

b)

location: 3/ComputeWarpMapping.m

c)

location: 3/WarpImage.m

c)

location: 3/mosaic.m
result location: 3/mosaic.jpg