Team Members:

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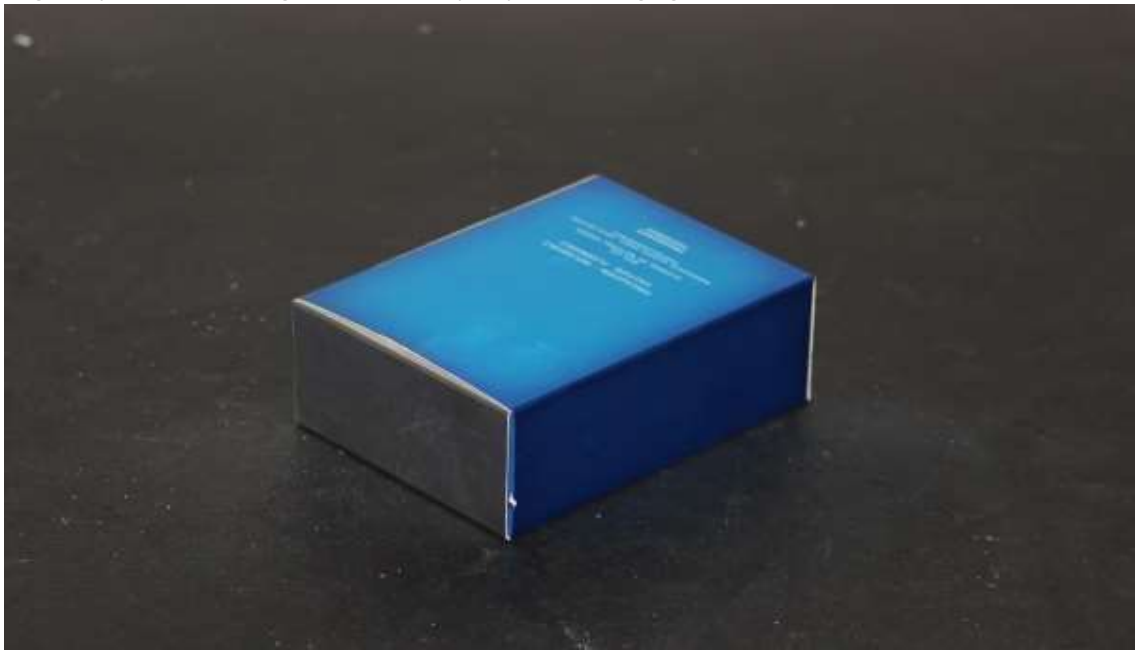
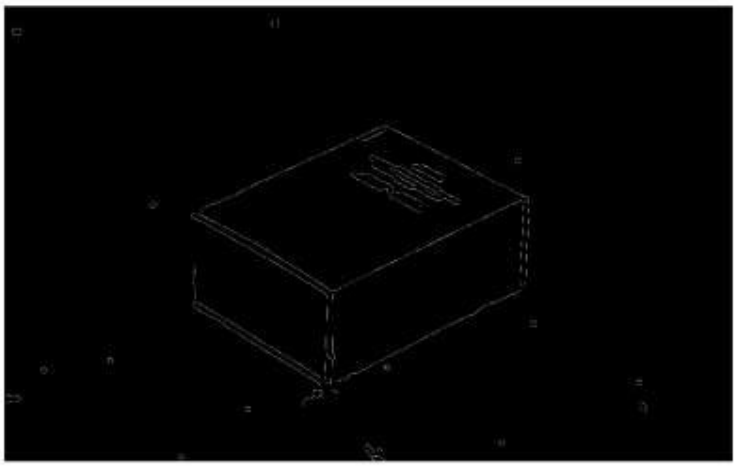
Title: Single view metrology

Step 1: Input Image:

Image acquisition referring to the 3 Point perspective image guide

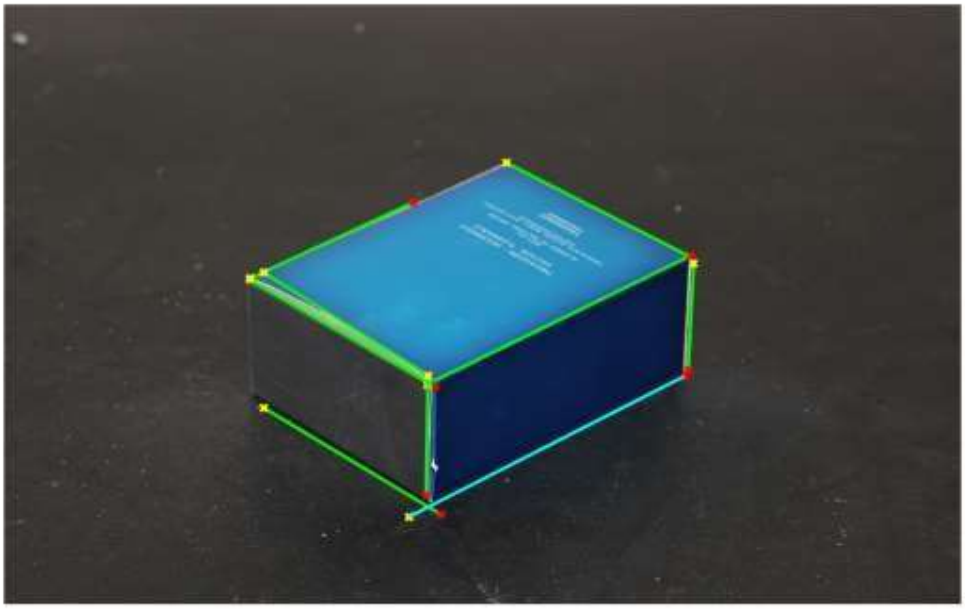


Step 2: Using canny edge detection different edges were found im2=edge(im,'Canny',0.088,7.8);



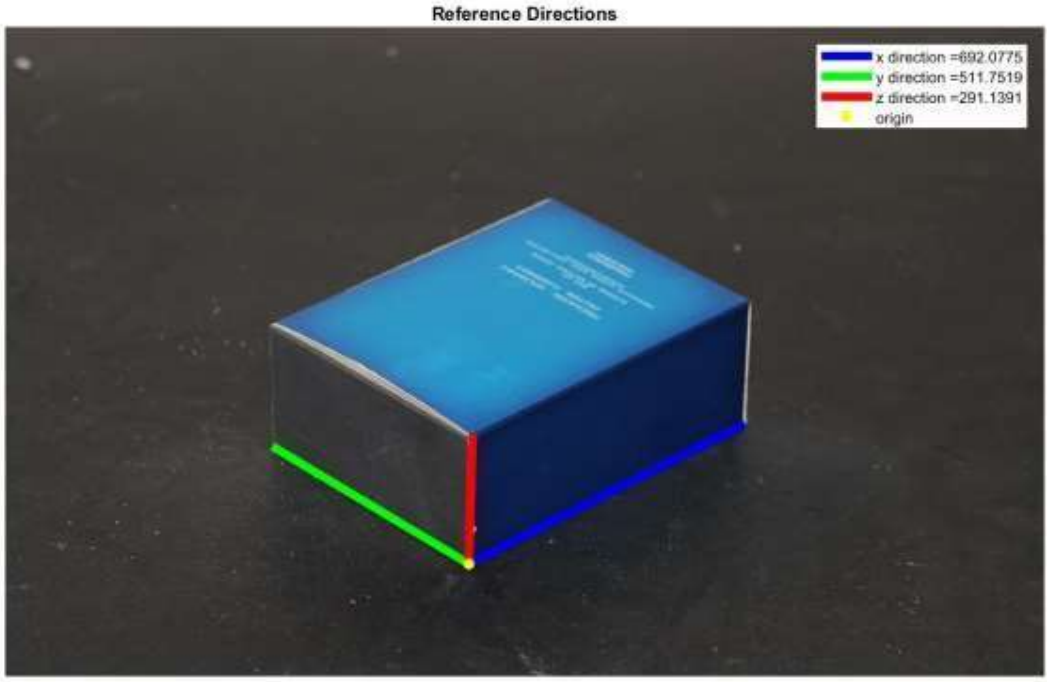
Step 3 : After the detection of edges we used Hough transform for the detection of the lines for Vanishing points

```
[H,T,R] = hough(im2);

P  = houghpeaks(H,9,'threshold',ceil(0.3*max(H(:))));

lines = houghlines(im2,T,R,P,'FillGap',260,'MinLength',100);
```



From the above image we can confirm at least two lines for each axis.

Step 4 : Selection X,Y,Z axis and respective reference points as follows:



With help of parallel lines vanishing points are found

Code snippet:

```
vpx = zeros(3, 1);
   vpx(1:2) = (linesx(1:2,:))'\(-1*linesx(3,:))';
vpx(3) = 1;

   vpy = zeros(3, 1);
   vpy(1:2) = (linesy(1:2,:))'\(-1*linesy(3,:))';
vpy(3) = 1;

   vpz = zeros(3, 1);
   vpz(1:2) = (linesz(1:2,:))'\(-1*linesz(3,:))';
vpz(3) = 1;
```

Matrix containing vanishing points

Vp=[vpx,vpy,vpz];

Vanishing points for given input image:

	Vx	Vy	Vz
X co-ordinate	17194	-5868.2	703
Y co-ordinate	-7006	-3147	1980

Step 5: Selecting the reference point and reference length

We chose the intersection of X-Y-Z axis of our image as the origin and the end points of the box in the respective direction as reference point and length of side of box as reference lengths (As shown in the image of step 3).

Step 6:

Calculation of the Projection matrix:

Calculation of scaling factors(a,b,c):

The below equation is for calculation of a. Similarly, we calculate for b and c.

$$\begin{bmatrix} aVx(1) & bVy(1) & cVz(1) & Origin(1) \\ aVx(2) & bVy(2) & cVz(2) & Origin(2) \\ aVx(3) & bVy(3) & cVz(3) & Origin(3) \end{bmatrix} \begin{bmatrix} X \\ 0 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} refX(1).w \\ refX(2).w \\ w \end{bmatrix}$$

Projection matrix is given by

[a*vp_x b*vp_y c*vp_z origin]
We have vanishing points we need to calculate scaling parameters a,b,c.

Code snippet:

```
for i=1:3
 scalingx(i,1)=(ref(i,1)-origin(i))/((Vp(i,1)-ref(i,1))*reflength(1));
scalingy(i,1)=(ref(i,2)-origin(i))/((Vp(i,2)-ref(i,2))*reflength(2));
scalingz(i,1)=(ref(i,3)-origin(i))/((Vp(i,3)-ref(i,3))*reflength(3)); end where
```

scaling parameters in X,Y,Z directions are calculated as a,b,c.

Step 7:

Calculate texture maps from the projection matrix

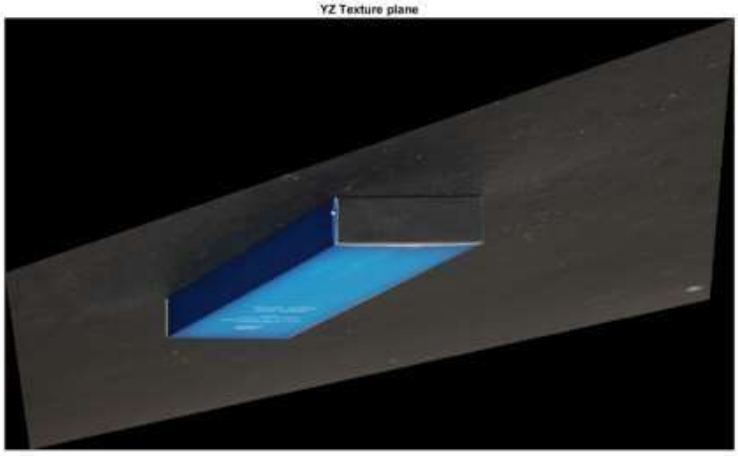
Hxy = 1,2,4 columns of the projection matrix

Hyz = 2,3,4 columns of the projection matrix

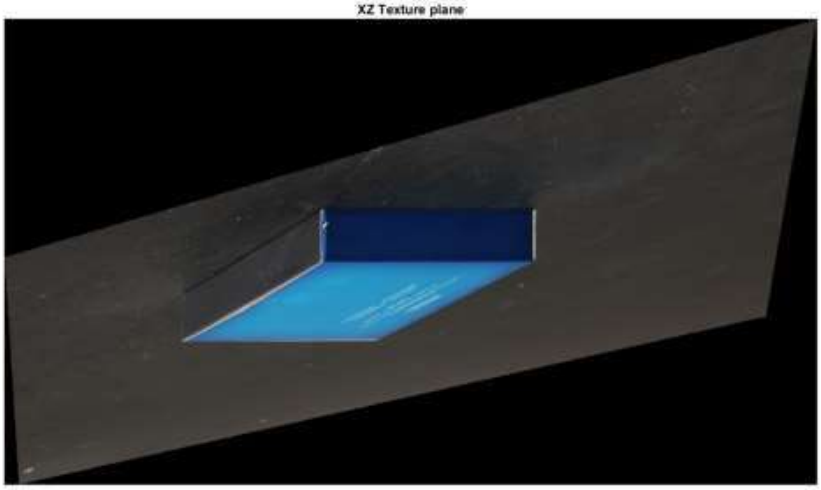
Hxz = 1,3,4 columns of the projection matrix

Using projective2d and imwarp commands in matlab we obtain the texture maps.

YZ Texture plane



XZ Texture plane



From the perspective images required area is cropped.

Cropped images :

XY Plane cropped image

YZ Plane cropped image

XZ Plane cropped image

Step 8:

With the cropped images 3D model is created in Blender Rendered 3D

model in Blender: