Assignment 3:-

1.the detect surf points function is called to find correspondences then .Locations on the surf array object gives the coordinates of the points .Plotting these points i noticed that these are upside down than those in image so i multiplied the second coordinate with minus one which made it similar to that in image .Then to make them correctly in pixel coordinated 2*v0 was added.These are image pixel coordinates ,to get normalizedimage coordinates from these I substractes (u0,v0) obtained from given K to centre the points about them but I could not remove the pixel length /scale factors kx,ky – so I assumed that normalization of these points should take care of these.

2.F is estimated by the 8-point algorithm on normalized coordinates and RANSAC .the margin for RANSAC is 0.05 . Some values obtained

Columns 409 through 412

0.0048 0.1563 0.0753 0.0179

Columns 413 through 416

0.0009 0.0048 0.0089 0.0645

Columns 417 through 420

0.0071 0.0238 0.3963 0.0085

Columns 421 through 424

0.0023 0.1040 0.0033 0.0001

Columns 425 through 428

0.0010 0.0269 0.1410 0.0063

Columns 429 through 432

0.0192 0.0125 0.0055 0.4546

Columns 433 through 436

0.0116 0.0066 0.1207 0.0120

Columns 437 through 440

Some values of x’*F*x .

492

1

513

22

513

22

513

22

513

22

513

22

513

22

524

28

524

28

Few index and number of inliers pairs for the ith F .

We pick F from 100 sets of random 8 points used for estimation.

The margin for RANSAC = 0.05

3.F is denormalized as given and E is obtained using the formula.For R,t reconstruction ,since K contains the pixel focal lengths and centres so the image pixel coordinates(not normalized),instead of the normalized image coordinates, are passes to the decompose function .R,t are obtained R has det 1 and orthogonal column vectors..

4.Algebraic triangulation is done as follows:

Linear triangulation

Minimizing the algebraic error

- This algorithm uses the two equations for perspective projection to solve for the 3D point that are optimal in a least squares sense
- Each perspective camera model gives rise to two equations on the three entries of $\boldsymbol{X}_i$
- Combining these equations we get an over determined homogeneous system of linear equations that we can solve with SVD
- The minimized algebraic error is not geometrically meaningful, but the method extends naturally to the case when $\boldsymbol{X}_i$ is observed in more than two images

$$\begin{bmatrix} v_i \boldsymbol{p}^{3T} - \boldsymbol{p}^{2T} \\ u_i \boldsymbol{p}^{3T} - \boldsymbol{p}^{1T} \\ v_i' \boldsymbol{p}'^{3T} - \boldsymbol{p}'^{2T} \\ u_i' \boldsymbol{p}'^{3T} - \boldsymbol{p}'^{1T} \\ \vdots \end{bmatrix} \tilde{\boldsymbol{X}}_i = \boldsymbol{0}$$

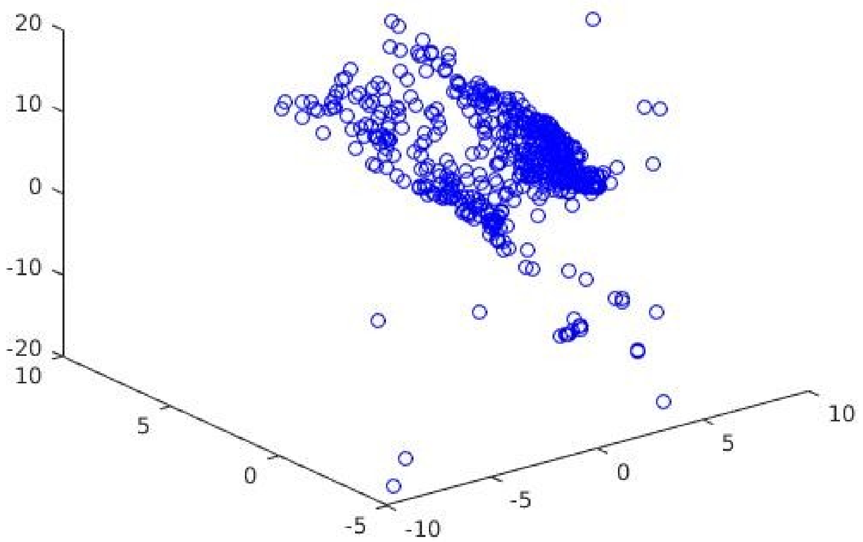
$$\begin{bmatrix} v_i p_{31} - p_{21} & v_i p_{32} - p_{22} & v_i p_{33} - p_{23} & v_i p_{34} - p_{24} \\ u_i p_{31} - p_{11} & u_i p_{32} - p_{12} & u_i p_{33} - p_{13} & u_i p_{34} - p_{14} \\ v_i' p_{31}' - p_{21}' & v_i' p_{32}' - p_{22}' & v_i' p_{33}' - p_{23}' & v_i' p_{34}' - p_{24}' \\ u_i' p_{31}' - p_{11}' & u_i' p_{32}' - p_{12}' & u_i' p_{33}' - p_{13}' & u_i' p_{34}' - p_{14}' \\ \vdots & \vdots & \vdots & \vdots \end{bmatrix} \tilde{\boldsymbol{X}}_i = \boldsymbol{0}$$

$$A\tilde{\boldsymbol{X}}_i = \boldsymbol{0}$$

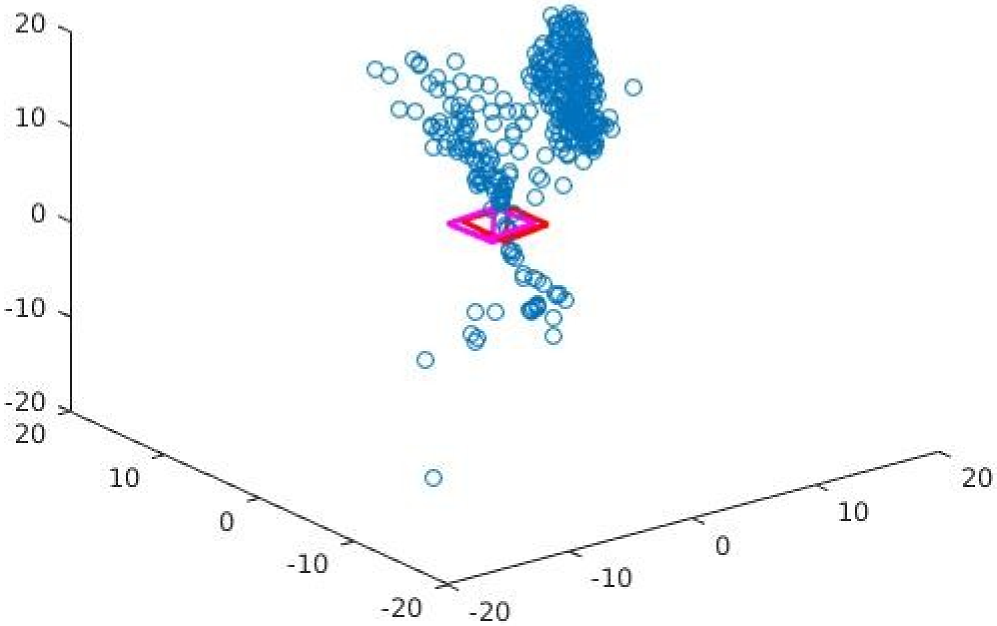
5.With R,t the projection matrices are calculated as given and trianulated using pixel coordinates again, 4x1 vector is obtained .The first three coordinates are divided by fourth to obtain Xc,Yc and Zc.The are then filtered of outliers/errors which are too out of bounds as coordinates fro +20 - -20 (eyeballed for few runs).

6.These are plotted and again with camera frustums the scale is obtained as 2.

World reconstruction:



With camera frustums:



Montag view of correspondences :

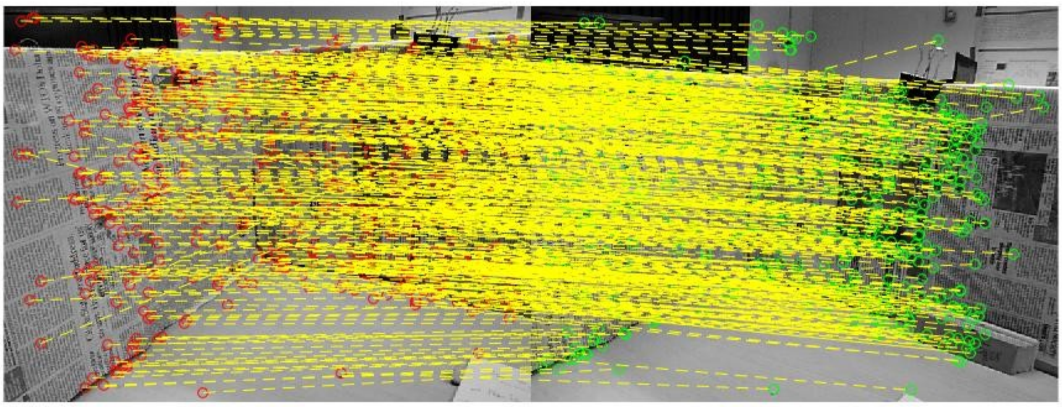


image coordinates after reflecting y coordinates (in pixels):

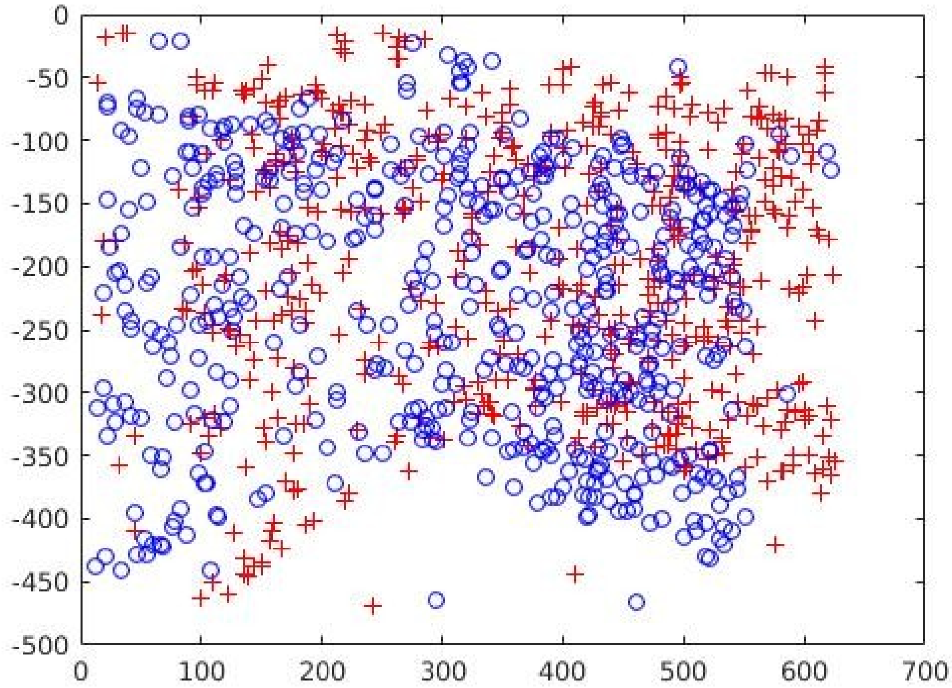


image coordinates(pixels) after +2*204.xxxx :