

## Image Based Data Collection Exercise 4 Spatial Intersection

The Spatial intersection method used to get the coordinates space from the images. For this method we need stereo images or in other words we need at least two points. I chose nine images which they have an easy object to select. After computing the object coordinates space, the back transformation should be applied in order to check your estimation.

The images which has been chosen are:

R0020774/ R0020813-16/ R0020849-52

The steps procedure:

$$x \times P \cdot X = 0$$

here x is image coordinates and X is the object coordinates, P is the objection matrix.

$$P = K[R|t] = \begin{bmatrix} p_{11} & p_{12} & p_{13} & p_{14} \\ p_{21} & p_{22} & p_{23} & p_{24} \\ p_{31} & p_{32} & p_{33} & p_{34} \end{bmatrix} = \begin{bmatrix} p^1 \\ p^2 \\ p^3 \end{bmatrix}$$

Thus

$$x(p^{3T}X) - (p^{1T}X) = 0$$

$$x(p^{3T}X) - (p^{2T}X) = 0$$

$$x(p^{2T}X) - y(p^{1T}X) = 0$$

Then A matrix

$$A = \begin{bmatrix} x_1 p_1^{3T} - (p_1^{1T}) \\ y_1 p_1^{3T} - (p_1^{2T}) \\ \dots \\ x_n p_n^{3T} - (p_n^{1T}) \\ y_n p_n^{3T} - (p_n^{2T}) \end{bmatrix}$$

Here X can be obtained from SVD.

When doing the back transformation

$$\begin{bmatrix} x_i \\ y_i \\ 1 \end{bmatrix} = P_i \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$$



**Fig-1: The back transformed coordinates on the image R0020774**

The object coordinates:

$$X = \begin{bmatrix} 512997.130 \\ 5427680.572 \\ 325.832 \end{bmatrix}$$

**Differences of the back transformation on x and y directions**

Diff_x	104.19	3.87	97.72	8.26	80.89	1.33	39.30	0.22	87.7
Diff_y	64.44	25.48	3.60	10.35	71.70	43.93	2015	0.71	4.82

**The respective error of the observed pixel measure from the transformation**

$$\sigma_{0x} = 5.3134, \sigma_{0y} = 4.0429$$

The reason behind these big error that I really not good at aiming, the method of detecting the points are not good. I used 'ginput' function which I cannot zoom while choosing the point. The reason I used this that I could not figure out how to extract the coordinates of the points from the images using the 'imtool' automatically.