Frame Transformation（座標変換）

Translation transformation（並進変換）

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = \begin{pmatrix} x \\ y \\ z \end{pmatrix} + \begin{pmatrix} \Delta x \\ \Delta y \\ \Delta z \end{pmatrix}$$

$$\begin{pmatrix} X \\ Y \\ Z \\ \hline 1 \end{pmatrix} = \left(\begin{array}{ccc|c} 1 & 0 & 0 & \Delta x \\ 0 & 1 & 0 & \Delta y \\ 0 & 0 & 1 & \Delta z \\ \hline 0 & 0 & 0 & 1 \end{array}\right) \begin{pmatrix} x \\ y \\ z \\ \hline 1 \end{pmatrix}$$

$$\begin{pmatrix} \boldsymbol{p}' \\ \hline 1 \end{pmatrix} = \left(\begin{array}{c|c} I & \boldsymbol{\Delta p} \\ \hline \boldsymbol{o}^T & 1 \end{array}\right) \begin{pmatrix} \boldsymbol{p} \\ \hline 1 \end{pmatrix}$$

Rotational transformation（回転変換）

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = \begin{pmatrix} a_x^X & a_x^Y & a_x^Z \\ a_y^X & a_y^Y & a_y^Z \\ a_z^X & a_z^Y & a_z^Z \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix}$$

$$\begin{pmatrix} X \\ Y \\ Z \\ \hline 1 \end{pmatrix} = \left(\begin{array}{ccc|c} a_x^X & a_x^Y & a_x^Z & 0 \\ a_y^X & a_y^Y & a_y^Z & 0 \\ a_z^X & a_z^Y & a_z^Z & 0 \\ \hline 0 & 0 & 0 & 1 \end{array}\right) \begin{pmatrix} x \\ y \\ z \\ \hline 1 \end{pmatrix}$$

$$\begin{pmatrix} \boldsymbol{p}' \\ \hline 1 \end{pmatrix} = \left(\begin{array}{c|c} R & \boldsymbol{o} \\ \hline \boldsymbol{o}^T & 1 \end{array}\right) \begin{pmatrix} \boldsymbol{p} \\ \hline 1 \end{pmatrix}$$

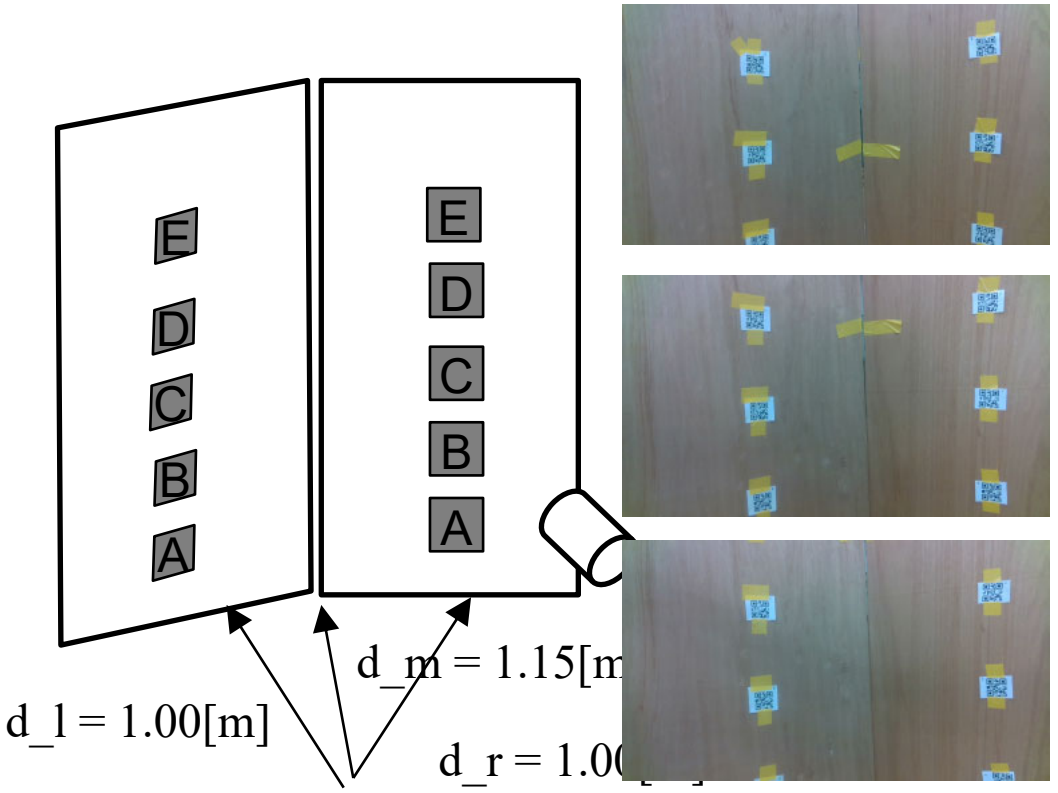
Homogeneous Transformation Matrix
（同次変換行列）

Translation and rotational transformation in a single step
（並進と回転変換を1ステップで）

$$\begin{pmatrix} X \\ Y \\ Z \\ \hline 1 \end{pmatrix} = \left(\begin{array}{ccc|c} a_x^X & a_x^Y & a_x^Z & \Delta x \\ a_y^X & a_y^Y & a_y^Z & \Delta y \\ a_z^X & a_z^Y & a_z^Z & \Delta z \\ \hline 0 & 0 & 0 & 1 \end{array}\right) \begin{pmatrix} x \\ y \\ z \\ \hline 1 \end{pmatrix}$$

$$\begin{pmatrix} \boldsymbol{p}' \\ \hline 1 \end{pmatrix} = \left(\begin{array}{c|c} R & \boldsymbol{\Delta p} \\ \hline \boldsymbol{o}^T & 1 \end{array}\right) \begin{pmatrix} \boldsymbol{p} \\ \hline 1 \end{pmatrix} = T \begin{pmatrix} \boldsymbol{p} \\ \hline 1 \end{pmatrix} = \begin{pmatrix} R\boldsymbol{p} + \boldsymbol{\Delta p} \\ 1 \end{pmatrix}$$

Data Set C: Middle position



Camera is place to cover two QR markers on each of the walls

Camera positions

- Height: 0.70, 0.95, 1.30 [m]

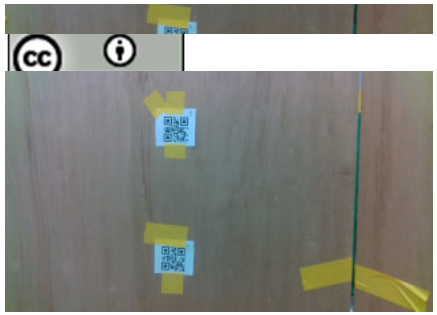
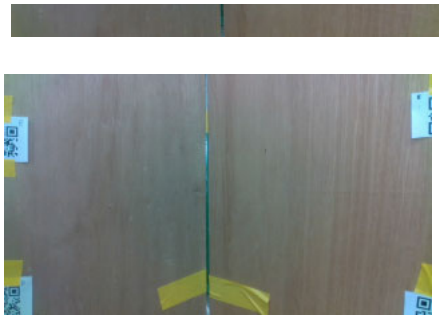
Take several RGB-D shots at each of camera positions

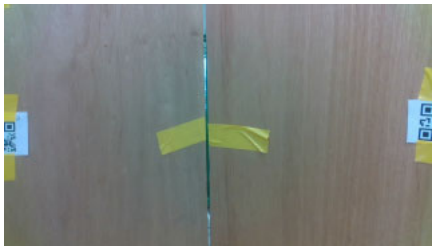
(E, D, C) img1583215775.png
(D, C, B) img1583215821.png
(C, B, A) img1583215857.png

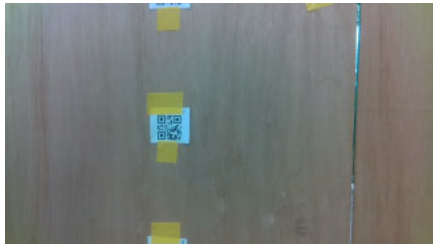
Data Set C: Middle position

Height: 0.70, 0.95, 1.30 [m]
(E, D, C) img1583215775.png
(D, C, B) img1583215821.png
(C, B, A) img1583215857.png

$$T_1 = \left(\begin{array}{ccc|c} 1 & 0 & 0 & \Delta x \\ 0 & 1 & 0 & \Delta y \\ 0 & 1 & 1 & \Delta z \\ \hline 0 & 0 & 0 & 1 \end{array}\right)$$




Left
(E) img1583215155.png
(E, D) img1583215200.png
(D) img1583215245.png
(D, C) img1583215338.png
(C) img1583215369.png
(C, B) img1583215403.png
(C, B) img1583215424.png
Middle
(B, C) img1583215494.png
(B, C) img1583215519.png
(D, C, D, C) img1583215556.png
(D, D) img1583215590.png
(E, D, E, D) img1583215627.png
(E, E) img1583215658.png
Right
(E, D, C) img1583215775.png
(D, C, B) img1583215821.png
(C, B, A) img1583215857.png