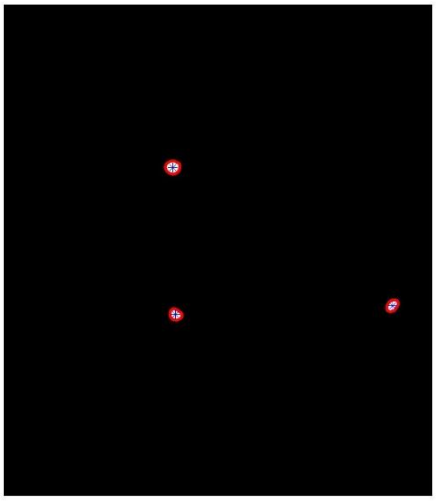
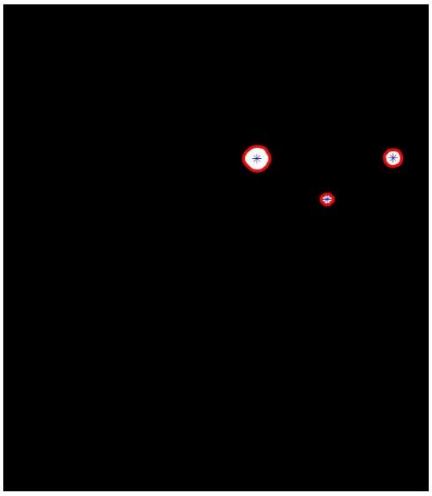
LabReport8_JiaweiGe

The dimensions of each red slice equal **215.6 mm x 247.92 mm**. The length **215.6 mm** is yield by **154 slices x 1.4 mm**. The width **247.92 mm** is yield by **240 pixels x 1.033 mm**. The distance between fiducials' plane and targets' plane equals **54.899 mm**, which is yield by adding up the depth information in the upper-right box in the screenshots **(33.629 mm + 21.270 mm)**.

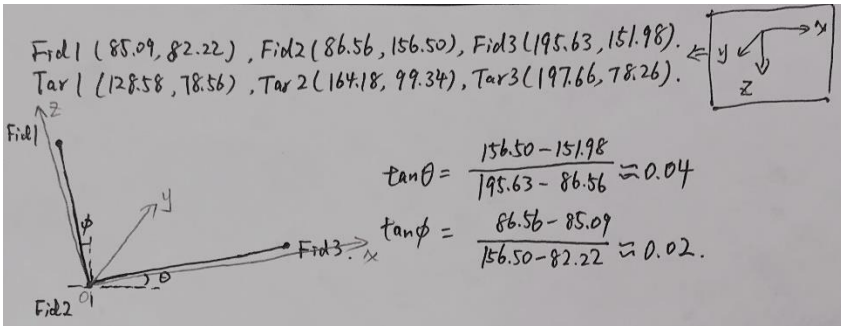
The fiducials' centers are **[619.2565, 596.6149]**, **[629.9568, 1.1356e+03]**, **[1.4237e+03, 1.1028e+03]** in the Matlab results. Because the bw size is **1799 x 1569**. Using the proportion of **240/1799**, we can get the y value of fiducials' centers, which are **79.59, 151.50, 147.12 = 80th, 152th, 147th pixel**, respectively. Using the proportion of **154/1569**, we can get the slice number of fiducials' centers, which are **60.78, 61.83, 139.74 = 61, 62, 140**, respectively. The true length and width have a **215.6/1569** and **247.92/1799** proportion, respectively. The true positions of the fiducials' centers in red slices, therefore, are **(85.09, 82.22), (86.56, 156.50), (195.63, 151.98) mm**.

The targets' centers are **[934.5005,567.5116], [1.1933e+03,717.6362], [1.4366e+03,565.3621]** in the Matlab results. Because the bw size is **1791 x 1567**. Using the proportion of **240/1791**, we can get the y values of targets' centers are **78.05, 96.17, 75.76 = 78th, 96th, 76th pixel**, respectively. Using the proportion of **154/1567**, we can get the slice number of fiducials' centers, which are **91.84, 117.23, 141.18 = 92, 117, 141**, respectively. The true length and width have a **215.6/1567** and **247.92/1791** proportion, respectively. The true positions of the targets' centers in red slices, therefore, are **(128.58, 78.56), (164.18, 99.34), (197.66, 78.26) mm**.





Fid1 (85.09, 82.22), Fid2 (86.56, 156.50), Fid3 (195.63, 151.98).
Tar1 (128.58, 78.56), Tar2 (164.18, 99.34), Tar3 (197.66, 78.26).



$$\tan\theta = \frac{156.50 - 151.98}{195.63 - 86.56} \simeq 0.04$$

$$\tan\phi = \frac{86.56 - 85.09}{156.50 - 82.22} \simeq 0.02.$$

Theoretically, $\tan\theta$ should equals $\tan\phi$.

Assume Fid2 to be the origin of Fid frame, and set tilting angle ψ satisfy $\tan\psi = \frac{0.04+0.02}{2} = 0.03$

Then the rotation matrix is $\begin{bmatrix} c\psi & s\psi \\ -s\psi & c\psi \end{bmatrix} \simeq \begin{bmatrix} 1 & 0.03 \\ -0.03 & 1 \end{bmatrix}$.

$\overrightarrow{Fid2 \cdot Fid1} = \begin{pmatrix} -1.47 \\ 0 \\ 74.28 \end{pmatrix}$

$\overrightarrow{Fid2 \cdot Fid3} = \begin{pmatrix} 109.07 \\ 0 \\ 4.52 \end{pmatrix}$

$\Rightarrow$ multiply with R. $\Rightarrow$ $Fid1^* = \begin{pmatrix} 0.76 \\ 0 \\ 74.3[illegible] \end{pmatrix}$, $Fid3^* = \begin{pmatrix} 109.21 \\ 0 \\ [illegible]1.25 \end{pmatrix}$

$\overrightarrow{Fid2 \cdot Tar1} = \begin{pmatrix} 42.02 \\ 54.90 \\ 77.94 \end{pmatrix}$

$\overrightarrow{Fid2 \cdot Tar2} = \begin{pmatrix} 77.62 \\ 54.90 \\ 57.16 \end{pmatrix}$

$\overrightarrow{Fid2 \cdot Tar3} = \begin{pmatrix} 111.10 \\ 54.90 \\ 78.24 \end{pmatrix}$

multiply by R $\Rightarrow$

$Tar1^* = \begin{pmatrix} 44.36 \\ 54.90 \\ 76.68 \end{pmatrix}$

$Tar2^* = \begin{pmatrix} 79.33 \\ 54.90 \\ 54.83 \end{pmatrix}$

$Tar3^* = \begin{pmatrix} 113.45 \\ 54.90 \\ 74.91 \end{pmatrix}$

Look up to the reference frame, both x and y values are accurate.

all z values are 3 mm less than the reference.

The center position of Fid1 equals **[3.9548e+02,3.8029e+02]**, the depth is **-20.271mm**, and the bw size is **1154 x 997**. The center position of Fid2 equals **[4.0654e+02,7.2571e+02]**, the depth is **-23.371mm**, and the bw size is **1153 x 1001**. The center position of Fid3 equals **[9.1061e+02,7.0301e+02]**, the depth is **-18.204mm**, and the bw size is **1151 x 997**. Using the same methods as mentioned above **(215.6 / bw(2) * Fid1(1) = x_fid; depth = y_fid; -247.92 / bw(1) * Fid1(2) = z_fid)**, we can easily yield that the fiducials' centers locate at **(85.52, -20.27, 81.70), (87.56, -23.37, 156.04), (196.92, -18.20, 151.43) mm**.