3D Reconstruction from 2D Images

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The effect of flatness of the object on the reconstruction

In this section, we try to modify the height of the box to see the effect of flatness of the object on the reconstruction. For the original parameters, $side = height = 210mm$. We change the noise by changing the standard deviation, σ, of the Gaussian distribution and look for the largest tolerable σ such that the reconstruction is successful.

We tried different values and find that the largest tolerable σ is around 0.21. Then we fix $side = 210mm$ and change *height* of the box. First, we fix σ to be 0.21, the largest tolerable value. Then we find that the tolerable *height* for this σ is 205 : 215 mm. So we find that the height can affect the reconstruction. If we want to achieve the same result from reconstruction for a particular σ , there is an interval of tolerance for *height* of the box.Figure 1 show some examples of reconstructions of boxes with different heights:

Figure 1 shows that for the same σ, the reconstruction of the box with *height* 200 mm is much better than that of the box with *height* 20 mm. The reason may due to the ratio between the *height* of the box and the σ. If *height* is too small compared to σ, the noise will play an important role in the reconstruction. In the extreme case, if the *height* is smaller than σ, then the corners on the same side of a square in vertical direction will have much influence on each other. In this case, the reconstruction will be meaningless.

We also simulate the reprojection errors, structure errors, rotation errors and translation errors

Figure 1: Left:the reconstructed box with height 200 mm at σ=0.21 Right:the reconstructed box with height 20 mm at σ=0.21

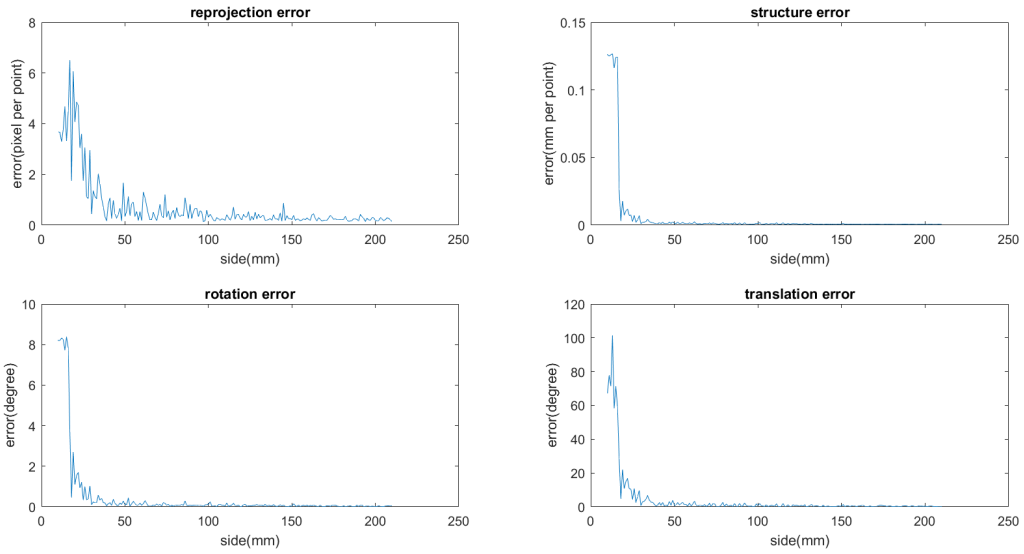

Figure 2: the error for boxes with heights from 10 mm to 210mm

from reconstruction of boxes with heights from 10 mm to 210 mm and 210 mm to 280 mm separately. The reason we chose to end at $height = 280$ is that when $height$ is larger than 280 the cameras will be technically lie in the box. In this case we actually can not take photos for the box. This can be show to run the program at $side = 210mm$ and $height = 300mm$.

Figure 2 shows that as long as the $height$ is larger than 45 mm, structure errors, rotation errors and translation errors from reconstruction of boxes is close to zero in their respective units. However, the reprojection error is not small even when the $height$ is larger 100 mm. This shows that the reconstruction is meaningless for $height < 100$ with $\sigma = 0.21$. Figure 3 shows that when $height$ is larger than 210 mm, the reprojection error, structure errors, rotation errors and translation errors from reconstruction of boxes oscillates. It means that when the $height$ is larger 210 mm, some specific $height$ may be good for reconstruction. For example, figure 4 shows the errors for reconstruction of boxes with $height = 250mm$.

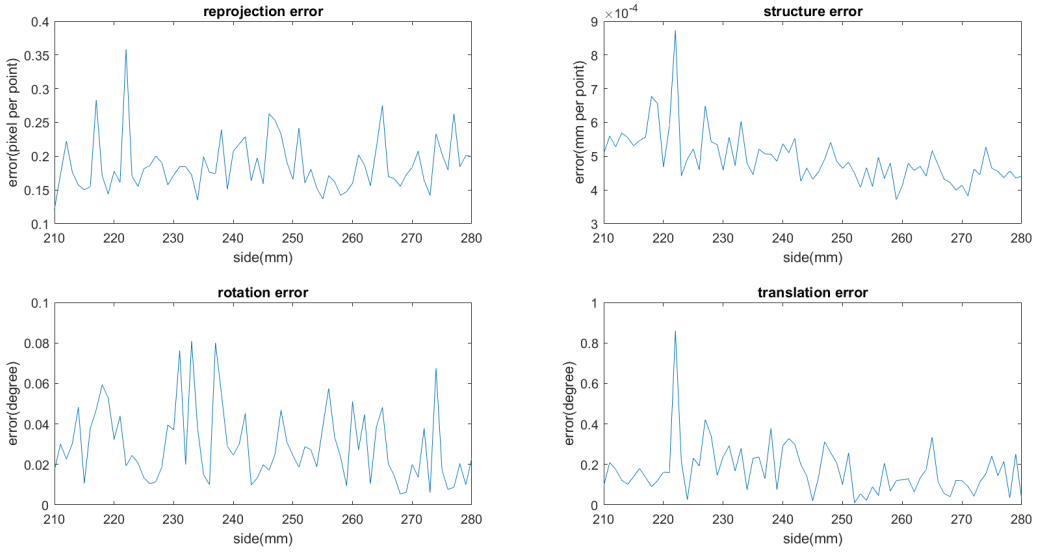

Figure 3: the error for boxes with heights from 210 mm to 280mm

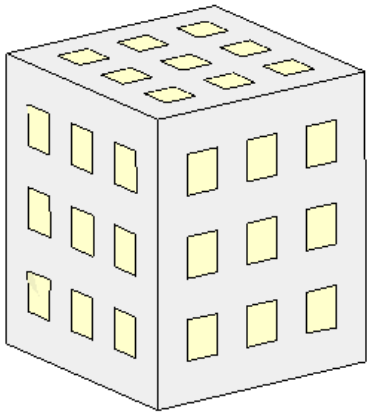

Figure 4: the error for boxes with height 250mm