GCV Assignment3: Geometric Computer Vision Homework

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1 Q1: Prove

$$\begin{aligned}
||\mathbf{u}-\mathbf{v}||^2 &= ||(1-\cos(\theta))\mathbf{i}+(\sin(\theta))\mathbf{j}||^2 \\
&= (1-\cos(\theta))^2+(\sin(\theta))^2 \\
&= 1-2\cos(\theta)+\cos^2(\theta)+\sin^2(\theta) \\
&= 2-2\cos(\theta) \\
&= 4\left(\sin^2\left(\frac{\theta}{2}\right)\right)
\end{aligned}$$

2 Q2: Implement the 1DSfM

The experimental results are as shown in the following table.

We can observe that when using 1dsfm and Huber loss, the error is minimized, proving that these two methods can effectively remove outliers. Similarly, when using 1dsfm and Huber loss, the runtime decreases somewhat due to the removal of outliers.

By observing the histogram we can find that:

- 1DSfM: This line shows a peak at the 0.3-0.4 error range, suggesting that errors were most frequently in this range for this method.
- 1DSfMHuber: This method appears to have a more controlled error distribution with a less pronounced peak, indicating it may have a more robust error profile with the use of a Huber loss function or similar technique.

	mean translation errors	median translation errors	mean run time
1DSfM	1106.7398	0.9593	76.4241
1DSfMHuber	10005.0361	0.2867	76.6937
BaselineHuber	1717713.5863	0.3454	87.8698
Baseline	982372.6601	1.7394	84.8973

- Baseline: The baseline method has its highest peak between the 0.8-0.9 error range, suggesting that this method yielded errors in this range most frequently.
- BaselineHuber: Similar to 1DSfMHuber, applying the Huber technique seems to have reduced the frequency and magnitude of errors as compared to the standard baseline.

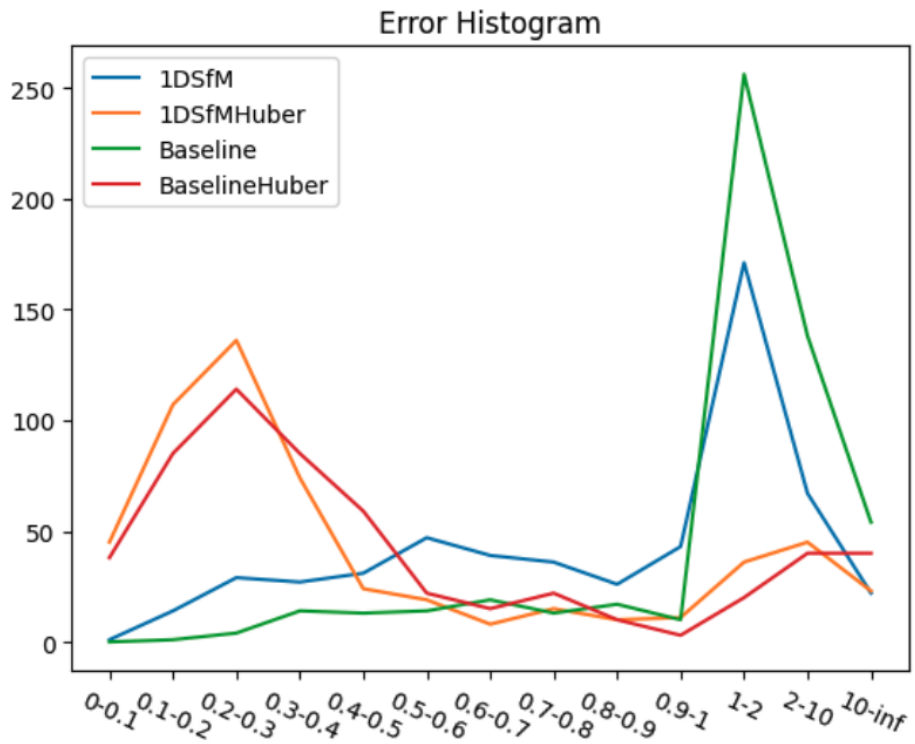

Figure 1: Error Histogram.