Supplementary Material for
Making Minimal Solvers for Absolute Pose Estimation Compact and Robust

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1. Elimination Ideal

To find the new constraints on the camera matrix,

\[ p_{21}p_{31} + p_{22}p_{32} + p_{23}p_{33} = 0 \]
\[ p_{11}p_{31} + p_{12}p_{32} + p_{13}p_{33} = 0 \]
\[ p_{11}p_{21} + p_{12}p_{22} + p_{13}p_{23} = 0 \]
\[ p_1^2 + p_2^2 + p_3^2 - p_{21}^2 - p_{22}^2 - p_{23}^2 = 0 \]
\[ p_{13}p_{22} - p_{21}p_{32} - p_{22}p_{13} + p_{23}p_{12} = 0 \]
\[ p_{11}p_{21}p_{31} + p_{21}p_{23} - p_{11}p_{23} - p_{21}p_{23} = 0 \]
\[ p_{12}p_{23}p_{31} - p_{11}p_{23}p_{31} + p_{12}p_{21}p_{31} - p_{11}p_{21}p_{31} = 0 \]
the following Macaulay2 [2] code was used:

```
KK = ZZ / 30097;
R = KK[p_{1,1}..p_{3,3},r_{1,1}..r_{3,3},f,s]
-- we can ignore translation since it poses
-- no extra constraint on P
P = map(Rˆ3,Rˆ3,(i,j) -> p_{i+1,j+1});
Q = map(Rˆ3,Rˆ3,(i,j) -> r_{i+1,j+1});
K = matrix({{f,0,0},{0,f,0},{0,0,1}});
eye = matrix({{s,0,0},{0,s,0},{0,0,s}});
eqs = flatten(P-K*Q | transpose(Q)*Q-eye);
I = saturate(ideal eqs, s);
elim_vars = {f,s, r_{1,1},r_{1,2},r_{1,3},
             r_{2,1},r_{2,2},r_{2,3},
             r_{3,1},r_{3,2},r_{3,3}};
J = eliminate(I,elim_vars);
```

2. Additional Figures from the Experiments

2.1. Noise Experiment

Figure 1 shows the errors in the radial distortion for the noise experiment in Section 4.2.

2.2. Evaluation on Real Images

Figure 2 and Figure 3 shows histograms of the relative errors for the Rotunda and Graffiti datasets. Figure 4 and Figure 5 shows example images from the datasets.

References

Figure 1. Comparison of the errors of radial distortion estimated by different solvers for varying levels of noise. The ground truth values were set to $f_{gt} = 1.5$ and $k_{gt} = -0.4$. Left: Median radial distortion errors. Right: Boxplot of radial distortion errors.

Figure 2. Errors ($\log_{10}$) for the Rotunda dataset. The measured errors are the relative focal length error $|f - f_{GT}|/f_{GT}$, the distortion error $|k - k_{GT}|$, the rotation error in degrees and the relative translation error $\|t - t_{GT}\|/\|t_{GT}\|$.

Figure 3. Errors ($\log_{10}$) for the Graffiti dataset. The measured errors are the relative focal length error $|f - f_{GT}|/f_{GT}$, the distortion error $|k - k_{GT}|$, the rotation error in degrees and the relative translation error $\|t - t_{GT}\|/\|t_{GT}\|$.
Figure 4. Some examples of the images in the Rotunda. Left: Original images. Right: Undistorted images.
Figure 5. Some examples of the images in the Graffiti. Left: Original images. Right: Undistorted images.