Exercise 2 Solution

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1 Exercise 1: Camera models

- What test_ex2.cpp tests?
  test_sex2.cpp tests four camera models, PinholeCamera, ExtendedUnifiedCamera, DoubleSphereCamera, KannalaBrandt4Camera. It first projects 3D point on to image plane and then unproject the point to 3D. And then compare the original 3D point and the reprojected 3D point. If they are close enough, we can pass the test.

2 Exercise 2: Optimization

- What is the difference between curve fitting and robust curve fitting?
  robust curve fitting has additionally using a loss function to deal with outliers and got a better result. The result from robust curve fitting is closer to the ground truth.

3 Exercise 3: Camera calibration

- What are the command line parameters that calibration.cpp uses?
  There are three command line parameters:
  –show-gui: True or false. To determine if we want to see the user interface.
  –dataset-path: To define the path of dataset, which dataset we want to use.
  –cam-model: Possible values: pinhole, ds, eucm, kb4. Default: ds. To define what camera model we want to use.

- Summary of calibration result
  We have tested four models: Pinhole Camera Model(pinhole), The Double Sphere Camera Model(ds), Extended Unified Camera Model(eucm), Kannala-Brandt Camera Model(kb4). We can observe it from the image that, among these four models, pinhole has the worst result. Most of the points are not perfectly align. Other three models are able to provide perfect aligned results. I can't tell their differences of optimization only using my eye.
  For quantitative measurement, i think we can take final cost as a criterion.

camera model	pinhole	eucm	kb4	ds
final cost	1.565735e+05	1.627604e+02	1.619844e+02	1.627482e+02

The model with a lower final cost should be the better one. We can observe that, in the table, pinhole model has a much higher cost than the other camera models. Pinhole model is too simple, less able to model the real world camera. Other three models have nearly the same final cost. This confirms our observation of the image. According to these final cost, Kannala-Brandt Camera Model best fits the lenses that were used to collect the dataset.