EE838 Assignment 8
Camera calibration

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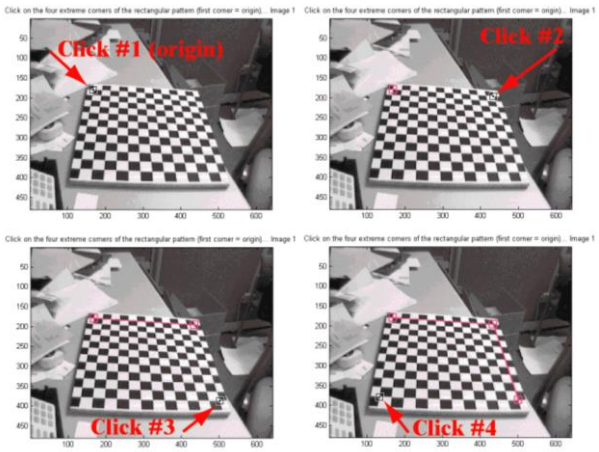
Detailed assignment explanation

1. Preliminary: read the manual about "Camera calibration toolbox for Matlab"
   A. http://www.vision.caltech.edu/bouguetj/calib_doc/
   B. http://www.vision.caltech.edu/bouguetj/calib_doc/htmls/example.html
2. Detailed implementation
   A. Download the camera calibration toolbox
      i. http://www.vision.caltech.edu/bouguetj/calib_doc/
      ii. "Go to the download page" (308Kb zipped)
   B. Download the images for the camera calibration toolbox
      i. http://www.vision.caltech.edu/bouguetj/calib_doc/htmls/example.html
      ii. "calib_example.zip" (4461Kb zipped)
      iii. All images must be in the "TOOLBOX_calib" folder
   C. Read the images
      i. Run "calib_gui.m"
      ii. Click on the "image names" button in the camera calibration tool window
      iii. Read the images (name, type)
   D. Extract the grid corners
      i. Click on the "extract grid corners" button in the camera calibration tool window
      ii. Click on the four extreme corners on the rectangular checkerboard pattern as follows:

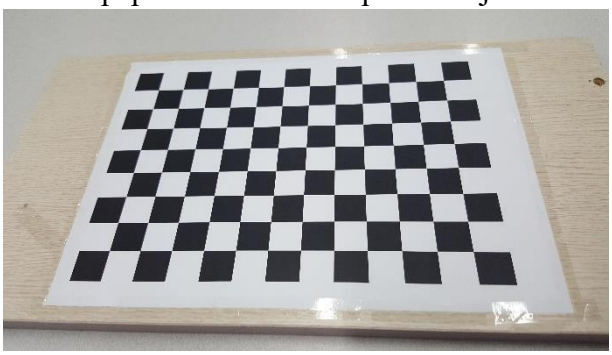


      iii. Enter the sizes dX and dY in X and Y of each square in the grid
      iv. Follow the remaining instructions in the manual
   E. Main calibration step
      i. Click on the button "calibration" of the camera calibration tool to run the main camera calibration procedure
      ii. The initialization step computes a closed-form solution for the calibration parameters based not including any lens distortion (program name: init_calib_param.m)
      iii. The non-linear optimization step minimizes the total reprojection error (in the least squares sense) over all the calibration parameters (9 DOF for intrinsic: focal, principal point, distortion coefficients, and 6*20 DOF extrinsic => 129 parameters)
      iv. The optimization is done by iterative gradient descent with an explicit (closed-form) computation of the Jacobian matrix (program name: go_calib_optim.m)

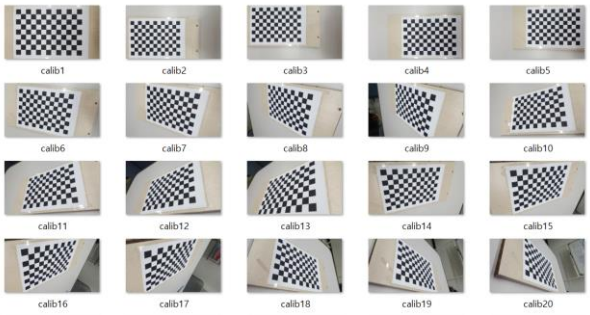
F. (Bonus) Camera calibration using images taken by yourself

i. Create a black / white checkboard using a text editor
(On the checkerboard, the length of the square should be 20mm in actual distance)

ii. Put the paper on a hard and planar object



iii. Take 20 pictures while moving the checkerboard as follows
(At this time, manual focus is taken so that the parameters of the camera do not change)



iv. Perform each calibration step (C, D, E) using images taken by yourself

3. In your report, answer the following questions.
   A. Understand and analyze each calibration step from the camera calibration toolbox for Matlab
   B. Show the calibration results for the initialization and non-linear optimization steps
   C. Visualize the re-projection errors and extrinsic parameters (3D plot)

Submission guidelines

- On the top of your report, clarify your name, ID number, and the assignment title.
- Make your report as a single PDF file.
- Write your report in either Korean or English.
- Title your report as "A#_firstname_lastname.pdf", where '#' indicates the assignment number (e.g., **A8_Gildong_Hong.pdf**).
- If there are additional files for assignments, put them into a folder along with your report, and then compress into a zip file (e.g., **A8_ Gildong_Hong.zip).**
- Upload your report (or zip file) to the submission page of the KLMS.

What to submit for assignment 8

- A report that does not exceed 3 pages
  (Focus on analysis & discussion rather than method descriptions or code explanations)