Computer Vision
Exercise 1 report

Amrollah Seifoddini

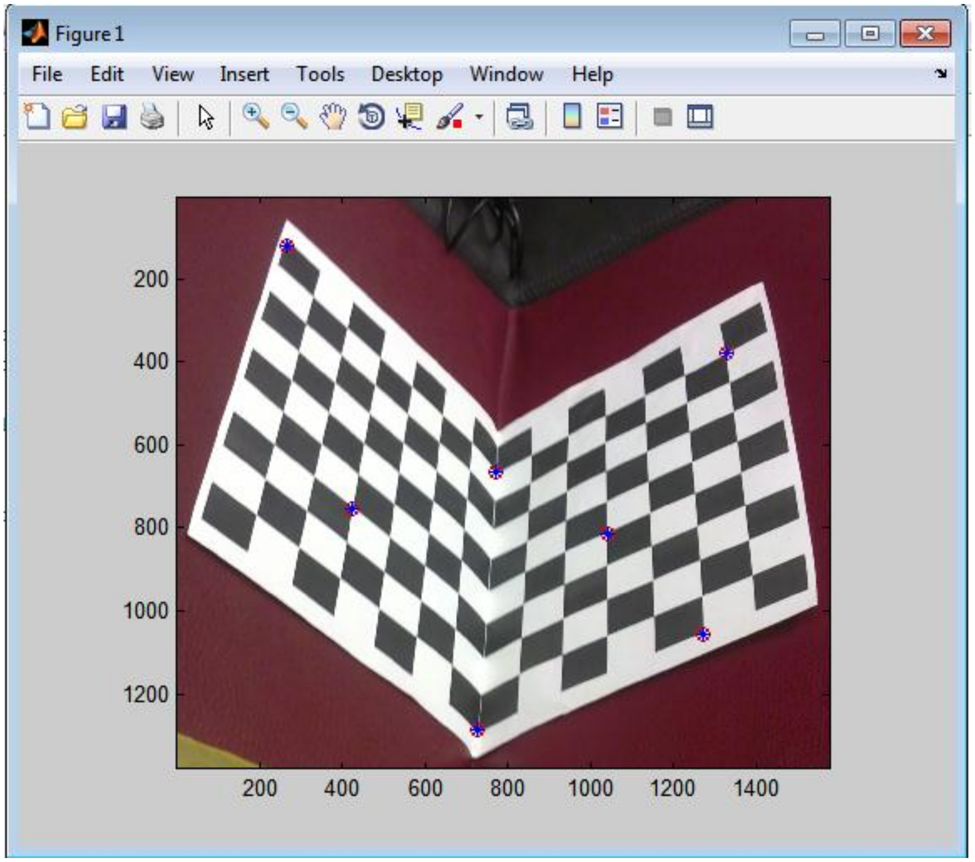
- The images are taken from Rabeeh Karimi, as all my efforts for connecting my mobile camera to the laptop failed.
- All the data and images are available in the attached zip file.
- The results of bouget’s toolbox are available as .mat file in the attachment.

Part 1) DLT:

Error: 0.6012

```
K =     [4142.76483968464     90.8717322544668      512.236301383930

        0                     3838.75395072845      776.611944924064

        0                     0                                    1]

R =     [-0.638551202776751   0.762524982409825     0.103961592106222

        -0.611268834602189    -0.420473548765596    -0.670486693851972

        -0.467549754867272    -0.491688566055142    0.734601647652789]


t =     [1.56101540709755

        4.26043521781777

        32.0342557109819]
```

For the implementation, I followed the exercise slides guide. First, normalization and then forming the matrix equation system is obvious. Afterwards, by using the SVD, I got V matrix and extract P out of it.



*Red circles are the original points and blue crosses are re-projected ones.

Part 2) Gold Standard Algorithm:

Error: 0.5984

K = [4139.84780964289 90.7837266099746 515.218190235403

0 3835.41490600405 779.112684068189

0 0 1]

R = [-0.638326013589452 0.762772761825715 0.103525910726592

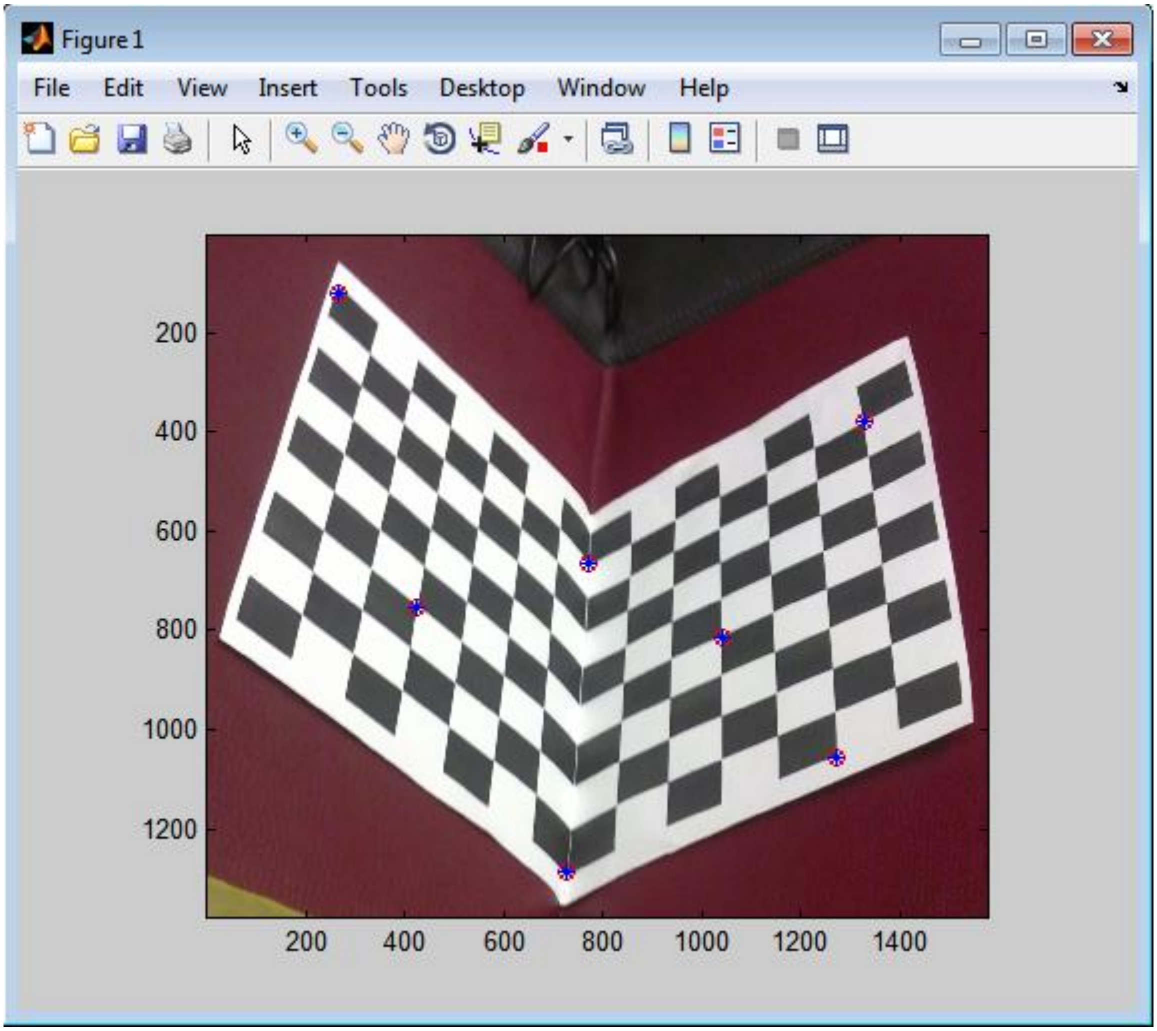
-0.610956517479677 -0.420217724726278 -0.670931589340505

-0.468264918741629 -0.491522916701390 0.734256895257548]

```
t =       [1.53831516387587

           4.23965491846563

           32.0097919390351]
```

For this part, I also followed the slides of the course and exercise guides. After normalization and initialization with DLT, I used an iterative loop for finding the best P^.

As we can see, we have an improvement (although little!) compared to DLT. This comes from our iterative approach.



Part 3) Bouget’s toolbox:

The result are as follows for 14 images that I used.

Focal Length: fc = [3527.27973 3604.87629] ± [148.79011 167.75616]

Principal point: cc = [1307.38494 651.10609] ± [175.67058 181.79677]

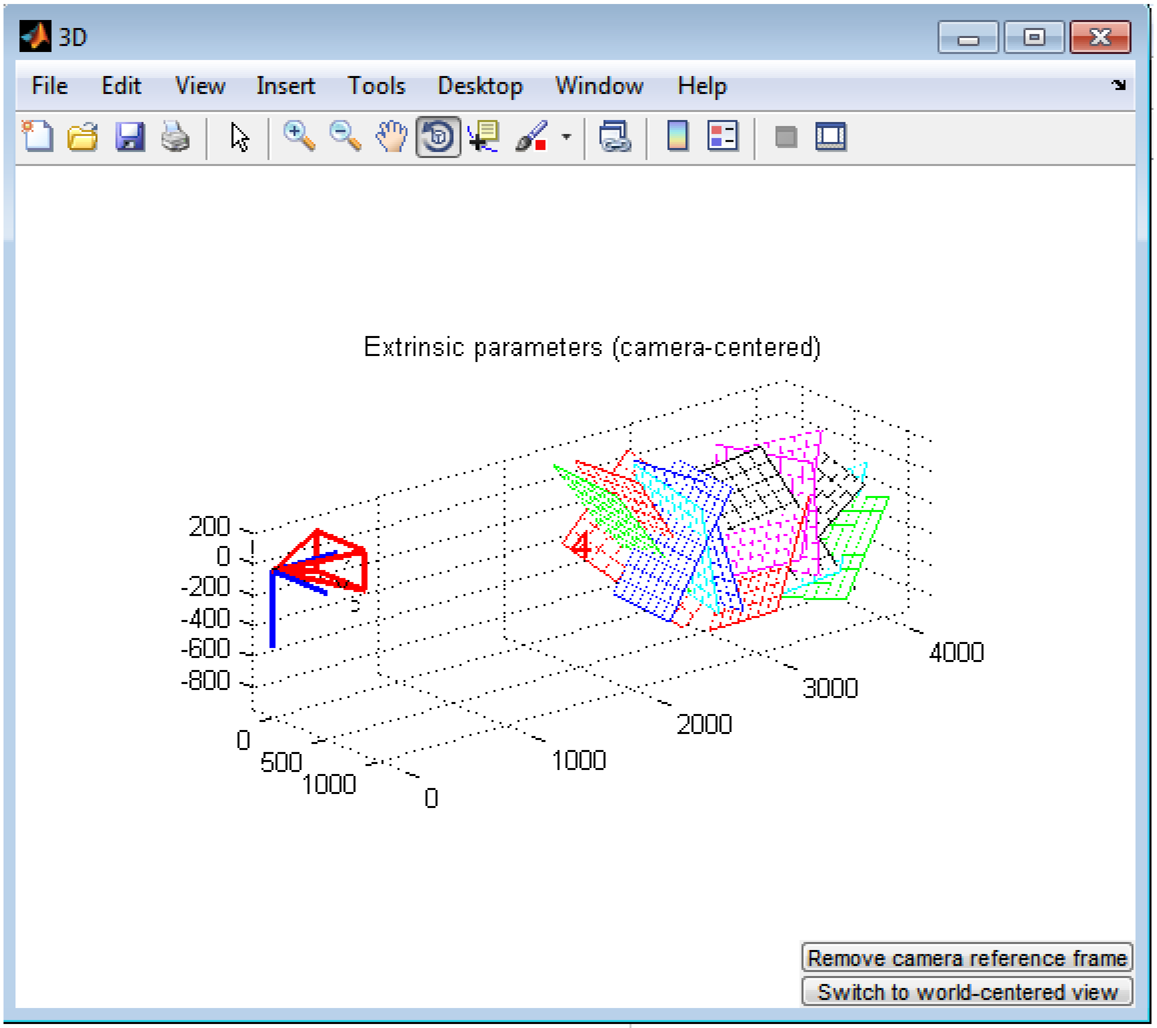
Skew: alpha_c = [0.00000] ± [0.00000] => angle of pixel axes = 90.00000 ± 0.00000 degrees

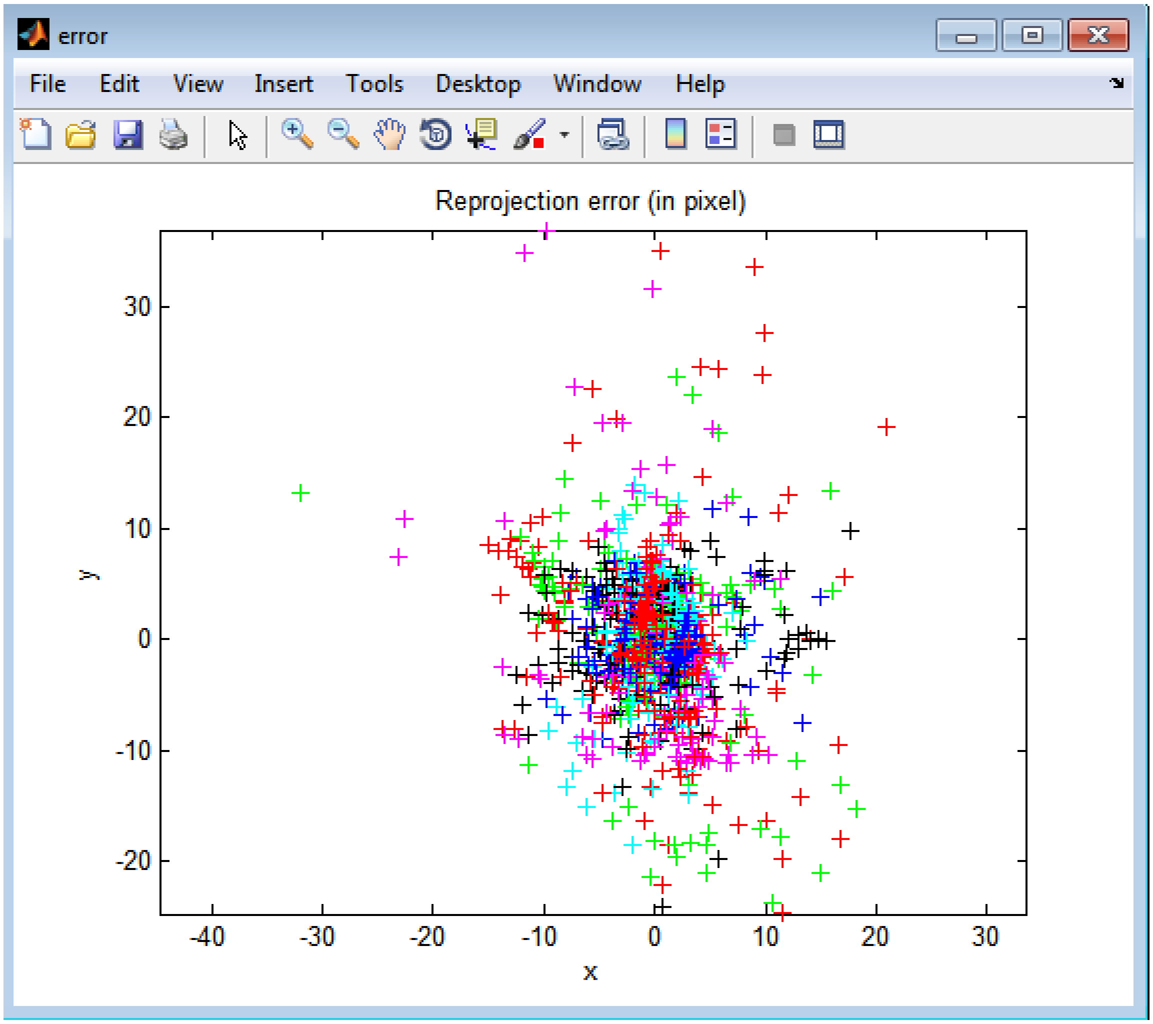
Distortion: kc = [0.08274 -0.56439 -0.01693 0.00463 0.00000] ± [0.17530 0.56595 0.01703 0.02165 0.00000]

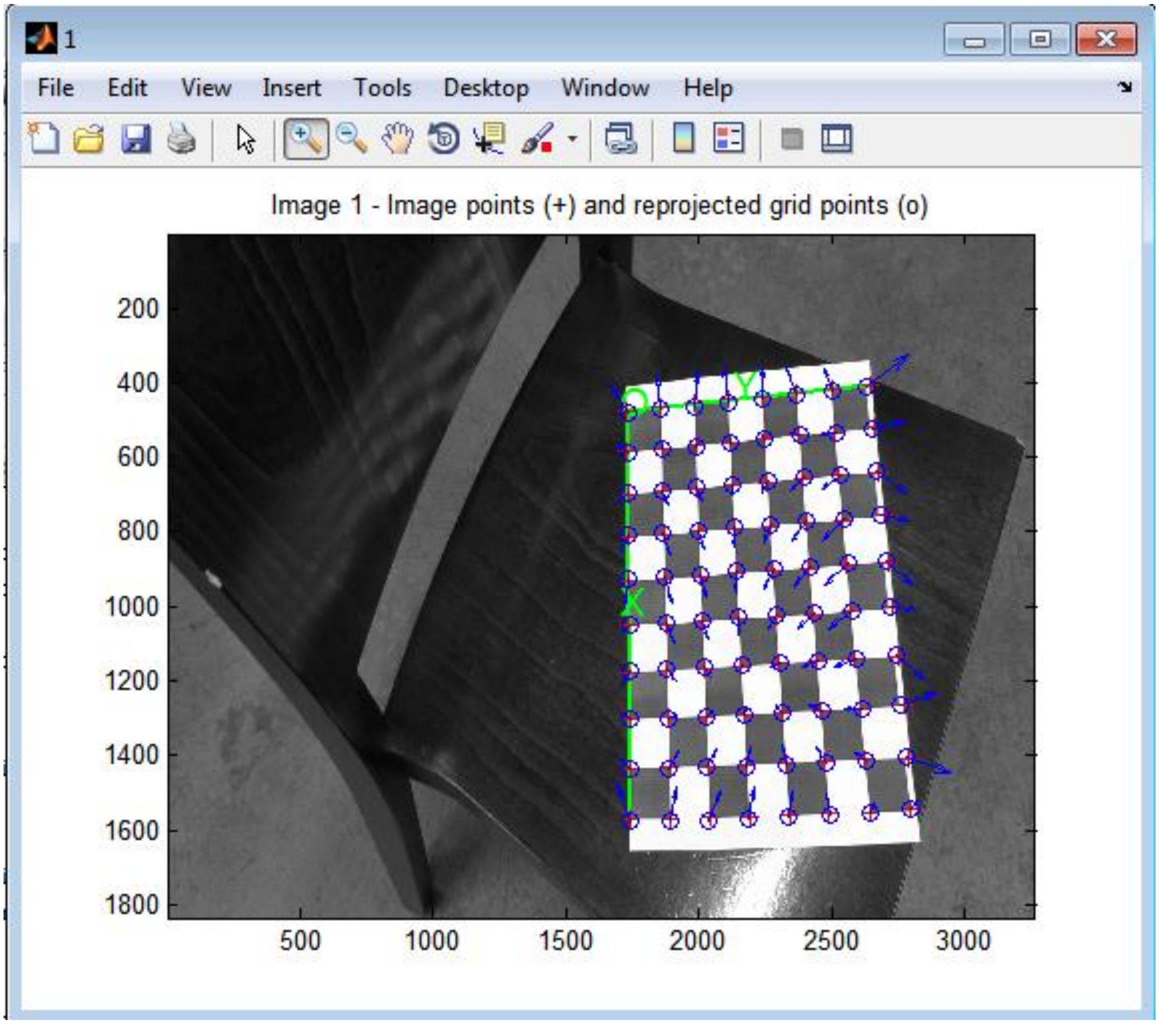
Pixel error: err = [5.28786 7.02424]

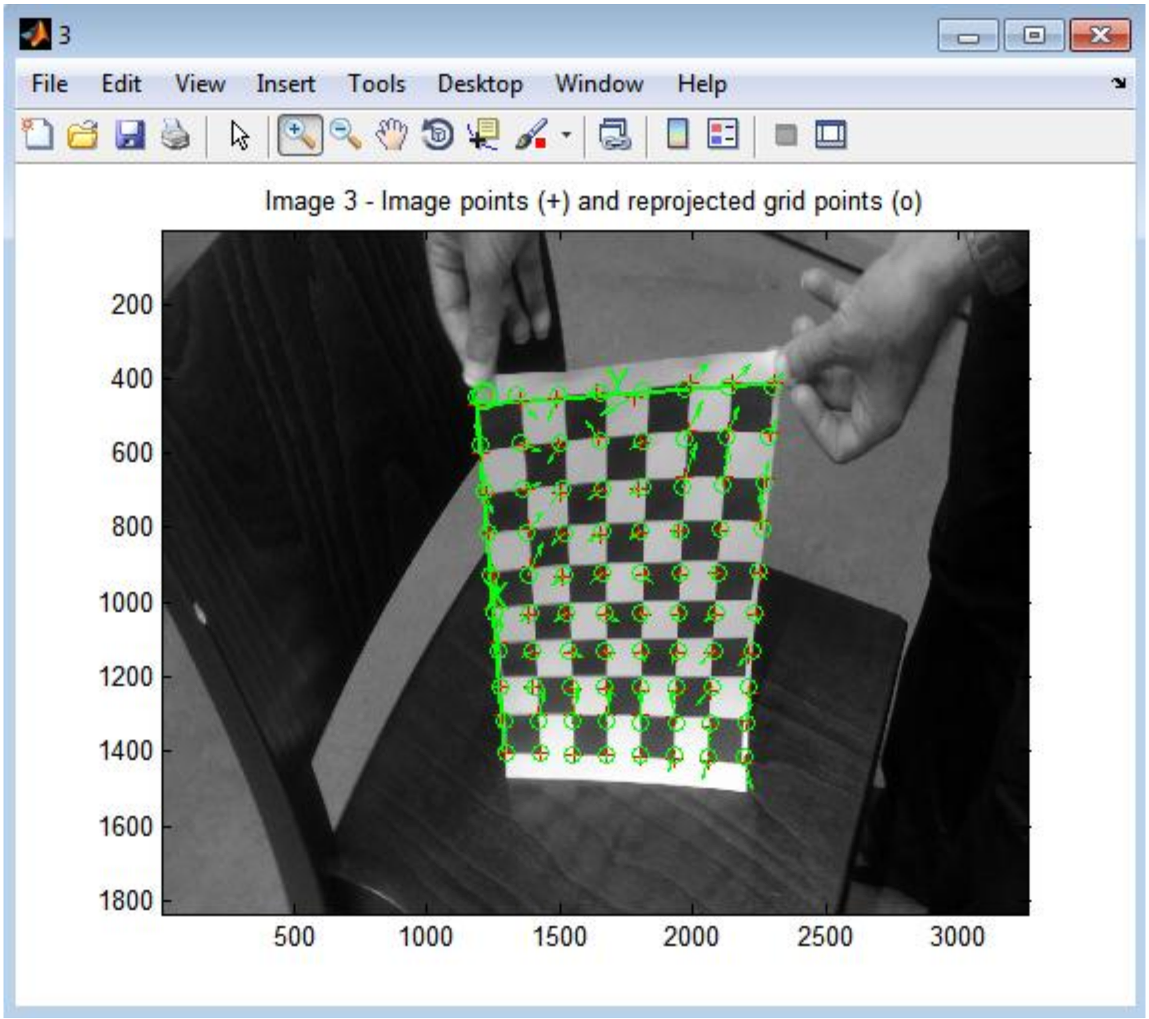
It can be seen that the error rate is much higher than DLT and Gold algorithms. I interpret this as a bad data issue. Because I used some steep angles and did not use the optional parameters that the toolbox offers, this is not a big surprise to see that much error. I mean the size of each square and window size and etc.

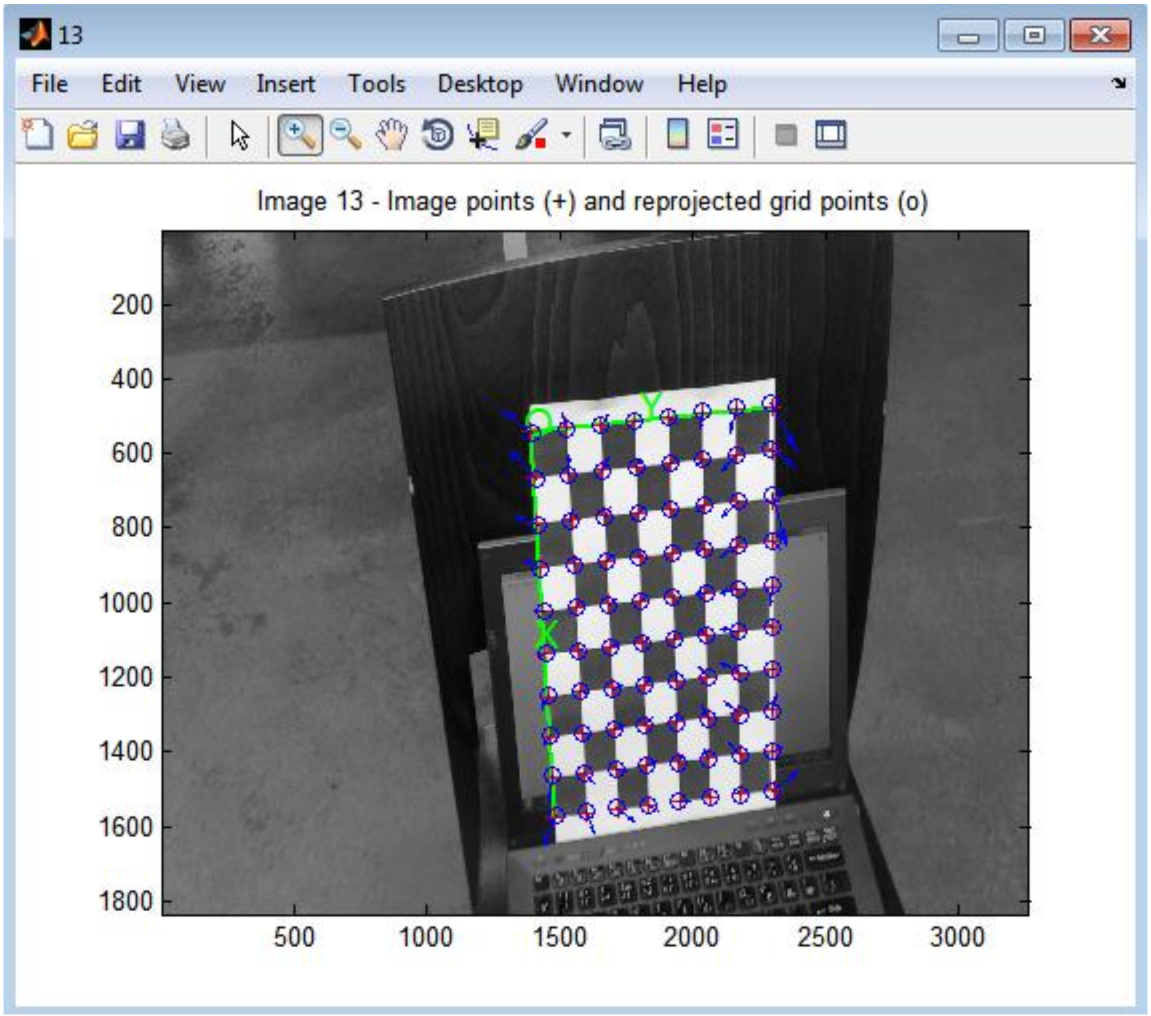
Some of the results are shown as pictures in the following.


3D
File
Edit
View
Insert
Tools
Desktop
Window
Help
Extrinsic parameters (camera-centered)
200
0
-200
-400
-600
-800
0
500
1000
0
1000
2000
3000
4000
4
Remove camera reference frame
Switch to world-centered view


error
File Edit View Insert Tools Desktop Window Help
Reprojection error (in pixel)
30
20
10
0
-10
-20
y
-40 -30 -20 -10 0 10 20 30
x


1
File
Edit
View
Insert
Tools
Desktop
Window
Help
Image 1 - Image points (+) and reprojected grid points (o)
O
Y
X
200
400
600
800
1000
1200
1400
1600
1800
500
1000
1500
2000
2500
3000


3
File
Edit
View
Insert
Tools
Desktop
Window
Help
Image 3 - Image points (+) and reprojected grid points (o)
200
400
600
800
1000
1200
1400
1600
1800
500
1000
1500
2000
2500
3000
X
Y


13
File
Edit
View
Insert
Tools
Desktop
Window
Help
Image 13 - Image points (+) and reprojected grid points (o)
200
400
600
800
1000
1200
1400
1600
1800
500
1000
1500
2000
2500
3000
O
Y
X