4105109 Computer Vision

Assignment #1

Deadline : 11/07(Tue) 11:59 pm.

1. Given the 2D-to-3D corresponding points, calculate the **projection matrix**.
2. Based on the projection matrix, calculate the **calibration** matrix、**rotation** matrix and **translation** matrix.
3. Use projection matrix to calculate the projected 2D points from 3D points. Calculate the **average projection error**.

Note:

- You need to handin the python code and the report
- Your report should include:
  - 1) Method description
  - 2) Experimental results
  - 3) Discussion of results
  - 4) Problems or difficulties you have encountered
- Upload your assignment to E-Course
- File Format
  - Zip all your files into a SINGLE file
  - Name your file by
    StudentID_hw1_version
    ex： 602410143_hw1_v1

Pt2D:

554.369	163.897
520.323	176.470
223.503	178.626
539.106	253.656
562.979	303.278
558.897	309.487
605.067	351.343
516.435	167.624
594.044	236.724
545.960	253.500
499.797	255.359
498.519	271.955
559.816	298.498
527.842	301.539
340.509	344.908
222.583	347.020
258.944	369.477
452.995	371.254
272.860	513.071
566.437	126.101
397.421	151.064
558.371	170.999
272.644	191.097
504.748	199.027
431.022	215.685
418.886	217.739
432.030	219.926
275.598	228.026
399.811	227.902
550.094	232.230
278.271	233.080
527.061	238.432
516.353	240.944
495.216	246.068
507.809	248.087
543.256	247.100
524.625	250.908
495.641	252.181
556.045	252.201
595.109	254.078
476.207	258.978

512.122	260.304
591.976	262.966
473.397	264.076
488.073	265.995
508.213	267.173
559.039	268.740
499.125	268.801
453.699	270.821
493.227	270.901
409.107	275.189
455.203	275.473
590.491	277.524
403.004	279.953
611.191	283.000
586.767	283.551
589.378	291.608
278.236	293.673
582.851	293.808
475.071	303.086
406.567	306.098
463.731	306.329
281.432	314.966
595.629	316.679
479.542	317.811
270.966	318.773
402.313	318.885
555.947	322.307
463.333	322.805
478.711	327.013
514.886	327.748
473.643	329.291
430.249	336.058
513.867	341.379
525.858	340.904
495.458	348.933
213.850	350.007
297.908	354.890
402.341	355.499
485.484	356.698
432.941	359.562
230.329	368.670
370.119	373.635
444.052	373.672

616.341	375.976
189.334	381.383
409.919	380.705
300.385	387.401
386.424	388.799
376.998	391.971
521.521	394.604
323.166	412.030
301.340	418.757
221.892	444.079
198.452	450.737
394.430	154.209
413.251	168.130
406.158	168.961
588.229	191.014
511.361	197.788
437.291	220.108
426.923	220.469
605.651	225.214
283.030	229.838
601.205	231.155
593.174	240.920
604.243	248.788
472.042	251.304
445.508	258.145
493.158	258.051
459.097	260.362
459.986	264.851
466.881	266.160
449.740	267.906
593.738	267.897
477.662	268.967
517.381	270.996
412.783	271.838
450.263	282.242
592.454	282.277
441.817	288.415
451.804	292.899
586.338	292.823
560.201	293.927
372.936	298.322
425.132	299.377
144.636	300.475

140.011	300.814
480.010	301.519
318.077	303.093
471.686	303.493
312.022	304.003
358.014	303.825
607.512	303.926
456.568	311.047
512.168	313.287
474.226	313.674
312.381	314.678
586.919	315.918
470.844	319.860
452.070	321.413
274.130	321.923
308.361	321.858
389.634	322.961
448.754	323.086
510.982	326.180
289.023	327.980
449.736	329.936
303.323	330.686
253.653	336.122
439.651	339.146
296.708	339.645
443.864	339.631
698.021	341.607
389.901	343.917
448.829	345.341
309.077	350.995
428.508	352.097
481.187	358.156
200.756	360.725
206.810	363.760
298.816	367.764
315.807	368.983
310.424	369.986
307.063	370.728
592.624	372.803
213.409	374.524
237.242	381.029
316.255	381.803
311.103	384.191

260.009	386.855
347.396	391.000
264.367	414.756
273.549	418.829
286.761	423.046
255.073	424.440
447.396	427.586
256.829	430.928
657.708	458.822
251.586	494.888
108.932	529.806
421.907	529.506
568.280	78.036
568.694	123.108
584.336	138.339
400.932	150.637
363.247	153.491
549.002	165.490
539.845	166.437
540.917	172.858
523.912	174.809
276.245	190.770
614.460	221.649
416.990	223.868
575.472	245.148
456.202	255.348
499.347	260.254
532.337	263.612
432.158	264.892
594.341	264.954
587.940	268.896
392.231	271.263
545.856	275.719
540.627	279.112
532.127	280.043
429.232	280.986
489.420	281.224
411.121	282.298
363.387	283.099
327.703	284.703
594.569	293.715
361.720	298.811
376.633	299.904

329.514	301.742
199.410	305.327
193.175	306.245
607.227	310.234
453.120	310.717
300.077	312.083
542.560	313.532
328.742	314.970
435.379	316.615
463.398	316.481
297.890	319.099
501.637	318.435
280.032	320.418
447.978	319.933
462.749	319.595
553.937	320.737
508.394	322.364
284.034	322.838
298.061	323.958
275.920	326.170
285.510	325.630
265.936	332.072
402.214	334.301
374.969	334.952
308.727	336.115
386.904	338.820
279.987	339.563
277.038	342.325
246.663	343.819
430.640	344.315
634.233	345.174
314.928	349.713
305.972	351.758
513.323	352.018
340.722	355.107
446.548	358.103
375.844	358.848
167.233	360.982
251.312	360.986
192.289	363.665
309.854	364.537
303.708	366.028
339.523	365.785

576.864	367.716
556.270	368.966
59.547	372.902
168.387	373.684
346.580	379.093
15.856	382.506
39.601	381.344
366.035	384.891
250.167	389.162
521.806	391.362
231.290	391.795
15.445	394.461
368.815	393.420
229.695	395.221
249.948	394.665
645.039	396.298
475.312	400.395
179.861	403.126
511.877	405.186
636.804	405.342
175.003	414.103
250.920	417.772
288.355	419.520
176.823	421.802
416.271	423.069
291.640	424.321
26.028	427.647
655.200	430.645
735.251	431.219
178.713	433.214
185.003	452.987
649.838	459.461
695.760	474.955
304.646	480.672
439.107	483.887
665.089	489.945
644.653	494.798
225.451	500.528
195.490	503.088
187.097	506.298
299.097	531.645
113.320	543.688

Pt3D:

1.489	1.094	-5.896
1.139	0.936	-5.628
-1.094	0.738	-4.531
1.264	0.278	-5.472
1.552	-0.132	-5.848
1.512	-0.187	-5.847
1.852	-0.533	-5.658
1.110	1.016	-5.653
1.821	0.448	-5.816
1.332	0.279	-5.514
0.901	0.250	-5.211
0.895	0.125	-5.263
1.517	-0.089	-5.805
1.216	-0.107	-5.649
-0.302	-0.387	-4.643
-0.996	-0.373	-4.179
-0.808	-0.534	-4.362
0.542	-0.661	-5.336
-0.622	-1.280	-3.864
1.708	1.516	-6.250
0.093	1.072	-5.243
1.518	1.024	-5.861
-0.784	0.669	-4.643
0.973	0.716	-5.414
0.350	0.538	-5.026
0.257	0.520	-4.973
0.355	0.507	-5.009
-0.731	0.401	-4.491
0.107	0.437	-4.877
1.348	0.450	-5.449
-0.710	0.369	-4.485
1.137	0.393	-5.330
1.038	0.368	-5.262
0.855	0.321	-5.152
0.969	0.308	-5.234
1.294	0.322	-5.457
1.128	0.284	-5.366
0.861	0.271	-5.163
1.414	0.302	-5.684
1.888	0.309	-6.014
0.696	0.213	-5.071

1.015	0.220	-5.311
1.838	0.218	-5.974
0.678	0.178	-5.075
0.803	0.168	-5.171
0.982	0.161	-5.305
1.471	0.159	-5.662
0.901	0.151	-5.254
0.519	0.130	-4.981
0.847	0.131	-5.221
0.182	0.088	-4.770
0.535	0.090	-5.017
1.842	0.090	-6.033
0.135	0.054	-4.753
2.076	0.049	-6.173
1.817	0.042	-6.054
1.846	-0.036	-6.091
-0.661	-0.043	-4.207
1.756	-0.058	-6.008
0.709	-0.120	-5.289
0.162	-0.133	-4.846
0.609	-0.144	-5.223
-0.656	-0.178	-4.324
1.933	-0.263	-6.175
0.768	-0.236	-5.393
-0.721	-0.198	-4.297
0.123	-0.229	-4.923
1.497	-0.297	-5.879
0.612	-0.275	-5.281
0.769	-0.317	-5.432
1.082	-0.329	-5.595
0.709	-0.333	-5.389
0.340	-0.366	-5.060
1.084	-0.449	-5.645
1.191	-0.459	-5.742
0.906	-0.503	-5.526
-1.048	-0.385	-4.160
-0.591	-0.450	-4.547
0.124	-0.510	-5.049
0.824	-0.562	-5.498
0.372	-0.544	-5.167
-0.971	-0.511	-4.255
-0.102	-0.619	-4.862
0.466	-0.671	-5.273

1.820	-0.686	-5.271
-1.201	-0.582	-4.168
0.202	-0.705	-5.116
-0.588	-0.690	-4.648
0.008	-0.757	-5.035
-0.051	-0.768	-4.951
1.025	-0.788	-4.976
-0.422	-0.871	-4.740
-0.579	-0.914	-4.696
-1.043	-1.012	-4.382
-1.194	-1.049	-4.347
0.070	1.049	-5.226
0.221	0.940	-5.244
0.163	0.928	-5.203
1.782	0.849	-5.863
1.033	0.734	-5.455
0.396	0.510	-5.024
0.306	0.490	-4.944
1.929	0.541	-5.850
-0.677	0.389	-4.493
1.890	0.496	-5.842
1.818	0.413	-5.844
1.945	0.346	-5.944
0.660	0.272	-5.022
0.453	0.217	-4.913
0.843	0.227	-5.181
0.559	0.205	-4.985
0.566	0.169	-5.000
0.621	0.161	-5.041
0.490	0.144	-4.967
1.890	0.186	-6.077
0.714	0.148	-5.120
1.065	0.135	-5.373
0.207	0.114	-4.775
0.493	0.043	-4.998
1.897	0.056	-6.139
0.428	-0.006	-4.975
0.507	-0.040	-5.039
1.823	-0.045	-6.087
1.516	-0.050	-5.804
-0.076	-0.075	-4.664
0.301	-0.082	-4.909
-1.686	-0.085	-4.686

-1.714	-0.091	-4.673
0.763	-0.110	-5.358
-0.433	-0.103	-4.436
0.685	-0.124	-5.282
-0.471	-0.109	-4.413
-0.175	-0.110	-4.608
2.063	-0.147	-6.233
0.554	-0.183	-5.137
1.047	-0.209	-5.512
0.710	-0.206	-5.325
-0.472	-0.180	-4.444
1.828	-0.257	-6.097
0.686	-0.254	-5.343
0.518	-0.256	-5.133
-0.703	-0.223	-4.318
-0.498	-0.225	-4.437
0.041	-0.252	-4.887
0.492	-0.269	-5.131
1.041	-0.315	-5.493
-0.616	-0.263	-4.388
0.503	-0.325	-5.164
-0.533	-0.285	-4.445
-0.826	-0.309	-4.276
0.420	-0.386	-5.119
-0.575	-0.343	-4.440
0.456	-0.399	-5.165
2.723	-0.463	-5.840
0.043	-0.410	-4.952
0.499	-0.449	-5.223
-0.512	-0.431	-4.583
0.336	-0.492	-5.114
0.782	-0.572	-5.468
-1.121	-0.448	-4.132
-1.094	-0.471	-4.170
-0.583	-0.544	-4.573
-0.470	-0.561	-4.658
-0.510	-0.569	-4.639
-0.530	-0.571	-4.629
1.662	-0.677	-5.351
-1.061	-0.546	-4.211
-0.936	-0.596	-4.308
-0.473	-0.658	-4.705
-0.509	-0.669	-4.680

-0.807	-0.649	-4.400
-0.263	-0.737	-4.799
-0.795	-0.844	-4.481
-0.743	-0.881	-4.533
-0.661	-0.923	-4.594
-0.854	-0.907	-4.473
0.448	-0.971	-4.660
-0.844	-0.952	-4.480
1.723	-1.062	-4.179
-0.783	-1.287	-4.188
-1.486	-1.319	-3.693
0.239	-1.319	-3.714
1.695	1.941	-6.176
1.739	1.571	-6.358
1.866	1.403	-6.270
0.121	1.082	-5.265
-0.187	1.093	-5.389
1.425	1.064	-5.811
1.333	1.045	-5.758
1.334	0.982	-5.717
1.271	1.053	-6.189
-0.766	0.679	-4.685
2.029	0.582	-5.910
0.241	0.471	-4.935
1.626	0.362	-5.704
0.535	0.239	-4.959
0.902	0.217	-5.251
1.199	0.193	-5.438
0.348	0.164	-4.838
1.894	0.209	-6.075
1.815	0.170	-6.003
0.059	0.116	-4.682
1.359	0.109	-5.662
1.302	0.071	-5.604
1.234	0.069	-5.622
0.330	0.050	-4.887
0.823	0.054	-5.262
0.193	0.041	-4.824
-0.138	0.030	-4.577
-0.369	0.018	-4.432
1.940	-0.056	-6.220
-0.152	-0.077	-4.613
-0.049	-0.085	-4.668

-0.360	-0.093	-4.465
-1.254	-0.117	-4.533
-1.295	-0.124	-4.530
2.081	-0.213	-6.306
0.524	-0.174	-5.108
-0.545	-0.159	-4.385
1.363	-0.223	-5.818
-0.368	-0.180	-4.500
0.384	-0.215	-5.036
0.614	-0.228	-5.233
-0.560	-0.206	-4.396
0.951	-0.251	-5.467
-0.665	-0.212	-4.325
0.485	-0.244	-5.130
0.611	-0.252	-5.253
1.463	-0.286	-5.822
1.017	-0.284	-5.529
-0.643	-0.228	-4.343
-0.560	-0.239	-4.405
-0.692	-0.249	-4.322
-0.634	-0.245	-4.345
-0.752	-0.284	-4.299
0.132	-0.344	-4.939
-0.064	-0.334	-4.765
-0.498	-0.323	-4.474
0.019	-0.372	-4.868
-0.673	-0.337	-4.366
-0.691	-0.354	-4.364
-0.866	-0.356	-4.257
0.353	-0.434	-5.122
2.106	-0.479	-5.654
-0.473	-0.423	-4.620
-0.530	-0.434	-4.570
1.083	-0.541	-5.678
-0.300	-0.468	-4.669
0.483	-0.548	-5.253
-0.059	-0.512	-4.848
-1.298	-0.441	-4.042
-0.846	-0.470	-4.302
-1.167	-0.464	-4.110
-0.508	-0.526	-4.613
-0.549	-0.535	-4.602
-0.310	-0.542	-4.687

1.556	-0.644	-5.427
1.357	-0.640	-5.291
-2.677	-0.693	-5.486
-1.296	-0.519	-4.062
-0.265	-0.648	-4.759
-2.989	-0.765	-5.400
-2.776	-0.747	-5.362
-0.131	-0.704	-4.870
-0.864	-0.658	-4.364
1.043	-0.782	-5.089
-0.971	-0.662	-4.296
-2.948	-0.840	-5.325
-0.112	-0.768	-4.899
-0.978	-0.682	-4.286
-0.865	-0.695	-4.366
1.935	-0.799	-4.961
0.679	-0.834	-4.993
-1.248	-0.705	-4.135
0.936	-0.851	-4.887
1.825	-0.847	-4.817
-1.281	-0.779	-4.151
-0.869	-0.851	-4.417
-0.650	-0.896	-4.588
-1.274	-0.827	-4.163
0.229	-0.942	-4.699
-0.630	-0.932	-4.607
-2.599	-1.011	-4.856
1.835	-0.959	-4.504
2.326	-0.942	-4.409
-1.276	-0.906	-4.206
-1.248	-1.041	-4.251
1.688	-1.074	-4.213
1.912	-1.132	-4.069
-0.471	-1.184	-4.154
0.352	-1.177	-4.064
1.667	-1.177	-3.920
1.530	-1.187	-3.877
-0.908	-1.237	-3.933
-1.091	-1.256	-3.958
-1.127	-1.263	-3.917
-0.433	-1.310	-3.644
-1.420	-1.358	-3.599