**Lab #2**

Tasks 1-4:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Image 27** | | |  | **Image 28** | | |
| **Fiducial Coordinates** | |  |  | **Fiducial Coordinates** | |  |
| X | Y |  |  | X | Y |  |
| -9.4492 | 96.2439 |  |  | -105.3835 | 98.7624 |  |
| 85.0325 | 103.7430 |  |  | -10.1310 | 109.6993 |  |
| -2.3240 | -6.0007 |  |  | -95.0282 | -4.8416 |  |
| 105.9490 | -0.4074 |  |  | 10.3289 | 4.0189 |  |
| 18.9146 | -81.8141 |  |  | -72.5433 | -79.7803 |  |
| 90.2871 | -91.0456 |  |  | -1.4113 | -86.9362 |  |
| 18.1697 | 109.5464 |  |  | -77.8452 | 113.3822 |  |
| 44.6791 | 7.4901 |  |  | -48.7951 | 10.1706 |  |
| -7.5846 | -49.0707 |  |  | -98.8174 | -48.0328 |  |
| 52.7325 | -93.1360 |  |  | -38.9301 | -90.0300 |  |
|  |  |  |  |  |  |  |
| **Principal Point Offset** | | |  | **Principal Point Offset** | | |
| **X** | **Y** | **Radius** |  | **X** | **Y** | **Radius** |
| -9.4431576 | 96.23791684 | 96.7001027 |  | -105.3775 | 98.7564 | 144.4204 |
| 85.03847611 | 103.7369713 | 134.137622 |  | -10.1250 | 109.6933 | 110.1595 |
| -2.31797657 | -6.00665112 | 6.43839056 |  | -95.0222 | -4.8476 | 95.1458 |
| 105.9550442 | -0.41335267 | 105.955851 |  | 10.3349 | 4.0129 | 11.0867 |
| 18.92058979 | -81.82010003 | 83.9792682 |  | -72.5373 | -79.7863 | 107.8309 |
| 90.29311622 | -91.05162049 | 128.231215 |  | -1.4053 | -86.9422 | 86.9535 |
| 18.17574591 | 109.5404195 | 111.038107 |  | -77.8392 | 113.3762 | 137.5249 |
| 44.68509712 | 7.48408807 | 45.3074991 |  | -48.7891 | 10.1646 | 49.8367 |
| -7.57860784 | -49.07673555 | 49.6584461 |  | -98.8114 | -48.0388 | 109.8700 |
| 52.73847417 | -93.14201246 | 107.036354 |  | -38.9241 | -90.0360 | 98.0896 |
|  |  |  |  |  |  |  |
| **Radial Lens Distortion Correction** | |  |  | **Radial Lens Distortion Correction** | |  |
| **Δxrad** | **Δyrad** |  |  | **Δxrad** | **Δyrad** |  |
| -7.6902E-05 | 7.8373E-04 |  |  | -1.3380E-04 | 1.2539E-04 |  |
| 1.3599E-03 | 1.6589E-03 |  |  | -1.9485E-04 | 2.1110E-03 |  |
| 2.0432E-04 | 5.2947E-04 |  |  | -6.1496E-04 | -3.1372E-05 |  |
| 1.7501E-03 | -6.8277E-06 |  |  | -8.9821E-04 | -3.4876E-04 |  |
| -1.3547E-04 | 5.8582E-04 |  |  | -1.2932E-03 | -1.4224E-03 |  |
| 1.8384E-03 | -1.8539E-03 |  |  | 4.6325E-06 | 2.8660E-04 |  |
| 3.5833E-04 | 2.1596E-03 |  |  | -9.4982E-04 | 1.3834E-03 |  |
| -2.6645E-03 | -4.4626E-04 |  |  | 2.6381E-03 | -5.4962E-04 |  |
| 4.1149E-04 | 2.6647E-03 |  |  | -1.8855E-03 | -9.1664E-04 |  |
| 9.1187E-04 | -1.6105E-03 |  |  | -3.7291E-04 | -8.6258E-04 |  |
|  |  |  |  |  |  |  |
| **Radial Lens Distortion Correction w/ Principal Point** | |  |  | **Radial Lens Distortion Correction w/ Principal Point** | |  |
| **x\_corrected** | **y\_corrected** |  |  | **x\_corrected** | **y\_corrected** |  |
| -9.4432 | 96.2387 |  |  | -105.3776 | 98.7566 |  |
| 85.0398 | 103.7386 |  |  | -10.1252 | 109.6954 |  |
| -2.3178 | -6.0061 |  |  | -95.0228 | -4.8476 |  |
| 105.9568 | -0.4134 |  |  | 10.3340 | 4.0125 |  |
| 18.9205 | -81.8195 |  |  | -72.5386 | -79.7877 |  |
| 90.2950 | -91.0535 |  |  | -1.4053 | -86.9419 |  |
| 18.1761 | 109.5426 |  |  | -77.8401 | 113.3775 |  |
| 44.6824 | 7.4836 |  |  | -48.7865 | 10.1641 |  |
| -7.5782 | -49.0741 |  |  | -98.8133 | -48.0397 |  |
| 52.7394 | -93.1436 |  |  | -38.9245 | -90.0369 |  |
|  |  |  |  |  |  |  |
| **Decentering Lens Distortion Correction** | |  |  | **Decentering Lens Distortion Correction** | |  |
| **Δxdec** | **Δydec** |  |  | **Δxdec** | **Δydec** |  |
| -1.2604E-03 | -9.6536E-05 |  |  | -5.5419E-03 | 2.3074E-03 |  |
| -4.5845E-03 | -2.8585E-03 |  |  | -1.6338E-03 | -1.4411E-04 |  |
| -7.3668E-06 | -5.1388E-06 |  |  | -3.6604E-03 | -2.3538E-04 |  |
| -4.5322E-03 | -1.2563E-04 |  |  | -4.6313E-05 | -1.3063E-05 |  |
| -1.0077E-03 | 1.6654E-04 |  |  | -3.1232E-03 | -1.8561E-03 |  |
| -4.2067E-03 | 1.8090E-03 |  |  | -1.0212E-03 | -3.1048E-04 |  |
| -1.7972E-03 | -9.8062E-04 |  |  | -3.9607E-03 | 1.8296E-03 |  |
| -8.2202E-04 | -1.1652E-04 |  |  | -9.6296E-04 | 1.0057E-04 |  |
| -3.5648E-04 | -1.8927E-04 |  |  | -4.3694E-03 | -1.4821E-03 |  |
| -2.1706E-03 | 9.6975E-04 |  |  | -1.7887E-03 | -1.2596E-03 |  |
|  |  |  |  |  |  |  |
| **Decentering Lens Distortion Correction w/ Principal Point** | |  |  | **Decentering Lens Distortion Correction w/ Principal Point** | |  |
| **x\_corrected** | **y\_corrected** |  |  | **x\_corrected** | **y\_corrected** |  |
| -9.4444 | 96.2378 |  |  | -105.3830 | 98.7588 |  |
| 85.0339 | 103.7341 |  |  | -10.1266 | 109.6931 |  |
| -2.3180 | -6.0067 |  |  | -95.0259 | -4.8478 |  |
| 105.9505 | -0.4135 |  |  | 10.3349 | 4.0128 |  |
| 18.9196 | -81.8199 |  |  | -72.5404 | -79.7882 |  |
| 90.2889 | -91.0498 |  |  | -1.4063 | -86.9425 |  |
| 18.1739 | 109.5394 |  |  | -77.8431 | 113.3780 |  |
| 44.6843 | 7.4840 |  |  | -48.7901 | 10.1647 |  |
| -7.5790 | -49.0769 |  |  | -98.8158 | -48.0403 |  |
| 52.7363 | -93.1410 |  |  | -38.9259 | -90.0372 |  |
|  |  |  |  |  |  |  |
| **Atmospheric Refraction Correction** | |  |  | **Atmospheric Refraction Correction** | |  |
| **Δxatm** | **Δyatm** |  |  | **Δxatm** | **Δyatm** |  |
| 1.5957E-04 | -1.6262E-03 |  |  | 2.4040E-03 | -2.2530E-03 |  |
| -1.8148E-03 | -2.2138E-03 |  |  | 1.8559E-04 | -2.0106E-03 |  |
| 2.8076E-05 | 7.2754E-05 |  |  | 1.5911E-03 | 8.1171E-05 |  |
| -1.8926E-03 | 7.3835E-06 |  |  | -1.2561E-04 | -4.8773E-05 |  |
| -2.9737E-04 | 1.2859E-03 |  |  | 1.3106E-03 | 1.4416E-03 |  |
| -1.8550E-03 | 1.8706E-03 |  |  | 2.2454E-05 | 1.3892E-03 |  |
| -3.3497E-04 | -2.0188E-03 |  |  | 1.6980E-03 | -2.4732E-03 |  |
| -5.8744E-04 | -9.8387E-05 |  |  | 6.5220E-04 | -1.3588E-04 |  |
| 1.0124E-04 | 6.5560E-04 |  |  | 1.8079E-03 | 8.7895E-04 |  |
| -9.4828E-04 | 1.6748E-03 |  |  | 6.6316E-04 | 1.5340E-03 |  |
|  |  |  |  |  |  |  |
| **Atmospheric Refraction Correction w/ Principal Point** | |  |  | **Atmospheric Refraction Correction w/ Principal Point** | |  |
| **x\_corrected** | **y\_corrected** |  |  | **x\_corrected** | **y\_corrected** |  |
| -9.4430 | 96.2363 |  |  | -105.3751 | 98.7542 |  |
| 85.0367 | 103.7348 |  |  | -10.1248 | 109.6912 |  |
| -2.3179 | -6.0066 |  |  | -95.0206 | -4.8475 |  |
| 105.9532 | -0.4133 |  |  | 10.3348 | 4.0128 |  |
| 18.9203 | -81.8188 |  |  | -72.5360 | -79.7849 |  |
| 90.2913 | -91.0497 |  |  | -1.4053 | -86.9408 |  |
| 18.1754 | 109.5384 |  |  | -77.8375 | 113.3737 |  |
| 44.6845 | 7.4840 |  |  | -48.7884 | 10.1645 |  |
| -7.5785 | -49.0761 |  |  | -98.8096 | -48.0379 |  |
| 52.7375 | -93.1403 |  |  | -38.9235 | -90.0345 |  |
|  |  |  |  |  |  |  |
| **Total Correction** | |  |  | **Total Correction** | |  |
| **x'** | **y'** |  |  | **x'** | **y'** |  |
| -9.4443 | 96.2370 |  |  | -105.3808 | 98.7566 |  |
| 85.0334 | 103.7336 |  |  | -10.1267 | 109.6932 |  |
| -2.3178 | -6.0061 |  |  | -95.0249 | -4.8477 |  |
| 105.9504 | -0.4135 |  |  | 10.3339 | 4.0124 |  |
| 18.9191 | -81.8181 |  |  | -72.5404 | -79.7881 |  |
| 90.2889 | -91.0498 |  |  | -1.4063 | -86.9408 |  |
| 18.1740 | 109.5396 |  |  | -77.8424 | 113.3769 |  |
| 44.6810 | 7.4834 |  |  | -48.7868 | 10.1640 |  |
| -7.5785 | -49.0736 |  |  | -98.8159 | -48.0403 |  |
| 52.7363 | -93.1410 |  |  | -38.9256 | -90.0366 |  |

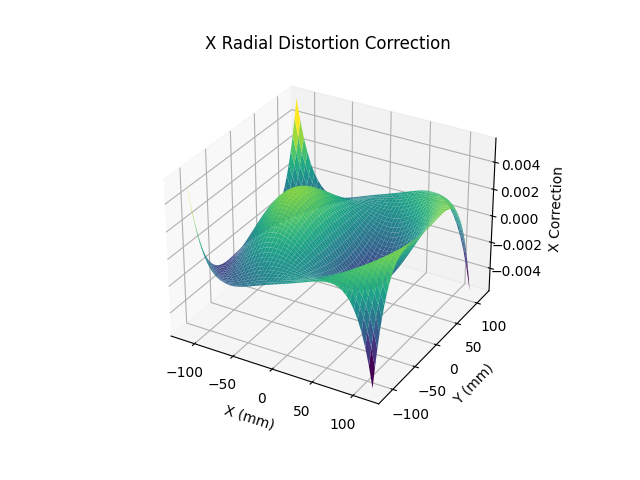
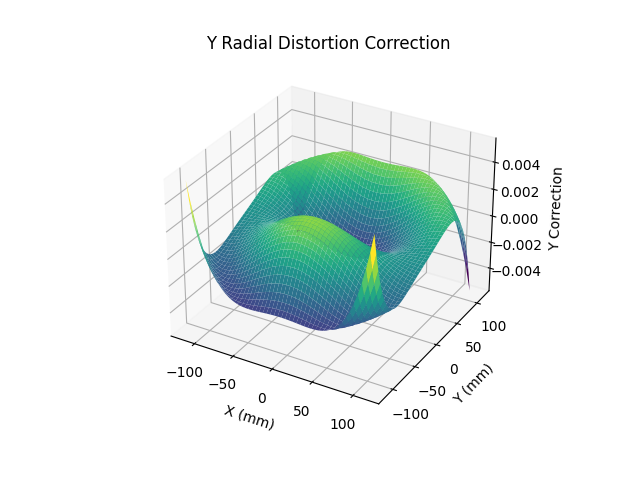
Task 5:

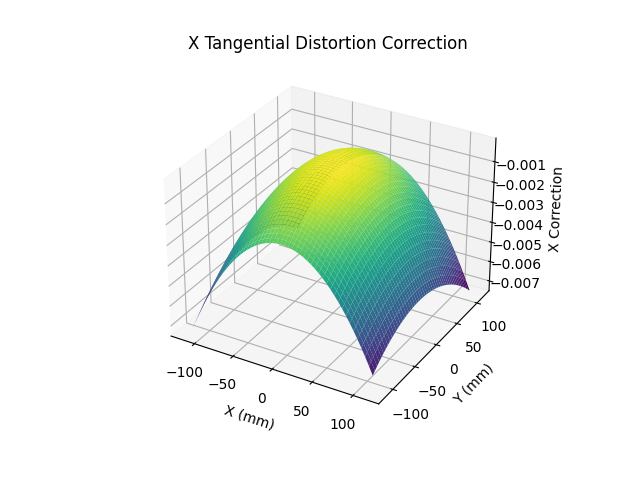
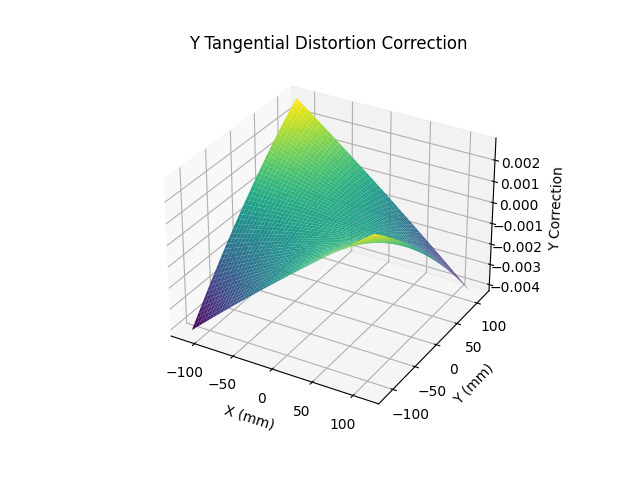
The maximum magnitude occurs at the corners of the image from the center (0,0) at the principal point. In mm, point (114.3, 114.3) was used to find distortion values.

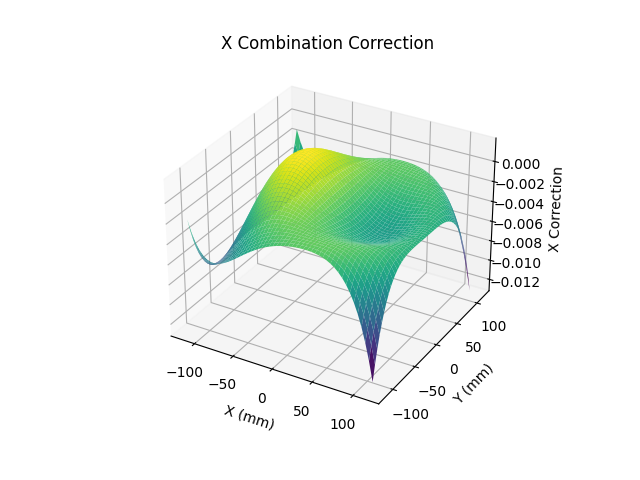
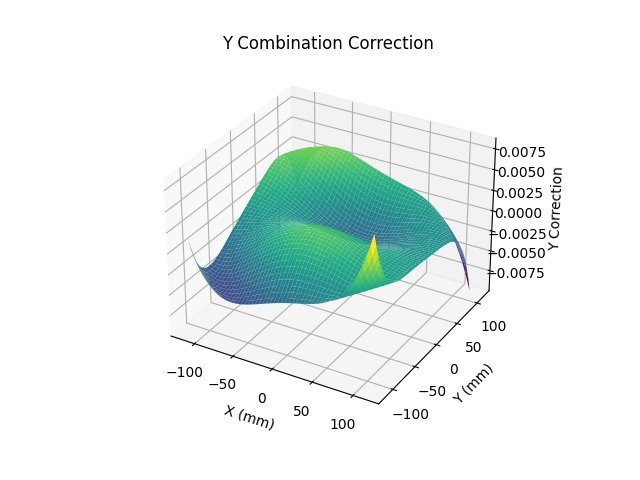
|  |  |
| --- | --- |
| **Max Magnitude** | |
| max radial distortion x | 0.00552854327567554 |
| max radial distortion y | 0.00552854327567554 |
| max tangential distortion x | 0.00735374013120000 |
| max tangential distortion y | 0.00415659813840000 |
| max atmospheric refraction x | 0.00291735710134084 |
| max atmospheric refraction y | 0.00291735710134084 |

|  |  |
| --- | --- |
| **Max Magnitude (Ground)** | |
| max radial distortion x | 27.6427163783777 |
| max radial distortion y | 27.6427163783777 |
| max tangential distortion x | 36.7687006560000 |
| max tangential distortion y | 20.7829906920000 |
| max atmospheric refraction x | 14.5867855067042 |
| max atmospheric refraction y | 14.5867855067042 |

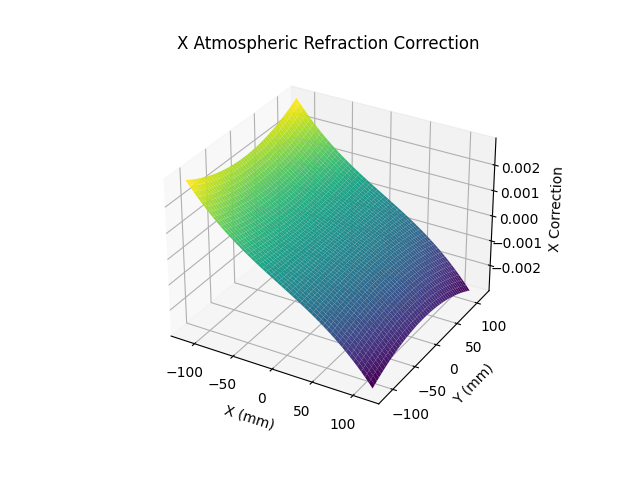
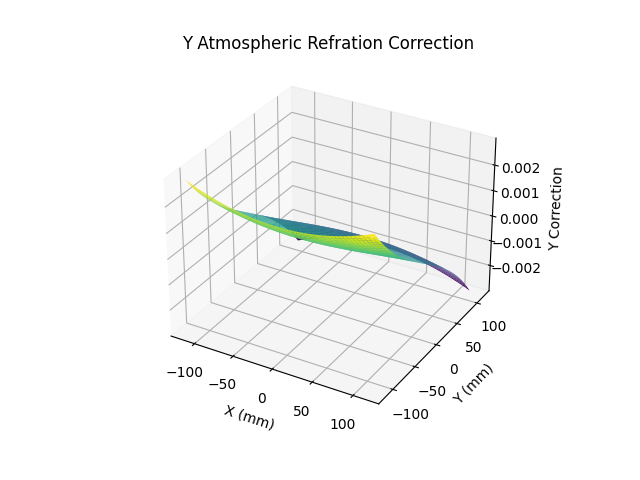
Task 6:

Task 7:

Questions:

Given the results from task 5. Which of the corrections are significant, and why? What are the magnitudes of these corrections in ground coordinates?

Pixel size is approximately 6-7 µm and looking at all three corrections are in the millimeters, all three of them are significant. Multiplying the coordinate with the scale number of 5000, we get:

|  |  |
| --- | --- |
| **Max Magnitude (Ground)** | |
| max radial distortion x | 27.6427163783777 |
| max radial distortion y | 27.6427163783777 |
| max tangential distortion x | 36.7687006560000 |
| max tangential distortion y | 20.7829906920000 |
| max atmospheric refraction x | 14.5867855067042 |
| max atmospheric refraction y | 14.5867855067042 |