CIVE 7397 – Optical Imaging Metrology

Lab #2 – Applying Image Corrections

Lab Description

The purpose of this lab is to correct measured image coordinates for lens distortion and atmospheric refraction.

The included spreadsheet (Lab2_Image_Measurements.xlsx) contains image measurements of common object points for both images 27 and 28. The camera calibration report for the camera used to acquire these images was the example given in Module#3 of the lecture notes. Please use the values for focal length, principal point offset, radial lens distortion and decentering distortion from this calibration certificate (Slide #7). The images were capture from an elevation of 1860 meters, with an average ground elevation of 1100 meters, the scale number of the imagery is 5000, and the images are standard 9 inch square analog photographs.

Assignment

Using an affine transformation, and the transformation parameters you determined in lab #1, transform the measured image coordinates for both images into the fiducial coordinate system. Then using a programming language of your choice (e.g. Python, MATLAB, or C/C++) write functions to perform the tasks given below. The code should be well documented with comments and descriptive variable names so that it is easy to understand. The output from the program should be neatly organized to display the required calculations and plotted results.

Tasks:

1. Correct the image measurements (in the fiducial coordinate system) for principal point offset. For each measurement, give the value of the individual (x and y) corrections applied to each observed value.
2. Correct the image measurements for radial, and decentering lens distortion. For each measurement, give the value of the individual (x and y) corrections applied to each observed value.
3. Compute atmospheric refraction corrections for each of the image measurements. Use the model for K given in the lecture notes. For each measurement, give the value of the individual (x and y) corrections applied to each observed value.
4. Compute final refined coordinates (i.e. with all of the corrections in tasks 1-3 applied). Be sure to give your answers in mm to 4 decimal places.
5. For each of the corrections (radial, tangential and atmospheric refraction), compute the maximum value of the correction for the images acquired. Use the standard image dimensions given above.
6. Compute radial and tangential distortion on a 2mm by 2mm grid covering the entire image (dimensions above). Plot a 3D surface of the radial and tangential distortions both separately, and as combined overall distortion.
7. Using the same 2mm by 2mm grid, compute atmospheric refraction corrections for the entire image and plot as a 3D surface.

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?

Notes:

- Points will be deducted for sloppy programming style and/or results format, and failure to properly document your code, and tabular results.

Due Date: March 8, 2023 at 10:00 am (hand in at start of class)