**Lab #4**

Tasks 1:

Initial Conditions:

|  |  |
| --- | --- |
| tX (m) | 79.9847 |
| tY (m) | -631.04195 |
| tZ (m) | 1854.9692 |
| omega (dd) | 0.0000 |
| phi (dd) | 0.0000 |
| kappa (dd) | -90.1947 |
| lambda | 4.9793 |

Unknowns after Convergence:

|  |  |
| --- | --- |
| tX (m) | 99.4938 |
| tY (m) | -628.5518 |
| tZ (m) | 1842.1882 |
| omega (dd) | -1.4761 |
| phi (dd) | -0.1841 |
| kappa (dd) | -90.1956 |
| lambda | 4.9791 |

Task 2:

S = 5000, σobs = 15 µm

c = 153.358 mm

For all the angles, I compared the difference of the old values with the new updated values. For the translations, I also compared the difference of the old values with the new updated values. The scale criteria is a small number, 1e-5 If the difference of the angles are less than Toltilt AND difference of translations are less than Tolcoords AND the scale difference is less than Tolscale, then we have reach convergence. All angles, translation, and scale values must meet the tolerance criteria for convergence. We reach convergence after **3 iterations**.

Task 3:

Transformed Object Points:

|  |  |  |  |
| --- | --- | --- | --- |
| **ID** | **Xo (m)** | **Yo (m)** | **Zo (m)** |
| **100** | -399.2691 | -679.7163 | 1090.9599 |
| **104** | 475.5403 | -538.2132 | 1090.4999 |
| **105** | 517.6187 | -194.4005 | 1090.6500 |

Residuals and RMS

|  |  |  |  |
| --- | --- | --- | --- |
| **ID** | **vX** | **vY** | **vZ** |
| **100** | 0.01093 | 0.003701 | -4.7602e-06 |
| **104** | -0.009621 | -0.033198 | -1.1104e-05 |
| **105** | -0.001309 | 0.029496 | 1.5864e-05 |
|  |  |  |  |
| **RMS** | 0.008441 | 0.02573 | 1.151293e-05 |

Task 4:

Object Space Coordinates for PC

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Image** | **Xm (mm)** | **Ym (mm)** | **Zm (mm)** | **Xo (m)** | **Yo (m)** | **Zo (m)** |
| **Left** | 0.00 | 0.00 | 0.00 | 99.5015 | -628.5543 | 1842.1882 |
| **Right** | 92.00 | -1.422 | -1.287 | 73.1077 | -170.529950 | 1852.1839 |

Task 5:

Transformed Object Points:

|  |  |  |  |
| --- | --- | --- | --- |
| **ID** | **Xo (m)** | **Yo (m)** | **Zo (m)** |
| **200** | -466.3736 | -542.2893 | 1091.6683 |
| **201** | 42.6833 | -412.1639 | 1091.0363 |
| **202** | 320.9841 | -667.4234 | 1083.7335 |
| **203** | 527.6329 | -375.7416 | 1092.1459 |

Residuals and RMS

|  |  |  |  |
| --- | --- | --- | --- |
| **ID** | **vX** | **vY** | **vZ** |
| **200** | 0.01639 | 0.02067 | 0.1183 |
| **201** | -0.04667 | 0.02610 | 0.2163 |
| **202** | -0.1059 | 0.02662 | 0.2435 |
| **203** | -0.1471 | -0.02161 | 0.14590 |
|  |  |  |  |
| **RMS** | 0.09395 | 0.02390 | 0.1880 |

Task 6:

S = 5000, σobs = 15 µm

B/H = 0.6

The RMSE values of from Task 3 are generally smaller than Task 5 except in the y direction, where they are very similar. The z residual from Task 3 is significantly smaller than Task 5’s. Point 203 x residual is almost twice the expected error, but it may not be an outlier.

Task 7:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Correlation Coefficient Matrix** | | | | | | | |
|  | **Ω** | **Φ** | **Κ** | **tx** | **ty** | **tz** | **Λ** |
| **Ω** | 1.0000 | -0.7500 | 0.0043 | -0.9289 | 0.7358 | 0.2499 | 0.0000 |
| **Φ** | -0.7500 | 1.0000 | -0.0027 | 0.6995 | -0.9820 | -0.4311 | 0.0000 |
| **Κ** | 0.0043 | -0.0027 | 1.0000 | -0.1198 | 0.0395 | 0.0008 | 0.0000 |
| **tx** | -0.9289 | 0.6995 | -0.1198 | 1.0000 | -0.6863 | -0.2886 | -0.0722 |
| **ty** | 0.7358 | -0.9820 | 0.0395 | -0.6863 | 1.0000 | 0.3787 | -0.0590 |
| **tz** | 0.2499 | -0.4311 | 0.0008 | -0.2886 | 0.3787 | 1.0000 | 0.7596 |
| **Λ** | 0.0000 | 0.0000 | 0.0000 | -0.0722 | -0.0590 | 0.7596 | 1.0000 |

The omega (Ω) is highly correlated with tx and phi (Φ) is highly correlated with ty, which are the rotation angles in their respective axes. To reduce correlation, we can add more points that are placed more randomly on the images, as opposed to points located on the same side of the image or points that form close to a straight line. For instance, the y coordinates of point 104 and 105 are close to each other.

Task 8:

Extracted Angles from M­ (o to i):

|  |  |  |
| --- | --- | --- |
| **Left** | w (dd) | -0.1892 |
|  | p (dd) | 1.4755 |
|  | k (dd) | 90.1957 |

|  |  |  |
| --- | --- | --- |
| **Right** | w (dd) | -0.4573 |
|  | p (dd) | 0.4970 |
|  | k (dd) | 88.4680 |