TECHNICAL UNIVERSITY BERLIN

GEODESY AND GEOINFORMATION SCIENCE

ADJUSTMENT CALCULATION

HOMEWORK V

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TASK I

Functional Model:

$$s_{61} = \sqrt{(x_1 - x_6)^2 + (y_1 - y_6)^2}$$

$$s_{91} = \sqrt{(x_1 - x_9)^2 + (y_1 - y_9)^2}$$

$$s_{96} = \sqrt{(x_6 - x_9)^2 + (y_6 - y_9)^2}$$

$$s_{151} = \sqrt{(x_1 - x_{15})^2 + (y_1 - y_{15})^2}$$

$$s_{159} = \sqrt{(x_9 - x_{15})^2 + (y_9 - y_{15})^2}$$

$$r_{16} = \tan^{-1}\left(\frac{y_6 - y_1}{x_6 - x_1}\right) - \omega_1$$

$$r_{115} = \tan^{-1}\left(\frac{y_{15} - y_1}{x_{15} - x_1}\right) - \omega_1$$

$$r_{61} = \tan^{-1}\left(\frac{y_1 - y_6}{x_1 - x_6}\right) - \omega_6$$

$$r_{69} = \tan^{-1}\left(\frac{y_9 - y_6}{x_9 - x_6}\right) - \omega_6$$

$$r_{915} = \tan^{-1}\left(\frac{y_{15} - y_9}{x_{15} - x_9}\right) - \omega_9$$

$$r_{91} = \tan^{-1}\left(\frac{y_1 - y_9}{x_1 - x_9}\right) - \omega_9$$

$$r_{96} = \tan^{-1}\left(\frac{y_6 - y_9}{x_6 - x_9}\right) - \omega_9$$

$$r_{151} = \tan^{-1}\left(\frac{y_1 - y_{15}}{x_1 - x_{15}}\right) - \omega_{15}$$

$$r_{159} = \tan^{-1}\left(\frac{y_9 - y_{15}}{x_9 - x_{15}}\right) - \omega_{15}$$

Observation Equation

$$s_{61} + v_1 = \sqrt{(x_1 - x_6)^2 + (y_1 - y_6)^2}$$

$$s_{91} + v_2 = \sqrt{(x_1 - x_9)^2 + (y_1 - y_9)^2}$$

$$s_{96} + v_3 = \sqrt{(x_6 - x_9)^2 + (y_6 - y_9)^2}$$

$$s_{151} + v_4 = \sqrt{(x_1 - x_{15})^2 + (y_1 - y_{15})^2}$$

$$s_{159} + v_5 = \sqrt{(x_9 - x_{15})^2 + (y_9 - y_{15})^2}$$

$$r_{16} + v_6 = \tan^{-1}\left(\frac{y_6 - y_1}{x_6 - x_1}\right) - \omega_1$$

$$r_{115} + v_7 = \tan^{-1}\left(\frac{y_{15} - y_1}{x_{15} - x_1}\right) - \omega_1$$

$$r_{61} + v_8 = \tan^{-1}\left(\frac{y_1 - y_6}{x_1 - x_6}\right) - \omega_6$$

$$r_{69} + v_9 = \tan^{-1}\left(\frac{y_9 - y_6}{x_9 - x_6}\right) - \omega_6$$

$$r_{915} + v_{10} = \tan^{-1}\left(\frac{y_{15} - y_9}{x_{15} - x_9}\right) - \omega_9$$

$$r_{91} + v_{11} = \tan^{-1}\left(\frac{y_1 - y_9}{x_1 - x_9}\right) - \omega_9$$

$$r_{96} + v_{12} = \tan^{-1}\left(\frac{y_6 - y_9}{x_6 - x_9}\right) - \omega_9$$

$$r_{151} + v_{13} = \tan^{-1}\left(\frac{y_1 - y_{15}}{x_1 - x_{15}}\right) - \omega_{15}$$

$$r_{159} + v_{14} = \tan^{-1}\left(\frac{y_9 - y_{15}}{x_9 - x_{15}}\right) - \omega_{15}$$

Stochastic Model:

$$\sum_{ll} = \begin{bmatrix} \sigma_s^2 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \sigma_r^2 \end{bmatrix}$$

Result:

Vector of adjusted Unknown:

```
Adjusted_Unknown =

   1.0e+06 *

   4.965804165317863
   5.314698152754688
   4.962997537828491
   5.320448851544192
  -0.000001570785137
  -0.000000000005203
   0.000000314142015
  -0.000000471248385
```

Standard Deviation of Adjusted Unknown:

```
Std_Dev_Adj_unkwn =

   0.030228896653077
   0.022371333095265
   0.027133358447850
   0.039873020648717
   0.000006904982993
   0.000005267637138
   0.000003978874041
   0.000006005847364
```

Vector of Residuals:

```
Residuals =

   0.006158735206438
   0.000243409139557
  -0.001472910277698
  -0.030444739934955
   0.011014231215076
  -0.000001396280299
   0.000001396280299
   0.000002430187053
  -0.000002430187053
  -0.000009597273603
   0.000006263348281
   0.000003333925322
  -0.000003059701964
   0.000003059701964
```

Standard Deviation of Residuals:

```
Std_Dev_Residuals =

   0.027593254407889
   0.029495880503038
   0.037097391685102
   0.021241972171481
   0.021897861881229
   0.000003082325872
   0.000003082325872
   0.000002491742222
   0.000002491742222
   0.000004075193097
   0.000004495930296
   0.000004257386720
   0.000003178117753
   0.000003178117753
```

Vector of Adjusted Observation:

```
Adjusted_Observation =

   1.0e+04 *

   0.430785715873521
   1.075985224340914
   0.680633052708972
   0.639903855526007
   0.875176801423121
   0.000232615161416
   0.000359562330335
   0.000389696433379
   0.000127535381108
   0.000326571837763
   0.000390253663993
   0.000410279924660
   0.000563767920494
   0.000909951612406
```

Standard deviation of Adjusted Observations:

```
Std_Dev_Adj_Obs =

   0.024795741187135
   0.022499100052855
                   0
   0.030413731900309
   0.029944951408685
   0.000004945305606
   0.000004945305606
   0.000005267637138
   0.000005267637138
   0.000004165282888
   0.000003707207992
   0.000003978874041
   0.000004884296046
   0.000004884296046
```