Technische Universität Berlin   Adjustment Theory I

Chair of Geodesy and   Winter Term 2021/22
Adjustment Theory

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Exercise 13: Adjustment Calculation - part VIII

- Combined horizontal network -

Group:	Surname, First name:	Matriculation number:	Signature*:

* With my signature I declare that I was involved in the elaboration of this homework.

Submission until: **17.02.2022**

Test Certificate

Received on:

Date	Grade	Signature

Objective

This exercise deals with the determination of 2D coordinates of points in a plane Cartesian coordinate system from observed directions and distances.
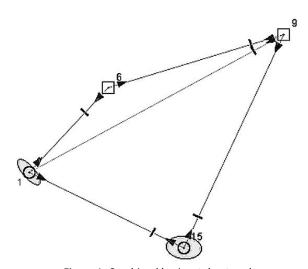

Figure 1: Combined horizontal network

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Task 1:

The Gauss-Krueger coordinates of the control points, which can be regarded as fixed (error free) values as well as the initial values for the Gauss-Krueger coordinates of the new points are listed in Table 1. The measurements of the combined horizontal network, depicted in Figure 1, are listed in Table 2. The observed distances have been performed with a standard deviation of 10 cm and are already reduced into the Gauss-Krueger projection. The observed directions have been performed with a standard deviation of 1 mgon. All measurements (distances and directions) are uncorrelated. Calculate the adjusted Gauss-Krueger coordinates of point 1 and 15 using least-squares adjustment.

- What are the unknowns?
- What are the observations?
- Are all observations reduced into the Gauss-Krueger projection?
- What is the redundancy?
- Set up an appropriate functional model as well as the observation equations.
- Set up the stochastic model.
- Choose appropriate values for the break-off condition ϵ and δ and justify your decision.
- Solve the normal equation system and determine the Gauss-Krueger coordinates of point 1 and 15 as well as their standard deviations.
- Calculate the residuals and the adjusted observations as well as their standard deviations.

Table 1: Gauss-Krueger coordinates for control and new points

Point No.	Easting [m]	Northing [m]	Remarks
6	53 17 651.428	49 68 940.373	Fixed point
9	53 24 162.853	49 70 922.160	Fixed point
1	53 14 698.13	49 65 804.18	Initial values
15	53 20 448.85	49 62 997.53	Initial values

Table 2: Observed distances and directions

From	To	Horizontal directions [gon]	Horizontal distances [m]
1	6	148.0875	
	15	228.9044	
6	1	248.0883	4307.851
	9	81.1917	
9	15	207.9027	
	1	248.4428	10759.852
	6	261.1921	6806.332
15	1	358.9060	6399.069
	9	57.9014	8751.757

Task 2 (Homework):

The Gauss-Krueger coordinates of the given control points (error free values) are listed in Table 3. Initial values for the Gauss-Krueger coordinates of the new points are given in Table 4. The measurements of the combined horizontal network are listed in Table 5. The observed distances have been performed with a standard deviation of 1 mm and are already reduced into the Gauss-Krueger projection. The observed directions have been performed with a standard deviation of 1 mgon. All measurements (distances and directions) are uncorrelated. Calculate the adjusted Gauss-Krueger coordinates of the new points using least-squares adjustment.

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- What are the unknowns?
- What are the observations?
- Are all observations reduced into the Gauss-Krueger projection? Please, give a short explanation.
- What is the redundancy?
- Set up an appropriate functional model as well as the observation equations.
- Set up the stochastic model.
- Choose appropriate values for the break-off condition ϵ and δ and justify your decision.
- Solve the normal equation system and determine the Gauss-Krueger coordinates of the new points as well as their standard deviations.
- Calculate the residuals and the adjusted observations as well as their standard deviations.
- Present all observations, residuals, adjusted observations and the standard deviations of the residuals and adjusted observations as well as the above mentioned parameters in one table.
- Present all unknowns as well as their standard deviations in one table.
- Comment and evaluate all results!

Table 3: Gauss-Krueger coordinates of the control points

ID	Easting [m]	Northing [m]
1000	4590337.390	5820823.642
2000	4589967.526	5820806.067
3000	4590078.021	5820681.807

Table 4: Initial values for the coordinates of the new points

ID	Easting [m]	Northing [m]
100	4590159.8	5820727.3
101	4589800.1	5820857.9
102	4590163.2	5820848.7
103	4589956.9	5820700.4

Table 5: Measurements

From	To	Distances [m]	Directions [gon]
1000	100	201.941	269.6980
	102	175.940	310.4634
2000	103	106.177	207.9866
	101	175.288	320.7754
3000	100	93.728	69.2435
	103	122.506	311.3932
100	1000	201.941	69.8977
	102	121.468	3.3149
	2000	207.826	326.2594
	3000	93.727	269.1427
101	103	222.323	151.8806
	2000	175.287	120.8758
102	1000	175.942	110.3651
	100	121.466	203.0060
	2000	200.334	287.5533
103	3000	122.507	111.2898
	2000	106.185	7.8869
	101	222.325	351.6806