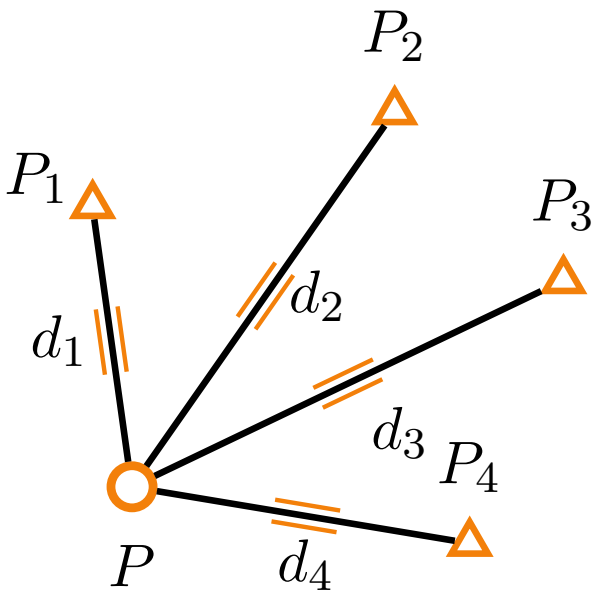
Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



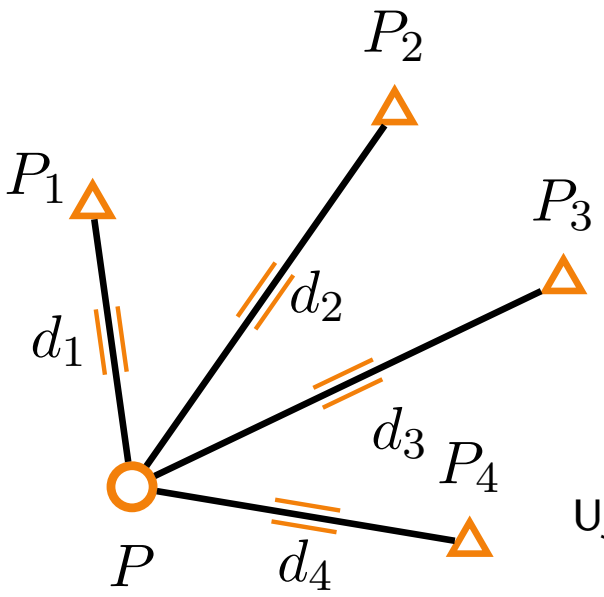
Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 8 \\ 15 \\ 15 \\ 12 \end{bmatrix} \text{ [mm]}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

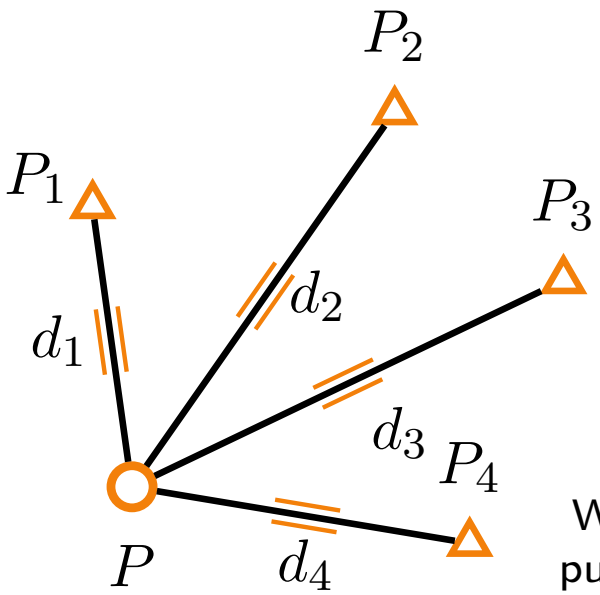
$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

Ujednolicenie jednostek

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

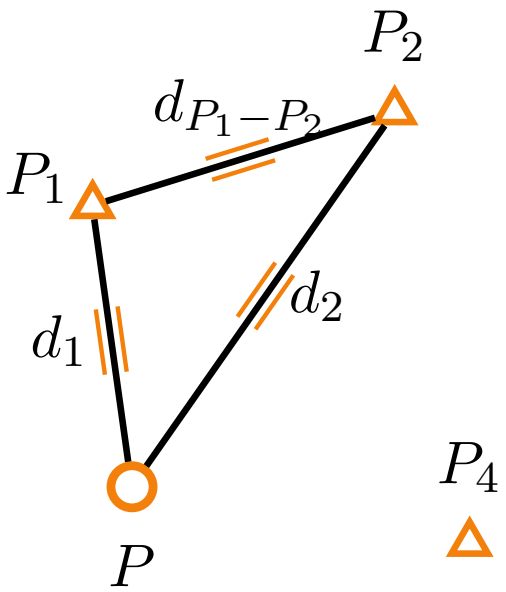
$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{[m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{[m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{[m]}$$

Wyznaczenie współrzędnych przybliżonych wszystkich punktów niewiadomych (na ćwiczeniach w trosce o czas, wartości te były podane, w projekcie nr 2 trzeba je sobie samodzielnie policzyć)

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

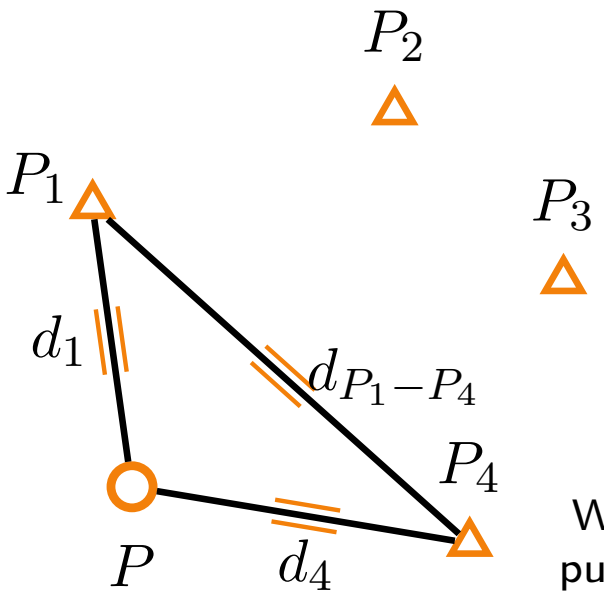
$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{[m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{[m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{[m]}$$

Wyznaczenie współrzędnych przybliżonych wszystkich punktów niewiadomych

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

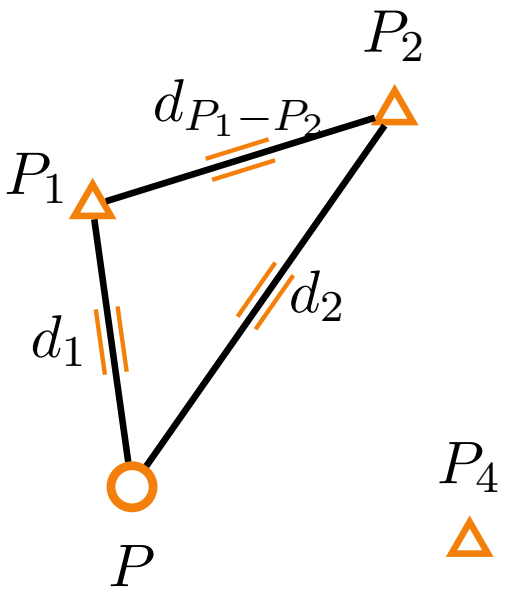
$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{[m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{[m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{[m]}$$

Wyznaczenie współrzędnych przybliżonych wszystkich punktów niewiadomych

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

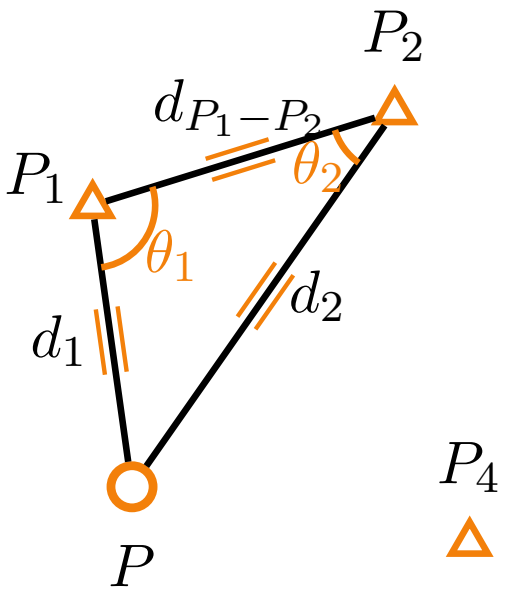
$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{[m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{[m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{[m]}$$

Wyznaczenie współrzędnych przybliżonych wszystkich punktów niewiadomych

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

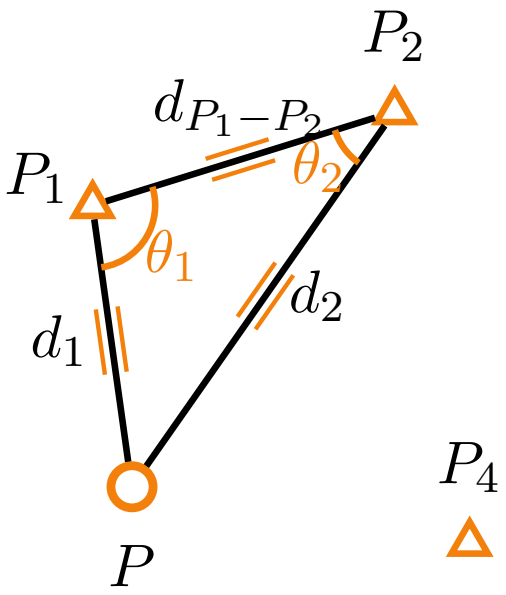
$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

Wyznaczenie współrzędnych przybliżonych wszystkich punktów niewiadomych

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

Wyznaczenie współrzędnych przybliżonych wszystkich punktów niewiadomych

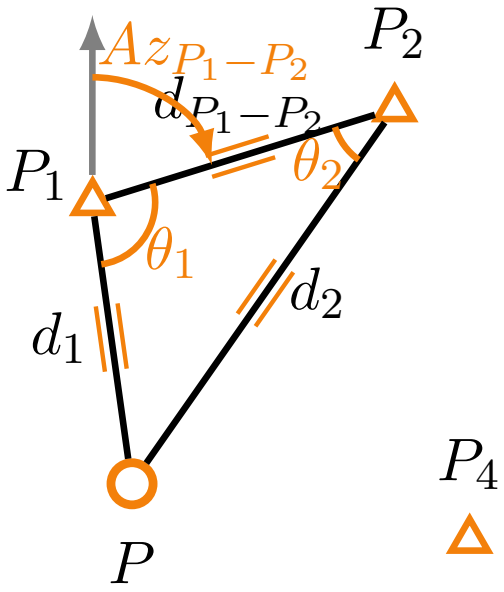
$$d_{P_1-P_2} = \sqrt{(X_{P_2} - X_{P_1})^2 + (Y_{P_2} - Y_{P_1})^2} = 167{,}9767\,\text{m}$$

$$\theta_1 = \arccos\left(\frac{d_1^2 + d_{P_1-P_2}^2 - d_2^2}{2 \cdot d_1 \cdot d_{P_1-P_2}}\right) = 1{,}738\,044\,\text{rad}\ (\sim 110{,}6^{\,\text{g}})$$

$$\theta_2 = \arccos\left(\frac{d_2^2 + d_{P_1-P_2}^2 - d_1^2}{2 \cdot d_2 \cdot d_{P_1-P_2}}\right) = 0{,}658\,430\,\text{rad}\ (\sim 41{,}9^{\,\text{g}})$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

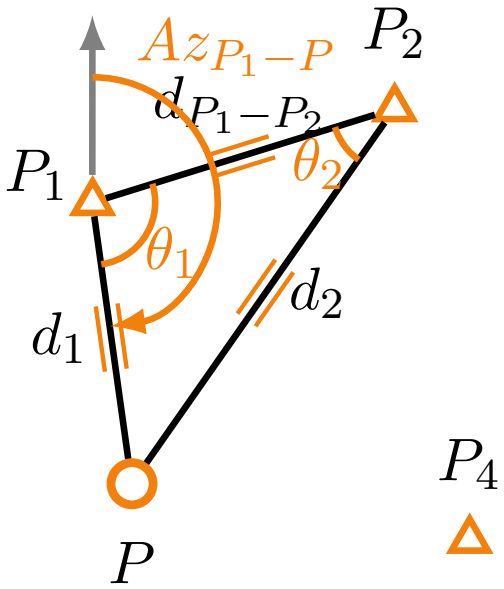
$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

Wyznaczenie współrzędnych przybliżonych wszystkich punktów niewiadomych

$$Az_{P_1P_2} = \operatorname{arc\,tg} \frac{Y_{P_2} - Y_{P_1}}{X_{P_2} - X_{P_1}} = 1{,}269\,304 \text{ rad } (\sim 80{,}8\,^{\text{g}})$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

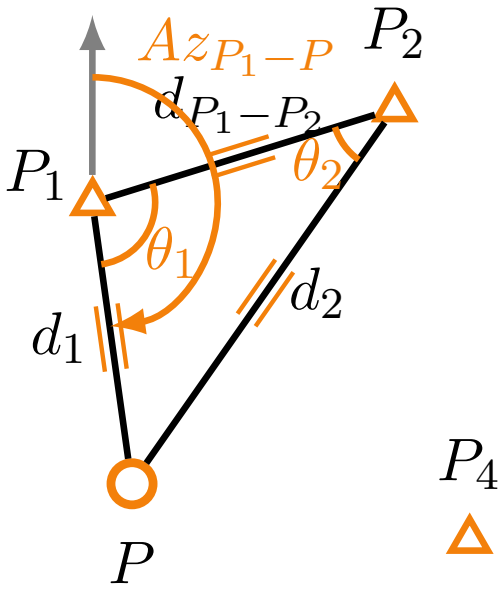
Wyznaczenie współrzędnych przybliżonych wszystkich punktów niewiadomych

$$Az_{P_1P_2} = \operatorname{arc\,tg} \frac{Y_{P_2} - Y_{P_1}}{X_{P_2} - X_{P_1}} = 1{,}269\,304 \text{ rad } (\sim 80{,}8^{\text{g}})$$

$$Az_{P_1P} = Az_{P_1P_2} + \theta_1 = 3{,}007\,348 \text{ rad } (\sim 191{,}5^{\text{g}})$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

Wyznaczenie współrzędnych przybliżonych wszystkich punktów niewiadomych

$$Az_{P_1P_2} = \operatorname{arc\,tg} \frac{Y_{P_2} - Y_{P_1}}{X_{P_2} - X_{P_1}} = 1{,}269\,304 \text{ rad } (\sim 80{,}8^{\text{g}})$$

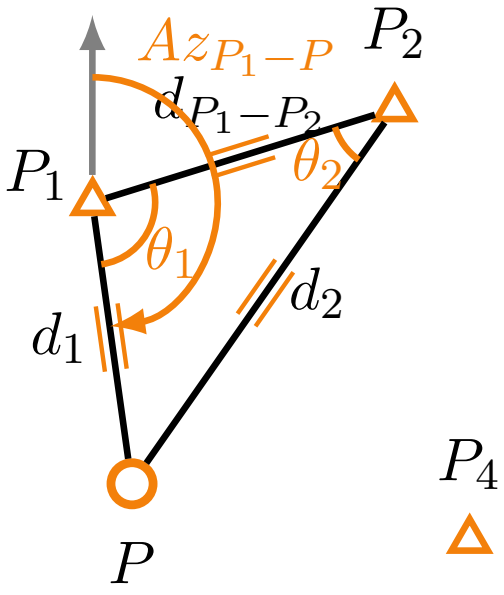
$$Az_{P_1P} = Az_{P_1P_2} + \theta_1 = 3{,}007\,348 \text{ rad } (\sim 191{,}5^{\text{g}})$$

$$X_P^0 = X_{P_1} + d_1 \cdot \cos Az_{P_1P} = 1249{,}983 \text{ m}$$

$$Y_P^0 = Y_{P_1} + d_1 \cdot \sin Az_{P_1P} = 2410{,}038 \text{ m}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{[m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{[m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{[m]}$$

Wyznaczenie współrzędnych przybliżonych wszystkich punktów niewiadomych

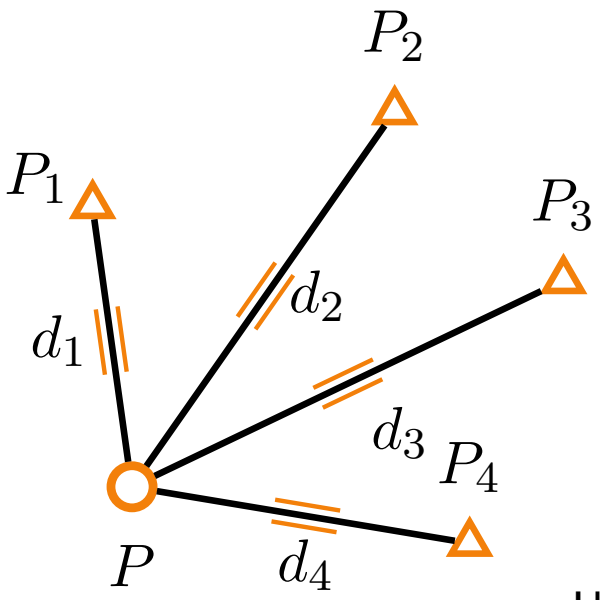
Z różnych kombinacji różne wyniki, ale rozbieżność nie większa niż kilkanaście cm

1249,983 m,	2410,038 m
1249,978 m,	2409,999 m
1249,980 m,	2410,017 m
1250,027 m,	2409,975 m
1249,996 m,	2410,019 m
1249,950 m,	2410,012 m

W dalszym przykładzie numerycznym przyjęto wartości [1250,180 m, 2409,860 m], tak jak były podane na ćwiczeniach.

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

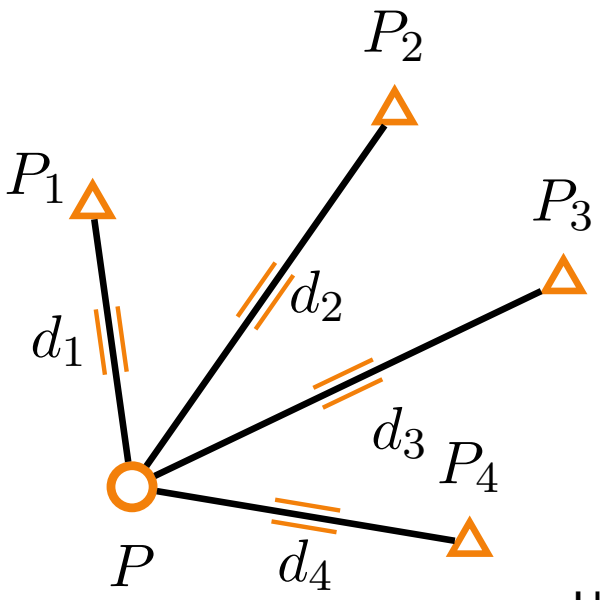
$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

Ułożenie równań poprawek w formie macierzowej

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{[m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{[m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{[m]}$$

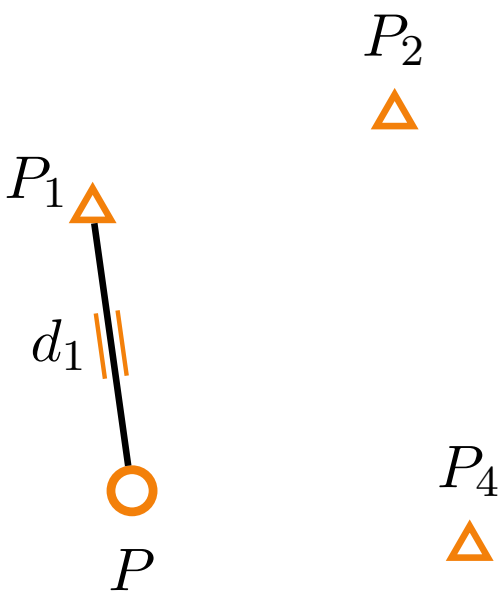
$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

Ułożenie równań poprawek w formie macierzowej
Przypomnienie:

$$\begin{aligned} v_{d_{pk}} = &- \cos A_{pk}^0 \cdot \Delta X_p - \sin A_{pk}^0 \cdot \Delta Y_p \\ &+ \cos A_{pk}^0 \cdot \Delta X_k + \sin A_{pk}^0 \cdot \Delta Y_k + \\ &+ d_{pk}^0 - d_{pk}^{obs} \end{aligned}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

$$X_P^0 = 1250{,}180\,\text{m}, \; Y_P^0 = 2409{,}860\,\text{m}$$

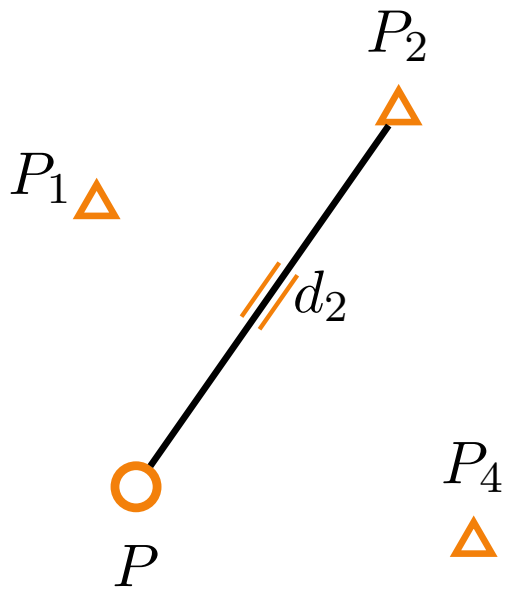
Ułożenie równań poprawek w formie macierzowej

$$\begin{aligned} v_{d_{P-P_1}} &= -\cos A^0_{P-P_1} \cdot \Delta X_P - \sin A^0_{P-P_1} \cdot \Delta Y_P \\ &\quad + d^0_{P-P_1} - d^{obs}_{P-P_1} \\ A^0_{P-P_1} &= \operatorname{arc\,tg} \frac{Y_{P_1} - Y_P^0}{X_{P_1} - X_P^0} = -0{,}133\,254\,\text{rad} \; (\sim -8{,}5^{\,\text{g}}) \\ d^0_{P-P_1} &= \sqrt{(X_{P_1} - X_P^0)^2 + (Y_{P_1} - Y_P^0)^2} = 151{,}3619\,\text{m} \end{aligned}$$

$$A = \begin{bmatrix} -0,9911347 & 0,1328604 \end{bmatrix} \quad L = \begin{bmatrix} -0,21914 \end{bmatrix} \text{ [m]}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

Ułożenie równań poprawek w formie macierzowej

$$\begin{aligned} v_{d_{P-P_2}} &= -\cos A^0_{P-P_2} \cdot \Delta X_P - \sin A^0_{P-P_2} \cdot \Delta Y_P \\ &\quad + d^0_{P-P_2} - d^{obs}_{P-P_2} \end{aligned}$$

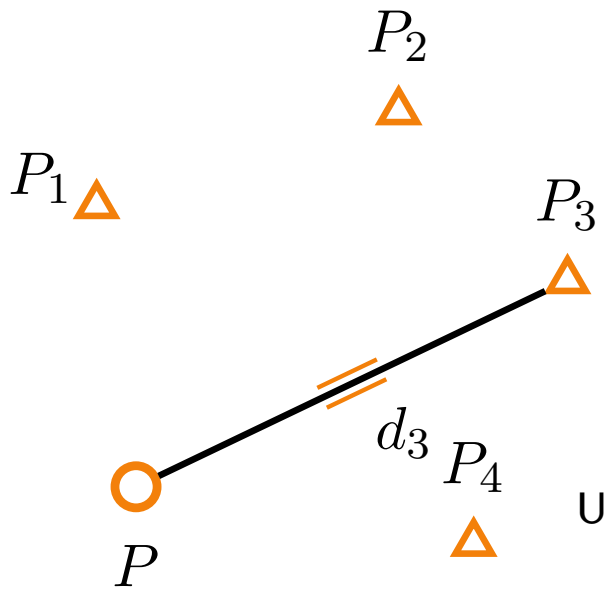
$$A^0_{P-P_2} = \operatorname{arc\,tg} \frac{Y_{P_2} - Y_P^0}{X_{P_2} - X_P^0} = 0{,}611\,934\,\text{rad}\ (\sim 39{,}0^{\,\text{g}})$$

$$d^0_{P-P_2} = \sqrt{(X_{P_2} - X_P^0)^2 + (Y_{P_2} - Y_P^0)^2} = 244{,}2157\,\text{m}$$

$$A = \begin{bmatrix} -0,9911347 & 0,1328604 \\ -0,8185387 & -0,5744512 \end{bmatrix} \quad L = \begin{bmatrix} -0,21914 \\ -0,05932 \end{bmatrix} \text{ [m]}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

Ułożenie równań poprawek w formie macierzowej

$$v_{d_{P-P_3}} = -\cos A^0_{P-P_3} \cdot \Delta X_P - \sin A^0_{P-P_3} \cdot \Delta Y_P + d^0_{P-P_3} - d^{obs}_{P-P_3}$$

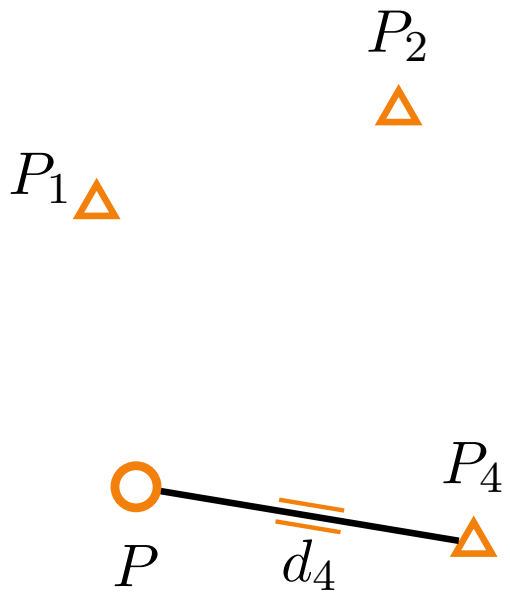
$$A^0_{P-P_3} = \operatorname{arc\,tg} \frac{Y_{P_3} - Y_P^0}{X_{P_3} - X_P^0} = 1{,}126\,596\,\text{rad}\ (\sim 71{,}7^{\,\text{g}})$$

$$d^0_{P-P_3} = \sqrt{(X_{P_3} - X_P^0)^2 + (Y_{P_3} - Y_P^0)^2} = 255{,}2731\,\text{m}$$

$$A = \begin{bmatrix} -0,9911347 & 0,1328604 \\ -0,8185387 & -0,5744512 \\ -0,4297358 & -0,9029546 \end{bmatrix} \quad L = \begin{bmatrix} -0,21914 \\ -0,05932 \\ 0,03806 \end{bmatrix} \text{ [m]}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

Ułożenie równań poprawek w formie macierzowej

$$v_{d\,P-P_4} = -\cos A^0_{P-P_4} \cdot \Delta X_P - \sin A^0_{P-P_4} \cdot \Delta Y_P + d^0_{P-P_4} - d^{obs}_{P-P_4}$$

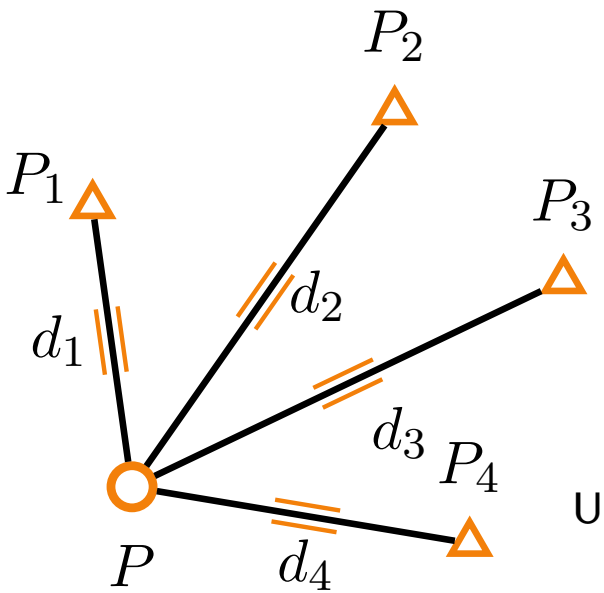
$$A^0_{P-P_4} = \operatorname{arc\,tg} \frac{Y_{P_4} - Y_P^0}{X_{P_4} - X_P^0} = 1{,}737\,152\,\text{rad}\ (\sim 110{,}6^{\,\text{g}})$$

$$d^0_{P-P_4} = \sqrt{(X_{P_4} - X_P^0)^2 + (Y_{P_4} - Y_P^0)^2} = 182{,}4994\,\text{m}$$

$$A = \begin{bmatrix} -0,9911347 & 0,1328604 \\ -0,8185387 & -0,5744512 \\ -0,4297358 & -0,9029546 \\ 0,1655895 & -0,9861947 \end{bmatrix} \quad L = \begin{bmatrix} -0,21914 \\ -0,05932 \\ 0,03806 \\ 0,18744 \end{bmatrix} \text{ [m]}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

Ułożenie równań poprawek w formie macierzowej

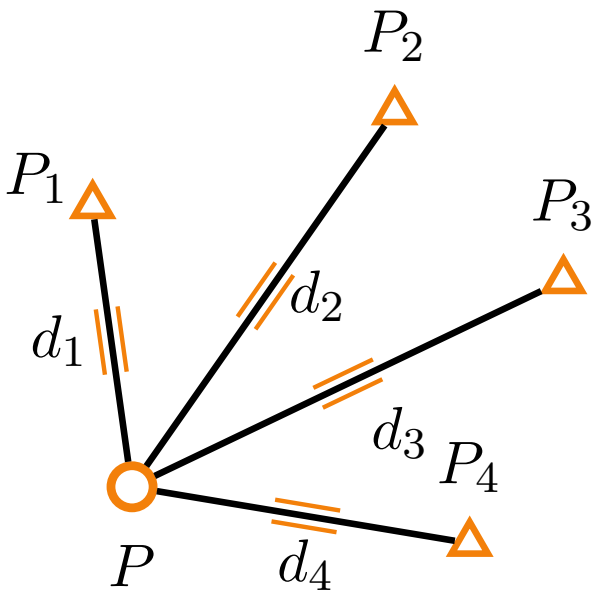
$$A = \begin{bmatrix} -0,9911347 & 0,1328604 \\ -0,8185387 & -0,5744512 \\ -0,4297358 & -0,9029546 \\ 0,1655895 & -0,9861947 \end{bmatrix} \quad L = \begin{bmatrix} -0,21914 \\ -0,05932 \\ 0,03806 \\ 0,18744 \end{bmatrix} \text{ [m]}$$

$$P = \begin{bmatrix} m_{d_1}^2 & 0 & 0 & 0 \\ 0 & m_{d_2}^2 & 0 & 0 \\ 0 & 0 & m_{d_3}^2 & 0 \\ 0 & 0 & 0 & m_{d_4}^2 \end{bmatrix}^{-1} =$$

$$\begin{bmatrix} 15625 & 0 & 0 & 0 \\ 0 & 4444,444 & 0 & 0 \\ 0 & 0 & 4444,444 & 0 \\ 0 & 0 & 0 & 6944,444 \end{bmatrix}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{[m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{[m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{[m]}$$

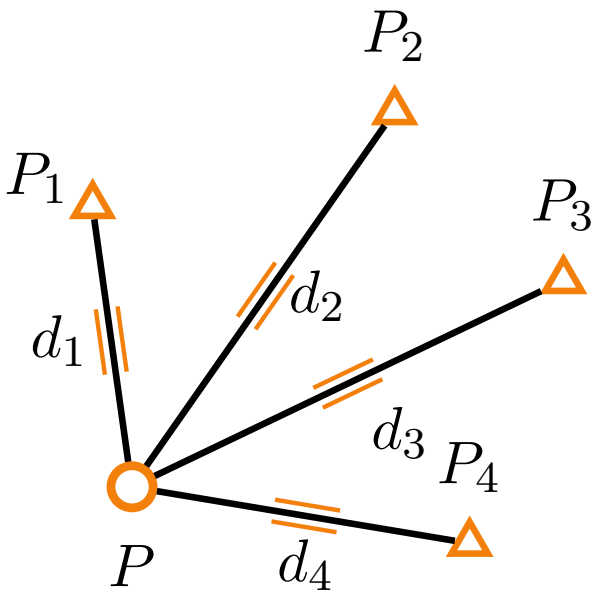
$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

Dalej już klasycznie

$$dX = \begin{bmatrix} \Delta X_P \\ \Delta Y_P \end{bmatrix} = -(A^{\mathrm{T}} P A)^{-1} (A^{\mathrm{T}} P L) = \begin{bmatrix} -0,1990 \\ 0,1538 \end{bmatrix} \text{[m]}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{[m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{[m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{[m]}$$

$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

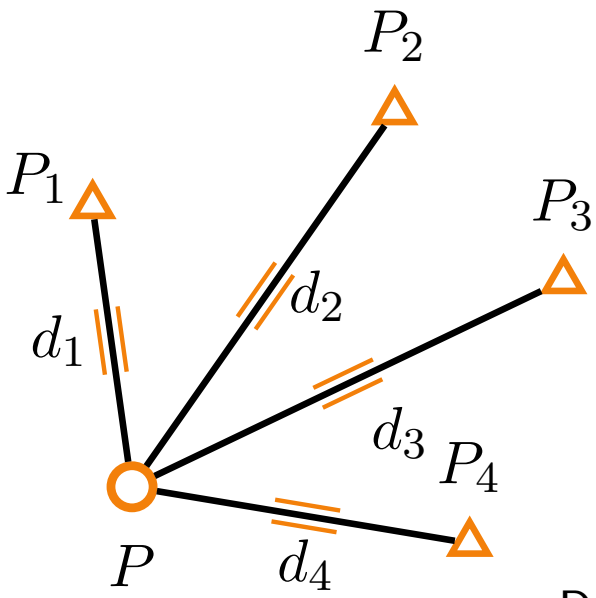
Dalej już klasycznie

$$dX = \begin{bmatrix} \Delta X_P \\ \Delta Y_P \end{bmatrix} = -(A^{\mathrm{T}} P A)^{-1} (A^{\mathrm{T}} P L) = \begin{bmatrix} -0,1990 \\ 0,1538 \end{bmatrix} \text{[m]}$$

$$X = \begin{bmatrix} X_P \\ Y_P \end{bmatrix} = \begin{bmatrix} X_P^0 \\ Y_P^0 \end{bmatrix} + \begin{bmatrix} \Delta X_p \\ \Delta Y_p \end{bmatrix} = \begin{bmatrix} 1249,9810 \\ 2410,0138 \end{bmatrix} \text{[m]}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{[m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{[m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{[m]}$$

$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

Dalej już klasycznie

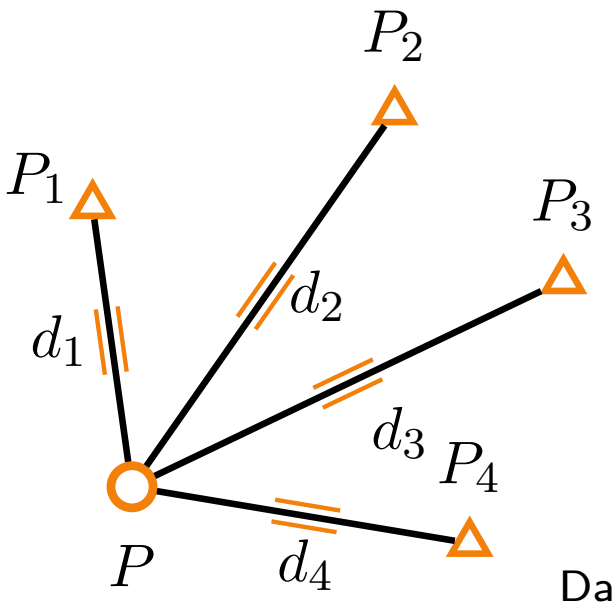
$$dX = \begin{bmatrix} \Delta X_P \\ \Delta Y_P \end{bmatrix} = -(A^{\mathrm{T}} P A)^{-1} (A^{\mathrm{T}} P L) = \begin{bmatrix} -0,1990 \\ 0,1538 \end{bmatrix} \text{[m]}$$

$$X = \begin{bmatrix} X_P \\ Y_P \end{bmatrix} = \begin{bmatrix} X_P^0 \\ Y_P^0 \end{bmatrix} + \begin{bmatrix} \Delta X_p \\ \Delta Y_p \end{bmatrix} = \begin{bmatrix} 1249,9810 \\ 2410,0138 \end{bmatrix} \text{[m]}$$

$$V = \begin{bmatrix} V_{d_1} \\ V_{d_2} \\ V_{d_3} \\ V_{d_4} \end{bmatrix} = A \cdot dX + L = \begin{bmatrix} -0,0015 \\ 0,0152 \\ -0,0153 \\ 0,0028 \end{bmatrix} \text{[m]}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{[m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{[m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{[m]}$$

$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

Dalej już klasycznie

$$dX = \begin{bmatrix} \Delta X_P \\ \Delta Y_P \end{bmatrix} = -(A^{\mathrm{T}} P A)^{-1} (A^{\mathrm{T}} P L) = \begin{bmatrix} -0,1990 \\ 0,1538 \end{bmatrix} \text{[m]}$$

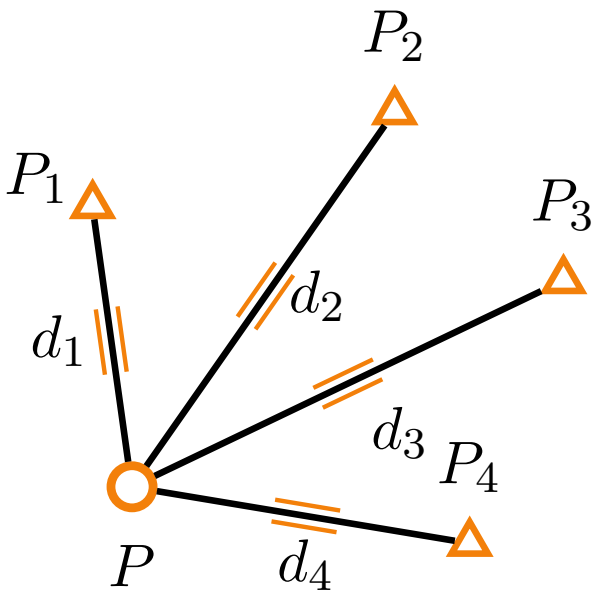
$$X = \begin{bmatrix} X_P \\ Y_P \end{bmatrix} = \begin{bmatrix} X_P^0 \\ Y_P^0 \end{bmatrix} + \begin{bmatrix} \Delta X_p \\ \Delta Y_p \end{bmatrix} = \begin{bmatrix} 1249,9810 \\ 2410,0138 \end{bmatrix} \text{[m]}$$

$$V = \begin{bmatrix} V_{d_1} \\ V_{d_2} \\ V_{d_3} \\ V_{d_4} \end{bmatrix} = A \cdot dX + L = \begin{bmatrix} -0,0015 \\ 0,0152 \\ -0,0153 \\ 0,0028 \end{bmatrix} \text{[m]}$$

Wszystkie kontrole jak przy sieci niwelacyjnej

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

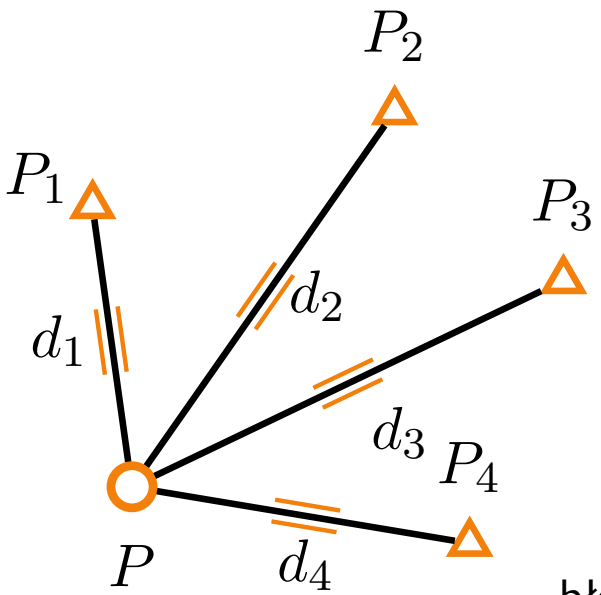
$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

$\sigma_0 = 1,0382$ [niemianowane!]
wyrównane obserwacje

$$y^w = y + V = \begin{bmatrix} 151,5795 \\ 244,2902 \\ 255,2197 \\ 182,3148 \end{bmatrix} \text{ [m]}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{[m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{[m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{[m]}$$

$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

błędy średnie wyrównanych niewiadomych, obie składowe

$$\text{cov}(dX) = \sigma_0^2 \cdot (A^{\text{T}} P A)^{-1} = \begin{bmatrix} m^2_{X_P^w} & cov(X_P^w, Y_P^w) \\ cov(X_P^w, Y_P^w) & m^2_{Y_P^w} \end{bmatrix}$$

$m_{X_P^w} = 7,4\,\text{mm}; \; m_{Y_P^w} = 9,4\,\text{mm}$

błąd położenia punktu

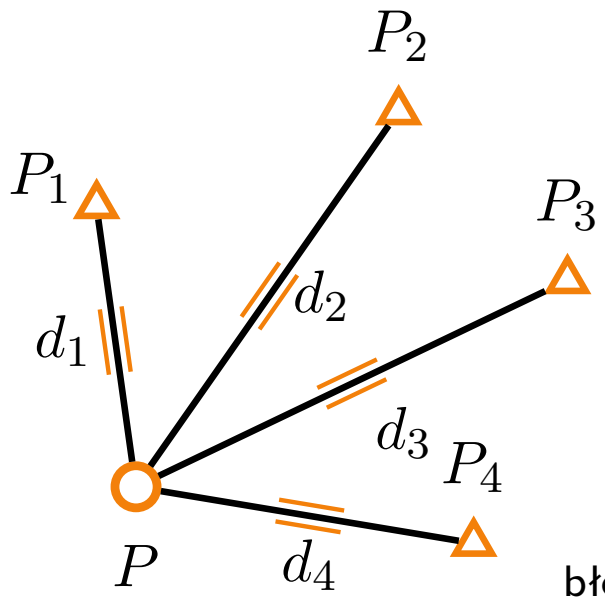
$$m_{p_P} = \sqrt{m^2_{X_P^w} + m^2_{Y_P^w}} = 12,0\,\text{mm}$$

korelacja

$$\rho_{X_P, Y_P} = \frac{cov(X_P^w, Y_P^w)}{m_{X_P^w} \cdot m_{Y_P^w}} = -0,04$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{ [m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{ [m]}$$

$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

błędy średnie pomiarow

$$\text{cov}(y) = \sigma_0^2 \cdot (A \cdot (A^{\text{T}} P A)^{-1} A^{\text{T}})$$

$$\begin{bmatrix} m_{d1^w} \\ m_{d2^w} \\ m_{d3^w} \\ m_{d4^w} \end{bmatrix} = \begin{bmatrix} 7,6 \\ 8,0 \\ 9,0 \\ 9,4 \end{bmatrix} \text{ [mm]}$$

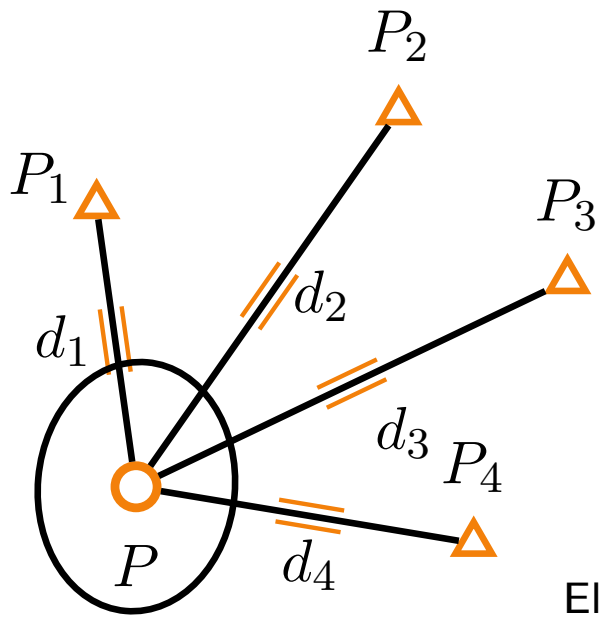
błędy średnie zadanych funkcji
macierz Jakobiego

$$D = \begin{bmatrix} 2{,}352 \cdot 10^{-3} & -3{,}352 \cdot 10^{-3} \\ 6{,}665 \cdot 10^{-3} & 4{,}973 \cdot 10^{-2} \end{bmatrix}$$

Z prawa propagacji kowariancji $m_{u1} = 7{,}6''$; $m_{u2} = 4{,}66 \cdot 10^{-4}$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 1



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{[m]}$$

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \end{bmatrix} = \begin{bmatrix} 151,581 \\ 244,275 \\ 255,235 \\ 182,312 \end{bmatrix} \text{[m]}, \quad \begin{bmatrix} m_{d_1} \\ m_{d_2} \\ m_{d_3} \\ m_{d_4} \end{bmatrix} = \begin{bmatrix} 0,008 \\ 0,015 \\ 0,015 \\ 0,012 \end{bmatrix} \text{[m]}$$

$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

Elipsa błędu średniego

$$Q = (A^{\mathrm{T}} P A)^{-1} = \begin{bmatrix} 5{,}180 \cdot 10^{-5} & -2{,}662 \cdot 10^{-6} \\ -2{,}662 \cdot 10^{-6} & 8{,}264 \cdot 10^{-5} \end{bmatrix}$$

$$a = \sigma_0 \cdot \sqrt{2\lambda_1} = 10,5\,\text{mm}$$

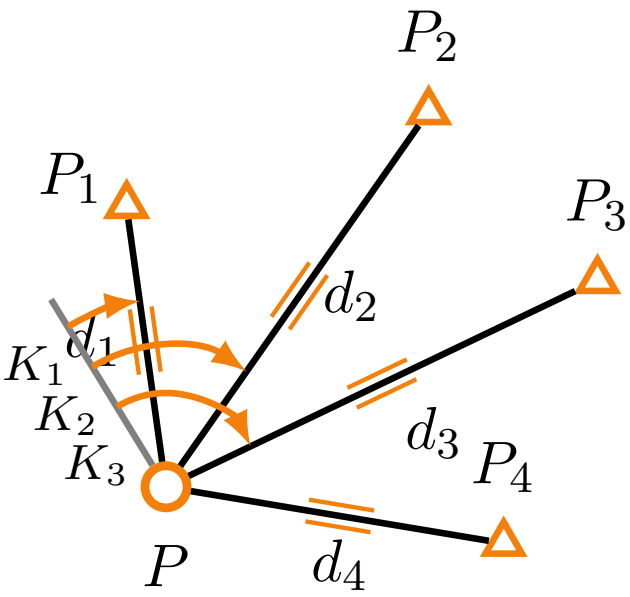
$$b = \sigma_0 \cdot \sqrt{2\lambda_2} = 13,3\,\text{mm}$$

$$\varphi = \frac{1}{2}\,\text{arctg}\left(\frac{2 \cdot Q_{XY}}{Q_X - Q_Y}\right) = -1.485\,\text{rad}(-94,6^{\,\text{g}})$$

(skala elipsy inna niż skala sieci)

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 2



Dane:

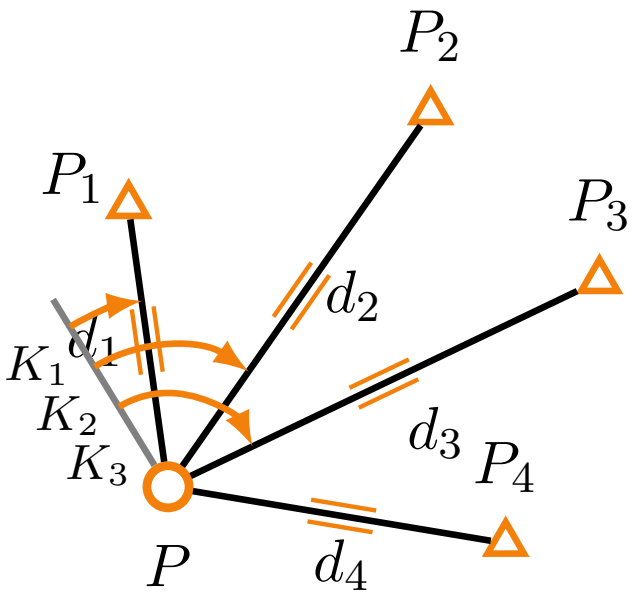
$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} K_1 \\ K_2 \\ K_3 \end{bmatrix} = \begin{bmatrix} 20{,}3450\,^{\text{g}} \\ 67{,}7770\,^{\text{g}} \\ 100{,}5460\,^{\text{g}} \end{bmatrix}, \quad \begin{bmatrix} m_{K_1} \\ m_{K_2} \\ m_{K_3} \end{bmatrix} = \begin{bmatrix} 10\,^{\text{cc}} \\ 10\,^{\text{cc}} \\ 10\,^{\text{cc}} \end{bmatrix}$$

$$X_P^0 = 1250{,}180\,\text{m}, \quad Y_P^0 = 2409{,}860\,\text{m}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 2



Dane:

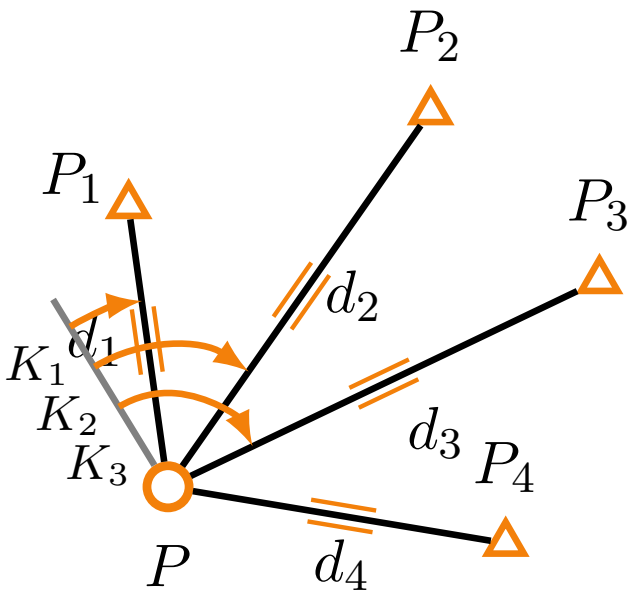
$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} K_1 \\ K_2 \\ K_3 \end{bmatrix} = \begin{bmatrix} 0{,}319\,578\,5 \text{ rad} \\ 1{,}064\,638\,6 \text{ rad} \\ 1{,}579\,372\,9 \text{ rad} \end{bmatrix}, \quad \begin{bmatrix} m_{K_1} \\ m_{K_2} \\ m_{K_3} \end{bmatrix} = \begin{bmatrix} 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \end{bmatrix}$$

$$X_P^0 = 1250{,}180 \text{ m}, \quad Y_P^0 = 2409{,}860 \text{ m}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 2



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} K_1 \\ K_2 \\ K_3 \end{bmatrix} = \begin{bmatrix} 0{,}319\,578\,5 \text{ rad} \\ 1{,}064\,638\,6 \text{ rad} \\ 1{,}579\,372\,9 \text{ rad} \end{bmatrix}, \quad \begin{bmatrix} m_{K_1} \\ m_{K_2} \\ m_{K_3} \end{bmatrix} = \begin{bmatrix} 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \end{bmatrix}$$

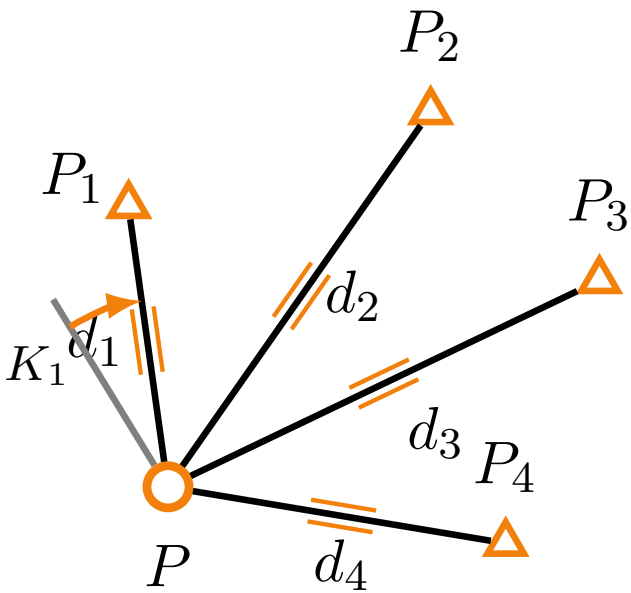
$$X_P^0 = 1250{,}180 \text{ m}, \quad Y_P^0 = 2409{,}860 \text{ m}$$

Przypomnienie

$$\begin{aligned} v_{K_{pk}} = & \frac{\Delta Y_{pk}^0}{(d_{pk}^0)^2} \cdot \Delta X_p - \frac{\Delta X_{pk}^0}{(d_{pk}^0)^2} \cdot \Delta Y_p \\ & - \frac{\Delta Y_{pk}^0}{(d_{pk}^0)^2} \cdot \Delta X_k + \frac{\Delta X_{pk}^0}{(d_{pk}^0)^2} \cdot \Delta Y_k - \Delta C_p + \\ & + A_{pk}^0 - C_p^0 - K_{pk}^{obs} \end{aligned}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 2



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} K_1 \\ K_2 \\ K_3 \end{bmatrix} = \begin{bmatrix} 0{,}319\,578\,5 \text{ rad} \\ 1{,}064\,638\,6 \text{ rad} \\ 1{,}579\,372\,9 \text{ rad} \end{bmatrix}, \quad \begin{bmatrix} m_{K_1} \\ m_{K_2} \\ m_{K_3} \end{bmatrix} = \begin{bmatrix} 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \end{bmatrix}$$

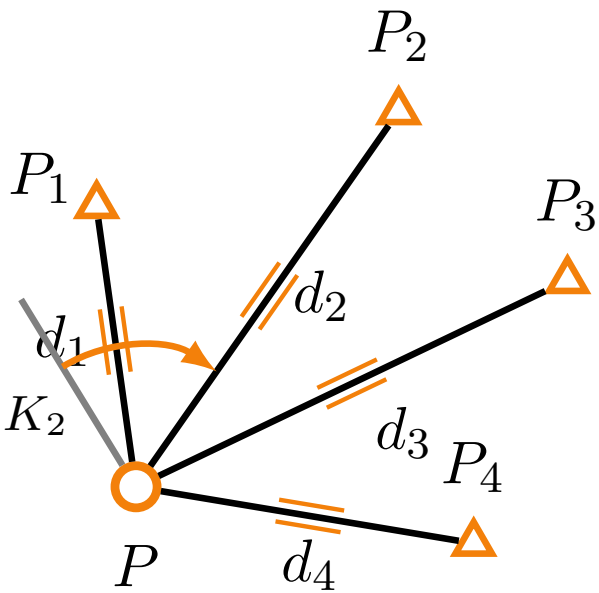
$$X_P^0 = 1250{,}180 \text{ m}, \quad Y_P^0 = 2409{,}860 \text{ m}$$

$$v_{K_{P-P1}} = \frac{\Delta Y^0_{P-P1}}{(d^0_{P-P1})^2} \cdot \Delta X_P - \frac{\Delta X^0_{P-P1}}{(d^0_{P-P1})^2} \cdot \Delta Y_P - \Delta C_p + A^0_{P-P1} - K^{obs}_{P-P1}$$

$$A = \begin{bmatrix} -0,9911347 & 0,1328604 & 0 \\ -0,8185387 & -0,5744512 & 0 \\ -0,4297358 & -0,9029546 & 0 \\ 0,1655895 & -0,9861947 & 0 \\ -0,0008777 & -0,0065481 & -1 \end{bmatrix} \quad L = \begin{bmatrix} -0,21914 \\ -0,05932 \\ 0,03806 \\ 0,18744 \\ -0,452833 \end{bmatrix} \text{ [m/rad]}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 2



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} K_1 \\ K_2 \\ K_3 \end{bmatrix} = \begin{bmatrix} 0{,}319\,578\,5 \text{ rad} \\ 1{,}064\,638\,6 \text{ rad} \\ 1{,}579\,372\,9 \text{ rad} \end{bmatrix}, \quad \begin{bmatrix} m_{K_1} \\ m_{K_2} \\ m_{K_3} \end{bmatrix} = \begin{bmatrix} 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \end{bmatrix}$$

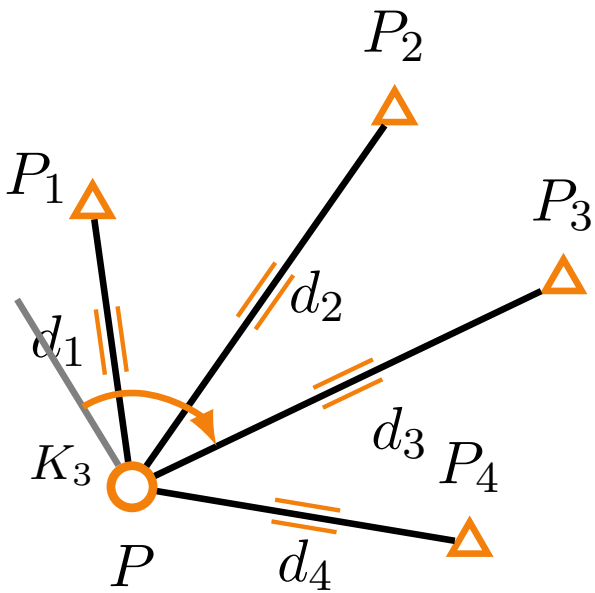
$$X_P^0 = 1250{,}180 \text{ m}, \quad Y_P^0 = 2409{,}860 \text{ m}$$

$$v_{K_{P-P2}} = \frac{\Delta Y^0_{P-P2}}{(d^0_{P-P2})^2} \cdot \Delta X_P - \frac{\Delta X^0_{P-P2}}{(d^0_{P-P2})^2} \cdot \Delta Y_P - \Delta C_p + A^0_{P-P2} - K^{obs}_{P-P2}$$

$$A = \begin{bmatrix} -0,9911347 & 0,1328604 & 0 \\ -0,8185387 & -0,5744512 & 0 \\ -0,4297358 & -0,9029546 & 0 \\ 0,1655895 & -0,9861947 & 0 \\ -0,0008777 & -0,0065481 & -1 \\ 0,0023522 & -0,0033517 & -1 \end{bmatrix} \quad L = \begin{bmatrix} -0,21914 \\ -0,05932 \\ 0,03806 \\ 0,18744 \\ -0,452833 \\ -0,452705 \end{bmatrix} \text{ [m/rad]}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 2



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} K_1 \\ K_2 \\ K_3 \end{bmatrix} = \begin{bmatrix} 0{,}319\,578\,5 \text{ rad} \\ 1{,}064\,638\,6 \text{ rad} \\ 1{,}579\,372\,9 \text{ rad} \end{bmatrix}, \quad \begin{bmatrix} m_{K_1} \\ m_{K_2} \\ m_{K_3} \end{bmatrix} = \begin{bmatrix} 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \end{bmatrix}$$

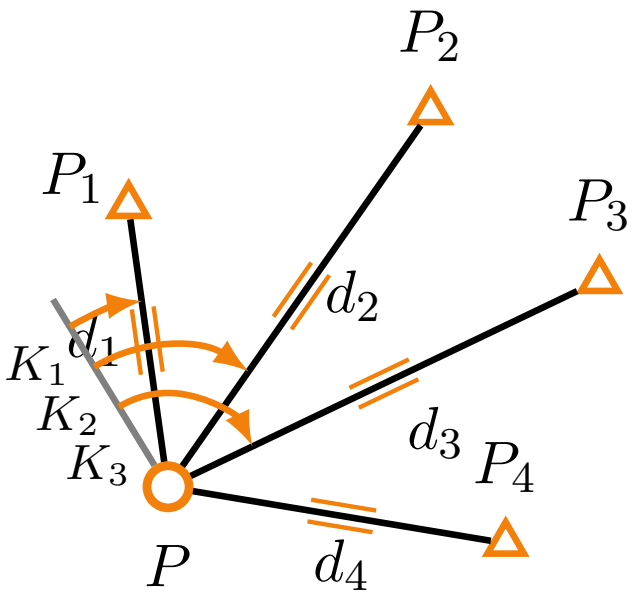
$$X_P^0 = 1250{,}180 \text{ m}, \quad Y_P^0 = 2409{,}860 \text{ m}$$

$$v_{K_{P-P3}} = \frac{\Delta Y^0_{P-P3}}{(d^0_{P-P3})^2} \cdot \Delta X_P - \frac{\Delta X^0_{P-P3}}{(d^0_{P-P3})^2} \cdot \Delta Y_P - \Delta C_p + A^0_{P-P3} - K^{obs}_{P-P3}$$

$$A = \begin{bmatrix} -0,9911347 & 0,1328604 & 0 \\ -0,8185387 & -0,5744512 & 0 \\ -0,4297358 & -0,9029546 & 0 \\ 0,1655895 & -0,9861947 & 0 \\ -0,0008777 & -0,0065481 & -1 \\ 0,0023522 & -0,0033517 & -1 \\ 0,0035372 & -0,0016834 & -1 \end{bmatrix} \quad L = \begin{bmatrix} -0,21914 \\ -0,05932 \\ 0,03806 \\ 0,18744 \\ -0,452833 \\ -0,452705 \\ -0,452777 \end{bmatrix} \text{ [m/rad]}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 2



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

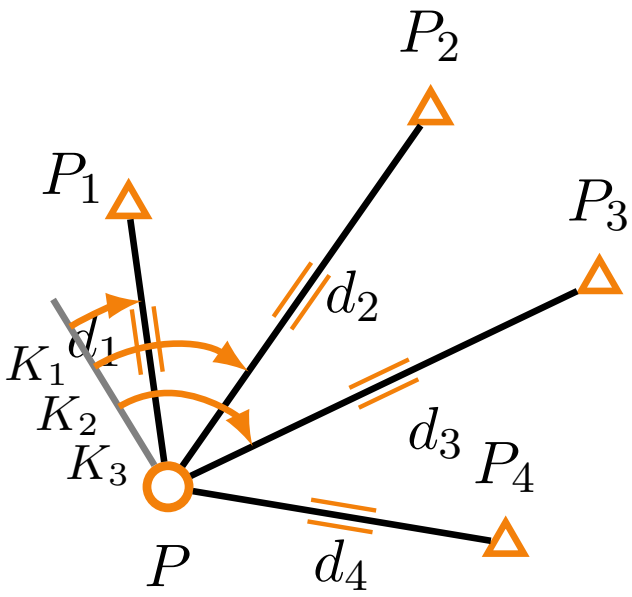
$$\begin{bmatrix} K_1 \\ K_2 \\ K_3 \end{bmatrix} = \begin{bmatrix} 0{,}319\,578\,5 \text{ rad} \\ 1{,}064\,638\,6 \text{ rad} \\ 1{,}579\,372\,9 \text{ rad} \end{bmatrix}, \quad \begin{bmatrix} m_{K_1} \\ m_{K_2} \\ m_{K_3} \end{bmatrix} = \begin{bmatrix} 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \end{bmatrix}$$

$$X_P^0 = 1250{,}180 \text{ m}, \quad Y_P^0 = 2409{,}860 \text{ m}$$

$$P = \begin{bmatrix} m_{d_1}^2 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & m_{d_2}^2 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & m_{d_3}^2 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & m_{d_4}^2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & m_{K_1}^2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & m_{K_2}^2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & m_{K_3}^2 \end{bmatrix}^{-1}$$

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 2



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

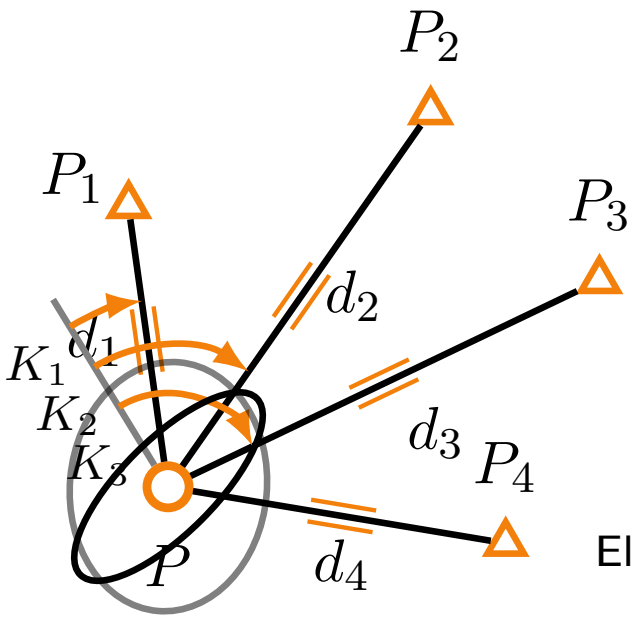
$$\begin{bmatrix} K_1 \\ K_2 \\ K_3 \end{bmatrix} = \begin{bmatrix} 0{,}319\,578\,5 \text{ rad} \\ 1{,}064\,638\,6 \text{ rad} \\ 1{,}579\,372\,9 \text{ rad} \end{bmatrix}, \quad \begin{bmatrix} m_{K_1} \\ m_{K_2} \\ m_{K_3} \end{bmatrix} = \begin{bmatrix} 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \end{bmatrix}$$

$$X_P^0 = 1250{,}180 \text{ m}, \quad Y_P^0 = 2409{,}860 \text{ m}$$

Mając macierze A, L i P, wszystkie pozostałe obliczenia wykonuje się identycznie.

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 2



Dane:

$$\begin{bmatrix} X_{P1} & Y_{P1} \\ X_{P2} & Y_{P2} \\ X_{P3} & Y_{P3} \\ X_{P4} & Y_{P4} \end{bmatrix} = \begin{bmatrix} 1400,200 & 2389,750 \\ 1450,080 & 2550,150 \\ 1359,880 & 2640,360 \\ 1219,960 & 2589,840 \end{bmatrix} \text{ [m]}$$

$$\begin{bmatrix} K_1 \\ K_2 \\ K_3 \end{bmatrix} = \begin{bmatrix} 0{,}319\,578\,5 \text{ rad} \\ 1{,}064\,638\,6 \text{ rad} \\ 1{,}579\,372\,9 \text{ rad} \end{bmatrix}, \quad \begin{bmatrix} m_{K_1} \\ m_{K_2} \\ m_{K_3} \end{bmatrix} = \begin{bmatrix} 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \\ 1{,}571 \cdot 10^{-5} \text{ rad} \end{bmatrix}$$

$$X_P^0 = 1250{,}180 \text{ m}, \quad Y_P^0 = 2409{,}860 \text{ m}$$

Elipsa błędu średniego

$$Q = \begin{bmatrix} 3{,}709 \cdot 10^{-5} & -2{,}783 \cdot 10^{-5} & 1{,}694 \cdot 10^{-7} \\ -2{,}783 \cdot 10^{-5} & 3{,}710 \cdot 10^{-5} & -1{,}897 \cdot 10^{-7} \\ 1{,}694 \cdot 10^{-7} & -1{,}897 \cdot 10^{-7} & 1{,}097 \cdot 10^{-9} \end{bmatrix}$$

$$a = \sigma_0 \cdot \sqrt{2\lambda_1} = 5,0 \text{ mm}$$

$$b = \sigma_0 \cdot \sqrt{2\lambda_2} = 13,3 \text{ mm}$$

$$\varphi = \frac{1}{2} \operatorname{arctg}\left(\frac{2 \cdot Q_{XY}}{Q_X - Q_Y}\right) = -0.785 \text{ rad}(-50,0^{\text{g}})$$

(skala elipsy inna niż, skala sieci)

Krok po kroku rozwiązanie zadania z ćwiczeń

Wariant 3