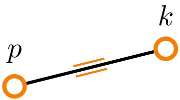
Równania obserwacyjne w sieciach kątowo-liniowych

ostatnia aktualizacja
11 grudnia 2019

Obserwacje kątowo-liniowe

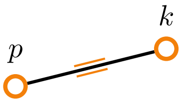
odległość



$$d = \sqrt{(X_k - X_p)^2 + (Y_k - Y_p)^2}$$

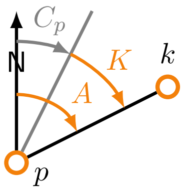
Obserwacje kątowo-liniowe

odległość



$$d = \sqrt{(X_k - X_p)^2 + (Y_k - Y_p)^2}$$

kierunek,
azymut

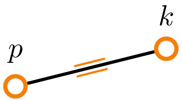


$$A = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right)$$

$$K = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right) - C_p$$

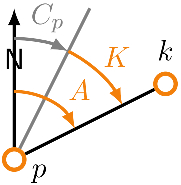
Obserwacje kątowo-liniowe

odległość



$$d = \sqrt{(X_k - X_p)^2 + (Y_k - Y_p)^2}$$

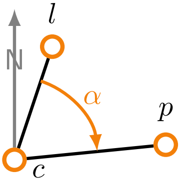
kierunek,
azymut



$$A = \mathrm{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right)$$

$$K = \mathrm{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right) - C_p$$

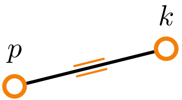
kąt



$$\alpha_{lcp} = A_{cp} - A_{cl} = K_{cp} - K_{cl} =$$
$$= \mathrm{arctg}\left(\frac{Y_p - Y_c}{X_p - X_c}\right) - \mathrm{arctg}\left(\frac{Y_l - Y_c}{X_l - X_c}\right)$$

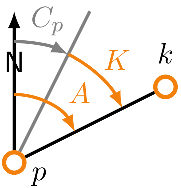
Obserwacje kątowo-liniowe

odległość



$$d = \sqrt{(X_k - X_p)^2 + (Y_k - Y_p)^2}$$

kierunek,
azymut



$$A = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right)$$

$$K = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right) - C_p$$

kąt

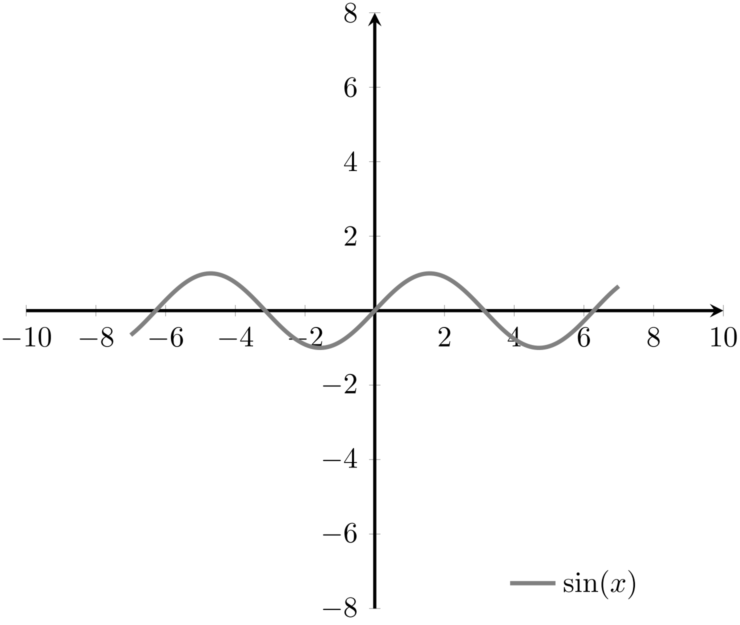
$$\alpha_{lcp} = A_{cp} - A_{cl} = K_{cp} - K_{cl} =$$
$$= \operatorname{arctg}\left(\frac{Y_p - Y_c}{\ldots}\right) - \operatorname{arctg}\left(\frac{Y_l - Y_c}{\ldots}\right)$$

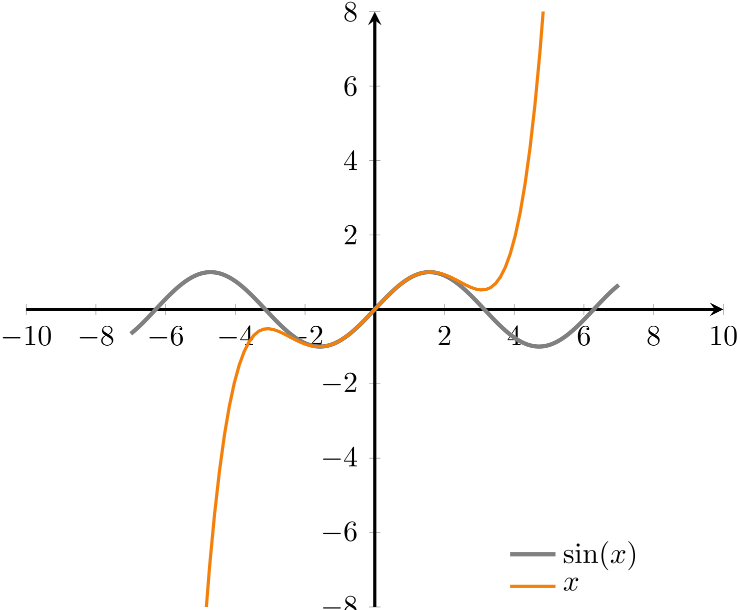
Współrzędne płaskie wszystkich wyznaczanych punktów (X, Y) to niewiadome pośredniczące – elementy wektora niewiadomych. We wszystkich wzorach powyżej niewiadome nie są w postaci liniowej co wykucza zastosowanie MNK.

Linearyzacja

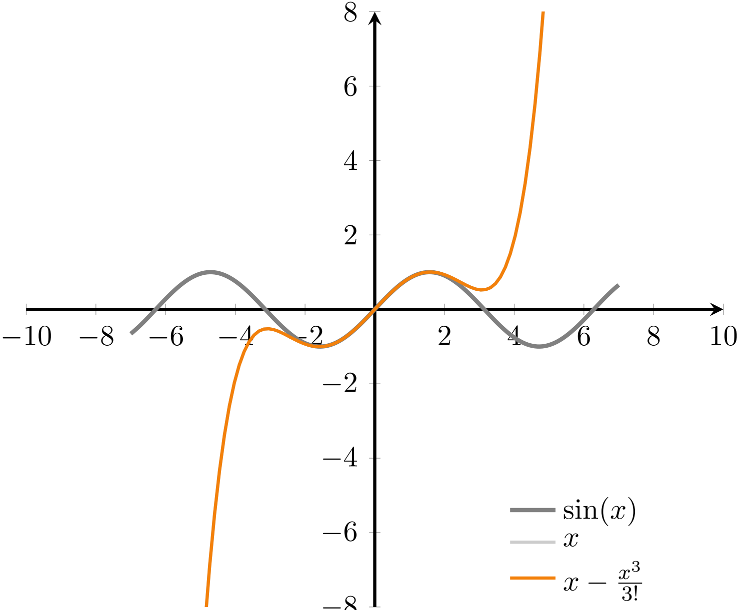
Rozwinięcie funkcji w szereg Taylora

$$
\begin{aligned}
f(x) &= f(a) + \frac{x-a}{1!}\left.\frac{\partial f}{\partial x}\right|_a + \frac{(x-a)^2}{2!}\left.\frac{\partial^2 f}{\partial x^2}\right|_a \\
&\quad + \ldots + \frac{(x-a)^n}{n!}\left.\frac{\partial^n f}{\partial x^n}\right|_a + R_n(x,a) \\
&= \sum_{k=0}^{n}\left(\frac{(x-a)^k}{k!}\left.\frac{\partial^k f}{\partial x^k}\right|_a\right) + R_n(x,a)
\end{aligned}
$$

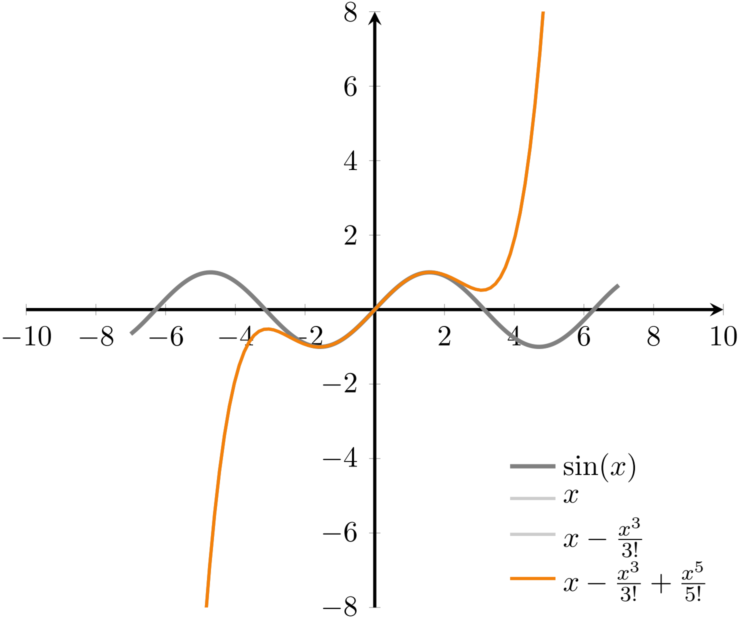

8
6
4
2
−2
−4
−6
−8
−10
−8
−6
−4
−2
2
4
6
8
10
sin(x)



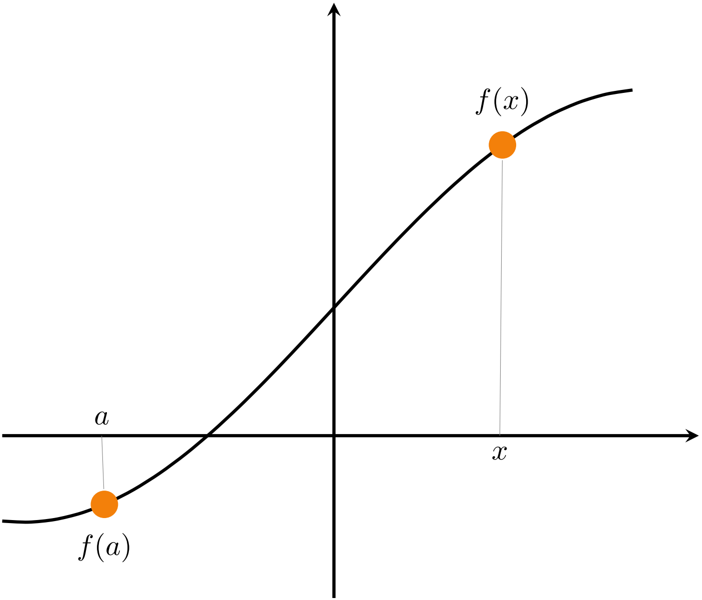
8
6
4
2
−2
−4
−6
−8
−10
−8
−6
−4
−2
2
4
6
8
10
sin(x)
x



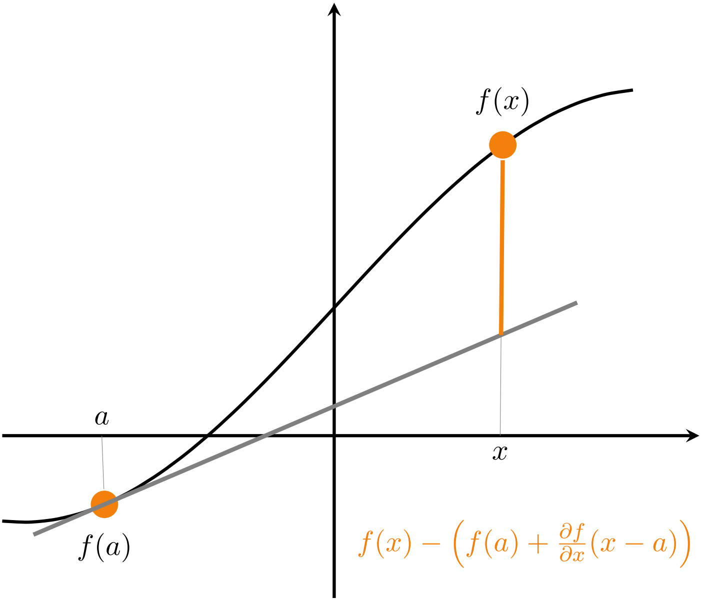
−10
−8
−6
−4
−2
2
4
6
8
10
8
6
4
2
−2
−4
−6
−8
$\sin(x)$
x
$x - \frac{x^3}{3!}$



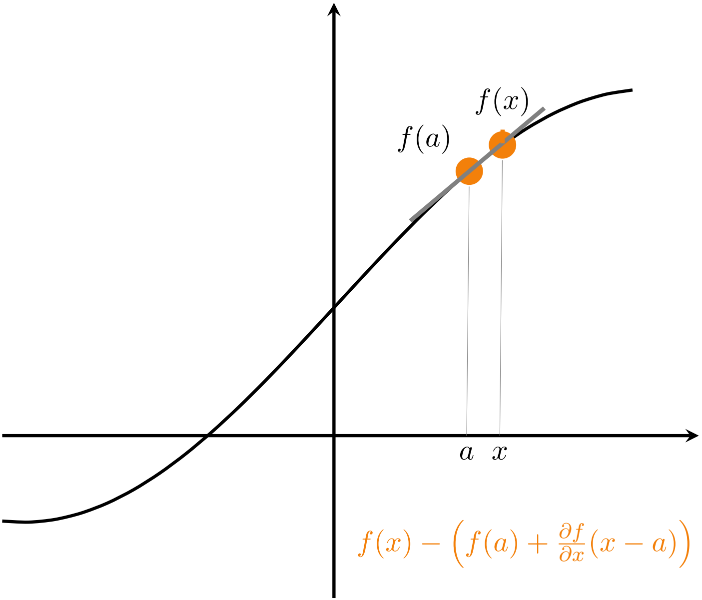
8
6
4
2
−2
−4
−6
−8
−10
−8
−6
−4
−2
2
4
6
8
10
$\sin(x)$
x
$x - \frac{x^3}{3!}$
$x - \frac{x^3}{3!} + \frac{x^5}{5!}$



$f(x)$
a
x
$f(a)$

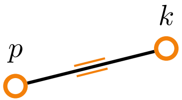


$f(x)$
a
x
$f(a)$
$f(x) - \left(f(a) + \frac{\partial f}{\partial x}(x-a)\right)$


$f(x)$
$f(a)$
a
x
$f(x) - \left(f(a) + \frac{\partial f}{\partial x}(x-a)\right)$

Obserwacje kątowo-liniowe

odległość



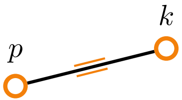
$$d = \sqrt{(X_k - X_p)^2 + (Y_k - Y_p)^2}$$

$$d_{pk}^{obs} + v_{d_{pk}} = d_{pk}$$

$$d_{pk} \; = \; d_{pk}^0 + \left.\frac{\partial d_{pk}}{\partial X_p}\right|_{X^0} \Delta X_p + \left.\frac{\partial d_{pk}}{\partial Y_p}\right|_{X^0} \Delta Y_p + \left.\frac{\partial d_{pk}}{\partial X_k}\right|_{X^0} \Delta X_k + \left.\frac{\partial d_{pk}}{\partial Y_k}\right|_{X^0} \Delta Y_k$$

Obserwacje kątowo-liniowe

odległość



$$d = \sqrt{(X_k - X_p)^2 + (Y_k - Y_p)^2}$$

$$d^0_{pk} = \sqrt{\left(X^0_k - X^0_p\right)^2 + \left(Y^0_k - Y^0_p\right)^2}$$

$$\left.\frac{\partial d_{pk}}{\partial X_p}\right|_{X^0} = \frac{-2(X_k - X_p)}{2\sqrt{\left(X^0_k - X^0_p\right)^2 + \left(Y^0_k - Y^0_p\right)^2}} = \frac{-\Delta X^0_{pk}}{d^0_{pk}} = -\cos A^0_{pk}$$

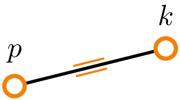
$$\left.\frac{\partial d_{pk}}{\partial Y_p}\right|_{X^0} = \frac{-2(Y_k - Y_p)}{2\sqrt{\left(X^0_k - X^0_p\right)^2 + \left(Y^0_k - Y^0_p\right)^2}} = \frac{-\Delta Y^0_{pk}}{d^0_{pk}} = -\sin A^0_{pk}$$

$$\left.\frac{\partial d_{pk}}{\partial X_k}\right|_{X^0} = \frac{2(X_k - X_p)}{2\sqrt{\left(X^0_k - X^0_p\right)^2 + \left(Y^0_k - Y^0_p\right)^2}} = \frac{\Delta X^0_{pk}}{d^0_{pk}} = \cos A^0_{pk}$$

$$\left.\frac{\partial d_{pk}}{\partial Y_k}\right|_{X^0} = \frac{2(Y_k - Y_p)}{2\sqrt{\left(X^0_k - X^0_p\right)^2 + \left(Y^0_k - Y^0_p\right)^2}} = \frac{\Delta Y^0_{pk}}{d^0_{pk}} = \sin A^0_{pk}$$

Obserwacje kątowo-liniowe

odległość



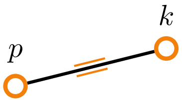
$$d = \sqrt{(X_k - X_p)^2 + (Y_k - Y_p)^2}$$

Równanie poprawki dla odległości

$$v_{d_{pk}} =$$
$$= -\cos A^0_{pk} \cdot \Delta X_p - \sin A^0_{pk} \cdot \Delta Y_p + \cos A^0_{pk} \cdot \Delta X_k + \sin A^0_{pk} \cdot \Delta Y_k +$$
$$+ d^0_{pk} - d^{obs}_{pk}$$

Obserwacje kątowo-liniowe

odległość



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Równanie poprawki dla odległości

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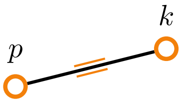
$$+ d^0_{pk} - d^{obs}_{pk}$$

współczynniki przy niewiadomych

Obserwacje kątowo-liniowe

odległość



$$d = \sqrt{(X_k - X_p)^2 + (Y_k - Y_p)^2}$$

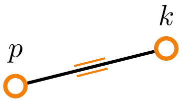
Równanie poprawki dla odległości

$$v_{d_{pk}} =$$
$$= -\cos A^0_{pk} \cdot \Delta X_p - \sin A^0_{pk} \cdot \Delta Y_p + \cos A^0_{pk} \cdot \Delta X_k + \sin A^0_{pk} \cdot \Delta Y_k +$$
$$+ d^0_{pk} - d^{obs}_{pk}$$

niewiadome

Obserwacje kątowo-liniowe

odległość



$$d = \sqrt{(X_k - X_p)^2 + (Y_k - Y_p)^2}$$

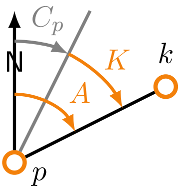
Równanie poprawki dla odległości

$$v_{d_{pk}} =$$
$$= -\cos A^0_{pk} \cdot \Delta X_p - \sin A^0_{pk} \cdot \Delta Y_p + \cos A^0_{pk} \cdot \Delta X_k + \sin A^0_{pk} \cdot \Delta Y_k +$$
$$+ d^0_{pk} - d^{obs}_{pk}$$

wyrazy wolne

Obserwacje kątowo-liniowe

kierunek,
azymut



$$A = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right)$$

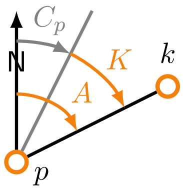
$$K = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right) - C_p$$

$$K_{pk}^{obs} + v_{K_{pk}} = K_{pk} = A_{pk} - C_p$$

$$K_{pk} = K_{pk}^0 + \left.\frac{\partial A_{pk}}{\partial X_p}\right|_{X^0} \Delta X_p + \left.\frac{\partial A_{pk}}{\partial Y_p}\right|_{X^0} \Delta Y_p + \left.\frac{\partial A_{pk}}{\partial X_k}\right|_{X^0} \Delta X_k + \left.\frac{\partial A_{pk}}{\partial Y_k}\right|_{X^0} \Delta Y_k - \Delta C_p$$

Obserwacje kątowo-liniowe

kierunek,
azymut



$$A = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right)$$

$$K = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right) - C_p$$

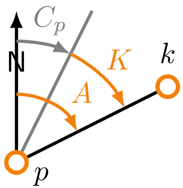
$$A^0_{pk} = \operatorname{arctg}\frac{\left(Y^0_k - Y^0_p\right)}{(X^0_k - X^0_p)}$$

$$\left.\frac{\partial A_{pk}}{\partial X_p}\right|_{X^0} = \frac{(Y_k - Y_p)}{(X^0_k - X^0_p)^2 + (Y^0_k - Y^0_p)^2} \qquad \left.\frac{\partial A_{pk}}{\partial Y_p}\right|_{X^0} = \frac{-(X_k - X_p)}{(X^0_k - X^0_p)^2 + (Y^0_k - Y^0_p)^2}$$

$$\left.\frac{\partial A_{pk}}{\partial X_k}\right|_{X^0} = \frac{-(Y_k - Y_p)}{(X^0_k - X^0_p)^2 + (Y^0_k - Y^0_p)^2} \qquad \left.\frac{\partial A_{pk}}{\partial Y_k}\right|_{X^0} = \frac{(X_k - X_p)}{(X^0_k - X^0_p)^2 + (Y^0_k - Y^0_p)^2}$$

Obserwacje kątowo-liniowe

kierunek,
azymut



$$A = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right)$$

$$K = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right) - C_p$$

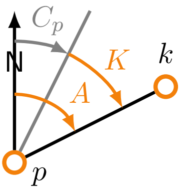
$$A_{pk}^0 = \operatorname{arctg}\frac{\left(Y_k^0 - Y_p^0\right)}{(X_k^0 - X_p^0)}$$

$$\left.\frac{\partial A_{pk}}{\partial X_p}\right|_{X^0} = \frac{\Delta Y_{pk}^0}{(d_{pk}^0)^2} \qquad \left.\frac{\partial A_{pk}}{\partial Y_p}\right|_{X^0} = -\frac{\Delta X_{pk}^0}{(d_{pk}^0)^2}$$

$$\left.\frac{\partial A_{pk}}{\partial X_k}\right|_{X^0} = -\frac{\Delta Y_{pk}^0}{(d_{pk}^0)^2} \qquad \left.\frac{\partial A_{pk}}{\partial Y_k}\right|_{X^0} = \frac{\Delta X_{pk}^0}{(d_{pk}^0)^2}$$

Obserwacje kątowo-liniowe

kierunek,
azymut



$$A = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right)$$

$$K = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right) - C_p$$

Równanie poprawki dla kierunku

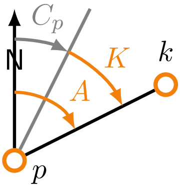
$$v_{K_{pk}} =$$

$$= \frac{\Delta Y_{pk}}{(d^0_{pk})^2} \cdot \Delta X_p - \frac{\Delta X^0_{pk}}{(d^0_{pk})^2} \cdot \Delta Y_p - \frac{\Delta Y^0_{pk}}{(d^0_{pk})^2} \cdot \Delta X_k + \frac{\Delta X^0_{pk}}{(d^0_{pk})^2} \cdot \Delta Y_k - \Delta C_p +$$

$$+ A^0_{pk} - C^0_p - K^{obs}_{pk}$$

Obserwacje kątowo-liniowe

kierunek,
azymut



$$A = \mathrm{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right)$$

$$K = \mathrm{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right) - C_p$$

Równanie poprawki dla kierunku

$$v_{K_{pk}} =$$

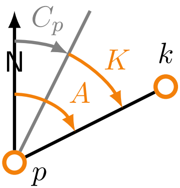
$$= \frac{\Delta Y_{pk}}{(d^0_{pk})^2} \cdot \Delta X_p - \frac{\Delta X^0_{pk}}{(d^0_{pk})^2} \cdot \Delta Y_p - \frac{\Delta Y^0_{pk}}{(d^0_{pk})^2} \cdot \Delta X_k + \frac{\Delta X^0_{pk}}{(d^0_{pk})^2} \cdot \Delta Y_k - \Delta C_p +$$

$$+ A^0_{pk} - C^0_p - K^{obs}_{pk}$$

współczynniki przy niewiadomych

Obserwacje kątowo-liniowe

kierunek,
azymut



$$A = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right)$$

$$K = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right) - C_p$$

Równanie poprawki dla kierunku

$$v_{K_{pk}} =$$

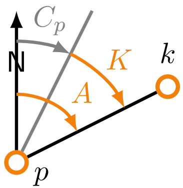
$$= \frac{\Delta Y_{pk}}{(d^0_{pk})^2} \cdot \Delta X_p - \frac{\Delta X^0_{pk}}{(d^0_{pk})^2} \cdot \Delta Y_p - \frac{\Delta Y^0_{pk}}{(d^0_{pk})^2} \cdot \Delta X_k + \frac{\Delta X^0_{pk}}{(d^0_{pk})^2} \cdot \Delta Y_k - \Delta C_p +$$

$$+ A^0_{pk} - C^0_p - K^{obs}_{pk}$$

niewiadome

Obserwacje kątowo-liniowe

kierunek,
azymut



$$A = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right)$$

$$K = \operatorname{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right) - C_p$$

Równanie poprawki dla kierunku

$$v_{K_{pk}} =$$

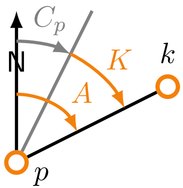
$$= \frac{\Delta Y_{pk}}{(d_{pk}^0)^2} \cdot \Delta X_p - \frac{\Delta X_{pk}^0}{(d_{pk}^0)^2} \cdot \Delta Y_p - \frac{\Delta Y_{pk}^0}{(d_{pk}^0)^2} \cdot \Delta X_k + \frac{\Delta X_{pk}^0}{(d_{pk}^0)^2} \cdot \Delta Y_k - \Delta C_p +$$

$$+A_{pk}^0 - C_p^0 - K_{pk}^{obs}$$

wyrazy wolne

Obserwacje kątowo-liniowe

kierunek,
azymut



$$A = \mathrm{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right)$$

$$K = \mathrm{arctg}\left(\frac{Y_k - Y_p}{X_k - X_p}\right) - C_p$$

Równanie poprawki dla azymutu

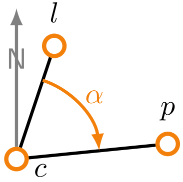
$$v_{A_{pk}} =$$

$$= \frac{\Delta Y_{pk}}{(d_{pk}^0)^2} \cdot \Delta X_p - \frac{\Delta X_{pk}^0}{(d_{pk}^0)^2} \cdot \Delta Y_p - \frac{\Delta Y_{pk}^0}{(d_{pk}^0)^2} \cdot \Delta X_k + \frac{\Delta X_{pk}^0}{(d_{pk}^0)^2} \cdot \Delta Y_k - \Delta C_p +$$

$$+ A_{pk}^0 - A_{pk}^{obs}$$

Obserwacje kątowo-liniowe

kąt



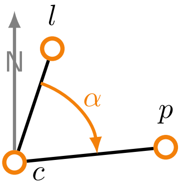
$$\alpha_{lcp} = A_{cp} - A_{cl} = K_{cp} - K_{cl} = \\ = \mathrm{arctg}\left(\frac{Y_p - Y_c}{X_p - X_c}\right) - \mathrm{arctg}\left(\frac{Y_l - Y_c}{X_l - X_c}\right)$$

$$\alpha_{lcp}^{obs} + v_{\alpha_{pk}} = \alpha_{lcp}$$

$$\begin{aligned}\alpha_{lcp} =& \alpha_{lcp}^{0} + \\ & + \left.\frac{\partial \alpha_{lcp}}{\partial X_l}\right|_{X^0} \Delta X_l + \left.\frac{\partial \alpha_{lcp}}{\partial Y_l}\right|_{X^0} \Delta Y_l \\ & + \left.\frac{\partial \alpha_{lcp}}{\partial X_p}\right|_{X^0} \Delta X_p + \left.\frac{\partial \alpha_{lcp}}{\partial Y_p}\right|_{X^0} \Delta Y_p \\ & + \left.\frac{\partial \alpha_{lcp}}{\partial X_c}\right|_{X^0} \Delta X_c + \left.\frac{\partial \alpha_{lcp}}{\partial Y_c}\right|_{X^0} \Delta Y_c\end{aligned}$$

Obserwacje kątowo-liniowe

kąt



$$\alpha_{lcp} = A_{cp} - A_{cl} = K_{cp} - K_{cl} = $$
$$= \operatorname{arctg}\left(\frac{Y_p - Y_c}{X_p - X_c}\right) - \operatorname{arctg}\left(\frac{Y_l - Y_c}{X_l - X_c}\right)$$

$$\alpha^0_{lcp} = \operatorname{arctg}\frac{\left(Y^0_p - Y^0_c\right)}{\left(X^0_l - X^0_c\right)} - \operatorname{arctg}\frac{\left(Y^0_l - Y^0_c\right)}{\left(X^0_l - X^0_c\right)}$$

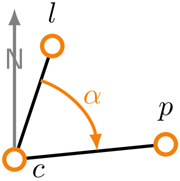
$$\left.\frac{\partial \alpha_{lcp}}{\partial X_l}\right|_{X^0} = \frac{\Delta Y^0_{cl}}{(d^0_{cl})^2} \qquad \left.\frac{\partial \alpha_{lcp}}{\partial Y_l}\right|_{X^0} = -\frac{\Delta X^0_{cl}}{(d^0_{cl})^2}$$

$$\left.\frac{\partial \alpha_{lcp}}{\partial X_l}\right|_{X^0} = -\frac{\Delta Y^0_{cp}}{(d^0_{cp})^2} \qquad \left.\frac{\partial \alpha_{lcp}}{\partial Y_l}\right|_{X^0} = \frac{\Delta X^0_{cp}}{(d^0_{cp})^2}$$

$$\left.\frac{\partial \alpha_{lcp}}{\partial X_c}\right|_{X^0} = \frac{\Delta Y^0_{cp}}{(d^0_{cp})^2} - \frac{\Delta Y^0_{cl}}{(d^0_{cl})^2} \qquad \left.\frac{\partial \alpha_{lcp}}{\partial Y_c}\right|_{X^0} = -\frac{\Delta X^0_{cp}}{(d^0_{cp})^2} + \frac{\Delta X^0_{cl}}{(d^0_{cl})^2}$$

Obserwacje kątowo-liniowe

kąt



$$\alpha_{lcp} = A_{cp} - A_{cl} = K_{cp} - K_{cl} =$$
$$= \operatorname{arctg}\left(\frac{Y_p - Y_c}{X_p - X_c}\right) - \operatorname{arctg}\left(\frac{Y_l - Y_c}{X_l - X_c}\right)$$

$$\alpha^0_{lcp} = \operatorname{arctg}\frac{\left(Y^0_p - Y^0_c\right)}{\left(X^0_l - X^0_c\right)} - \operatorname{arctg}\frac{\left(Y^0_l - Y^0_c\right)}{\left(X^0_l - X^0_c\right)}$$

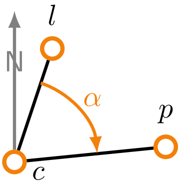
$$\left.\frac{\partial\alpha_{lcp}}{\partial X_l}\right|_{X^0} = \frac{\Delta Y^0_{cl}}{(d^0_{cl})^2} \qquad \left.\frac{\partial\alpha_{lcp}}{\partial Y_l}\right|_{X^0} = -\frac{\Delta X^0_{cl}}{(d^0_{cl})^2}$$

$$\left.\frac{\partial\alpha_{lcp}}{\partial X_l}\right|_{X^0} = -\frac{\Delta Y^0_{cp}}{(d^0_{cp})^2} \qquad \left.\frac{\partial\alpha_{lcp}}{\partial Y_l}\right|_{X^0} = \frac{\Delta X^0_{cp}}{(d^0_{cp})^2}$$

$$\left.\frac{\partial\alpha_{lcp}}{\partial X_c}\right|_{X^0} = \frac{\Delta Y^0_{cp}}{(d^0_{cp})^2} - \frac{\Delta Y^0_{cl}}{(d^0_{cl})^2} \qquad \left.\frac{\partial\alpha_{lcp}}{\partial Y_c}\right|_{X^0} = -\frac{\Delta X^0_{cp}}{(d^0_{cp})^2} + \frac{\Delta X^0_{cl}}{(d^0_{cl})^2}$$

Obserwacje kątowo-liniowe

kąt



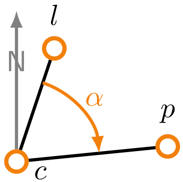
$$\alpha_{lcp} = A_{cp} - A_{cl} = K_{cp} - K_{cl} =$$
$$= \operatorname{arctg}\left(\frac{Y_p - Y_c}{X_p - X_c}\right) - \operatorname{arctg}\left(\frac{Y_l - Y_c}{X_l - X_c}\right)$$

Równanie poprawki dla kąta

$$v_{\alpha_{pk}} =$$
$$= \frac{\Delta Y^0_{cl}}{(d^0_{cl})^2} \cdot \Delta X_l - \frac{\Delta X^0_{cl}}{(d^0_{cl})^2} \cdot \Delta Y_l - \frac{\Delta Y^0_{cp}}{(d^0_{cp})^2} \cdot \Delta X_p + \frac{\Delta X^0_{cp}}{(d^0_{cp})^2} \cdot \Delta Y_p +$$
$$+ \left(\frac{\Delta Y^0_{cp}}{(d^0_{cp})^2} - \frac{\Delta Y^0_{cl}}{(d^0_{cl})^2}\right) \cdot \Delta X_c + \left(-\frac{\Delta X^0_{cp}}{(d^0_{cp})^2} + \frac{\Delta X^0_{cl}}{(d^0_{cl})^2}\right) \cdot \Delta Y_c +$$
$$+ \alpha^0_{lcp} - \alpha^{obs}_{lcp}$$

Obserwacje kątowo-liniowe

kąt



$$\alpha_{lcp} = A_{cp} - A_{cl} = K_{cp} - K_{cl} =$$
$$= \operatorname{arctg}\left(\frac{Y_p - Y_c}{X_p - X_c}\right) - \operatorname{arctg}\left(\frac{Y_l - Y_c}{X_l - X_c}\right)$$

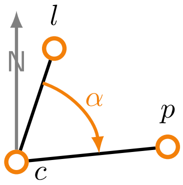
Równanie poprawki dla kąta

$$v_{\alpha_{pk}} =$$
$$= \frac{\Delta Y_{cl}^0}{(d_{cl}^0)^2} \cdot \Delta X_l - \frac{\Delta X_{cl}^0}{(d_{cl}^0)^2} \cdot \Delta Y_l - \frac{\Delta Y_{cp}^0}{(d_{cp}^0)^2} \cdot \Delta X_p + \frac{\Delta X_{cp}^0}{(d_{cp}^0)^2} \cdot \Delta Y_p +$$
$$+ \left(\frac{\Delta Y_{cp}^0}{(d_{cp}^0)^2} - \frac{\Delta Y_{cl}^0}{(d_{cl}^0)^2}\right) \cdot \Delta X_c + \left(-\frac{\Delta X_{cp}^0}{(d_{cp}^0)^2} + \frac{\Delta X_{cl}^0}{(d_{cl}^0)^2}\right) \cdot \Delta Y_c +$$
$$+ \alpha_{lcp}^0 - \alpha_{lcp}^{obs}$$

współczynniki przy niewiadomych

Obserwacje kątowo-liniowe

kąt



$$\alpha_{lcp} = A_{cp} - A_{cl} = K_{cp} - K_{cl} = \\ = \operatorname{arctg}\left(\frac{Y_p - Y_c}{X_p - X_c}\right) - \operatorname{arctg}\left(\frac{Y_l - Y_c}{X_l - X_c}\right)$$

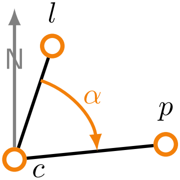
Równanie poprawki dla kąta

$$v_{\alpha_{pk}} = \\ = \frac{\Delta Y^0_{cl}}{(d^0_{cl})^2} \cdot \Delta X_l - \frac{\Delta X^0_{cl}}{(d^0_{cl})^2} \cdot \Delta Y_l - \frac{\Delta Y^0_{cp}}{(d^0_{cp})^2} \cdot \Delta X_p + \frac{\Delta X^0_{cp}}{(d^0_{cp})^2} \cdot \Delta Y_p + \\ + \left(\frac{\Delta Y^0_{cp}}{(d^0_{cp})^2} - \frac{\Delta Y^0_{cl}}{(d^0_{cl})^2}\right) \cdot \Delta X_c + \left(-\frac{\Delta X^0_{cp}}{(d^0_{cp})^2} + \frac{\Delta X^0_{cl}}{(d^0_{cl})^2}\right) \cdot \Delta Y_c + \\ + \alpha^0_{lcp} - \alpha^{obs}_{lcp}$$

niewiadome

Obserwacje kątowo-liniowe

kąt



$$\alpha_{lcp} = A_{cp} - A_{cl} = K_{cp} - K_{cl} =$$
$$= \mathrm{arctg}\left(\frac{Y_p - Y_c}{X_p - X_c}\right) - \mathrm{arctg}\left(\frac{Y_l - Y_c}{X_l - X_c}\right)$$

Równanie poprawki dla kąta

$$v_{\alpha_{pk}} =$$
$$= \frac{\Delta Y_{cl}^0}{(d_{cl}^0)^2} \cdot \Delta X_l - \frac{\Delta X_{cl}^0}{(d_{cl}^0)^2} \cdot \Delta Y_l - \frac{\Delta Y_{cp}^0}{(d_{cp}^0)^2} \cdot \Delta X_p + \frac{\Delta X_{cp}^0}{(d_{cp}^0)^2} \cdot \Delta Y_p +$$
$$+ \left(\frac{\Delta Y_{cp}^0}{(d_{cp}^0)^2} - \frac{\Delta Y_{cl}^0}{(d_{cl}^0)^2}\right) \cdot \Delta X_c + \left(-\frac{\Delta X_{cp}^0}{(d_{cp}^0)^2} + \frac{\Delta X_{cl}^0}{(d_{cl}^0)^2}\right) \cdot \Delta Y_c +$$
$$+\alpha_{lcp}^0 - \alpha_{lcp}^{obs}$$

wyrazy wolne

Obserwacje kątowo-liniowe

Równanie poprawki dla odległości

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

Równanie poprawki dla kierunku

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

Równanie poprawki dla kąta

$$v_{\alpha_{pk}} = \frac{\Delta Y_{cl}^0}{(d_{cl}^0)^2} \cdot \Delta X_l - \frac{\Delta X_{cl}^0}{(d_{cl}^0)^2} \cdot \Delta Y_l - \frac{\Delta Y_{cp}^0}{(d_{cp}^0)^2} \cdot \Delta X_p + \frac{\Delta X_{cp}^0}{(d_{cp}^0)^2} \cdot \Delta Y_p + \\ + \left(\frac{\Delta Y_{cp}^0}{(d_{cp}^0)^2} - \frac{\Delta Y_{cl}^0}{(d_{cl}^0)^2} \right) \cdot \Delta X_c + \left(- \frac{\Delta X_{cp}^0}{(d_{cp}^0)^2} + \frac{\Delta X_{cl}^0}{(d_{cl}^0)^2} \right) \cdot \Delta Y_c + \\ + \alpha_{lcp}^0 - \alpha_{lcp}^{obs}$$