29-1

$$\begin{bmatrix} -W & A^T & 0 \\ A & 0 & B \\ 0 & B^T & 0 \end{bmatrix} \begin{bmatrix} v \\ k \\ \Delta \end{bmatrix} = \begin{bmatrix} 0 \\ f \\ 0 \end{bmatrix}$$

$$-Wv + A^T k = 0$$
$$Av + B\delta = f$$
$$B^T k = 0$$

$v = QA^T k$

$AQA^T k + B\delta = f$

$k = (AQA^T)^{-1}(f - B\delta)$

$B^T W_e (f - B\delta) = 0$

$B^T W_e B\delta = B^T W_e f$

$N \qquad t$

$\Delta = N^{-1} t$

$k = W_e (f - B\delta)$

$v = QA^T k$

$x = x + \Delta$

$l^\circ = l + v$

$\delta l = l^\circ_{new} - l^\circ_{prior}$

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29-2

A: $\frac{\partial F}{\partial l}$

B: $\frac{\partial F}{\partial x}$

$f: -F(l^\circ, x^\circ) - A(l - l^\circ)$

$n = 11 \times 2 = 22$

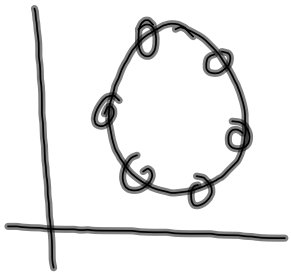
$n_0 = 3 + 11 = 14$

$r = 8$

$M = 3$, X_0, Y_0, R

$C = r + M$, $8 + 3 > 11$

Example GLS



x,y observed

points = 11

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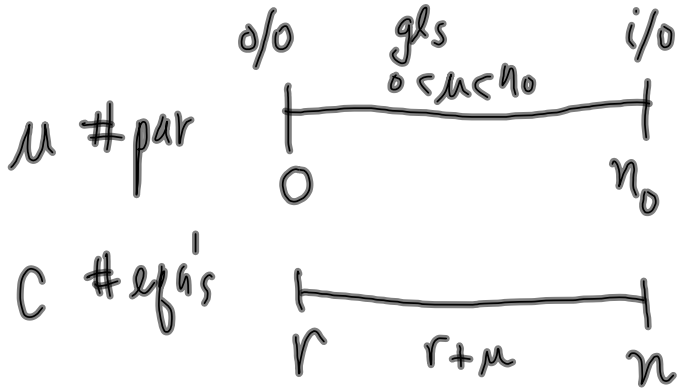
29-3



C = 11, also # of points

$$(x_i - x_0)^2 + (y_i - y_0)^2 = R^2$$

$$F: (x_i - x_0)^2 + (y_i - y_0)^2 - R^2 = 0$$

$$F: \left[(x_i - x_0)^2 + (y_i - y_0)^2\right]^{1/2} - R = 0 \quad \checkmark$$

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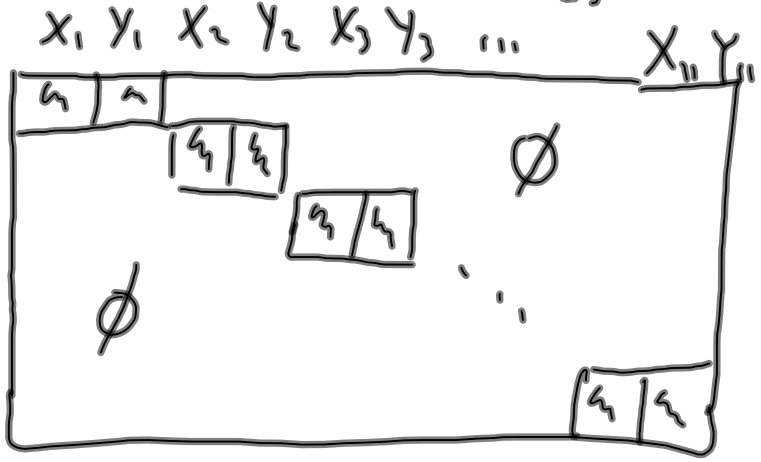
29-4

$$F = \left[(x_i - x_0)^2 + (y_i - y_0)^2\right]^{1/2} - R = 0$$

$$\frac{\partial F}{\partial x_i} = \frac{1}{2}[\cdot]^{-1/2} 2(x_i - x_0) = \frac{x_i - x_0}{[\cdot]^{1/2}}$$

$$\frac{\partial F}{y_i} = \frac{1}{2}[\cdot]^{-1/2} 2(y_i - y_0) = \frac{y_i - y_0}{[\cdot]^{1/2}}$$



A

(C, n)

(11, 22)

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B $\frac{\partial F}{\partial X_0} = -\frac{(X_i - X_0)}{(\cdot)^{1/2}}$, $\frac{\partial F}{\partial Y_0} = \frac{-(Y_i - Y_0)}{(\cdot)^{1/2}}$, $\frac{\partial F}{\partial R} = -1$ 29-5

$c_{1,m}$

$11,3$

	X_0	Y_0	R
point 1	$\frac{-(X_1 - X_0)}{(\cdot)^{1/2}}$	$\frac{-(Y_1 - Y_0)}{(\cdot)^{1/2}}$	-1
point 2	$\frac{-(X_2 - X_0)}{(\cdot)^{1/2}}$	$\frac{-(Y_2 - Y_0)}{(\cdot)^{1/2}}$	-1
⋮	⋮	⋮	

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$f = -F^0(l^0, x^0) - A\underline{(l - l^0)}$ 29-6

$c_{1,1}$

$11,1$

$f_i = -F_i(X_i^0, Y_i^0, X_0^0, Y_0^0, R^0) - A_i \underset{\text{non zero}}{\underset{1,2}{}} \begin{pmatrix} X_i - X_i^0 \\ Y_i - Y_i^0 \end{pmatrix}_{2,1}$

3D conformal coordinate transformation

7-parameter transf. (rigid body transf.)

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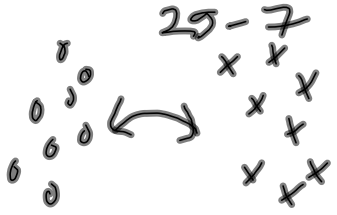
$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \underset{\sim}{\lambda} M \begin{pmatrix} X \\ Y \\ Z \end{pmatrix} + \begin{pmatrix} t_x \\ t_y \\ t_z \end{pmatrix} \quad \checkmark$$



$$F = \begin{matrix} F_1 \\ F_2 \\ F_3 \end{matrix} : \begin{pmatrix} x \\ y \\ z \end{pmatrix} - \lambda M \begin{pmatrix} X \\ Y \\ Z \end{pmatrix} - \begin{pmatrix} t_x \\ t_y \\ t_z \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

$n_p = 8$ observed sats

systems

$n = 8 \times 6 = 48$

$n_0 = 7 + 3 \times 8 = 31$

$r = 17$

$\mu = 7$ $\lambda, \underbrace{\omega, \varphi, k}_{M}, t_x\ t_y\ t_z$

$C = r + \mu = 17 + 7 = \underline{24}$

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