

### Quesito 1

$$x_1' = {}^0T_{CT} \cdot x_{CT1} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 21.5 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 0 \\ 21.5 \\ 0 \\ 1 \end{bmatrix}$$

$$x_2' = \begin{bmatrix} 0 \\ 21.5 \\ 10.0 \\ 1 \end{bmatrix}$$

$$x_3' = \begin{bmatrix} 0 \\ 0.5 \\ 0 \\ 1 \end{bmatrix}$$

$$FRE_2 = 5 \text{ mm}$$

$$FRE_1 = \|x_1' - x_{01}\| = \left\| \begin{pmatrix} 0 \\ 21.5 \\ 0 \end{pmatrix} - \begin{pmatrix} 0 \\ 26.5 \\ 0 \end{pmatrix} \right\| = 5 \text{ mm} \quad FRE_3 = 0.5 \text{ mm}$$

$$FRE = \sqrt{\frac{1}{3} (5^2 + 5^2 + 0.5^2)} = 4.1 \text{ mm}$$

### Quesito 2

$$x_1'' = {}^{0}_{\text{note}}T_0 \cdot {}^0T_{CT} \cdot x_{CT1} = {}^{0}_{\text{note}}T_0 \cdot x_1' = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 2.5 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 0 \\ 21.5 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 0 \\ 24 \\ 0 \\ 1 \end{bmatrix}$$

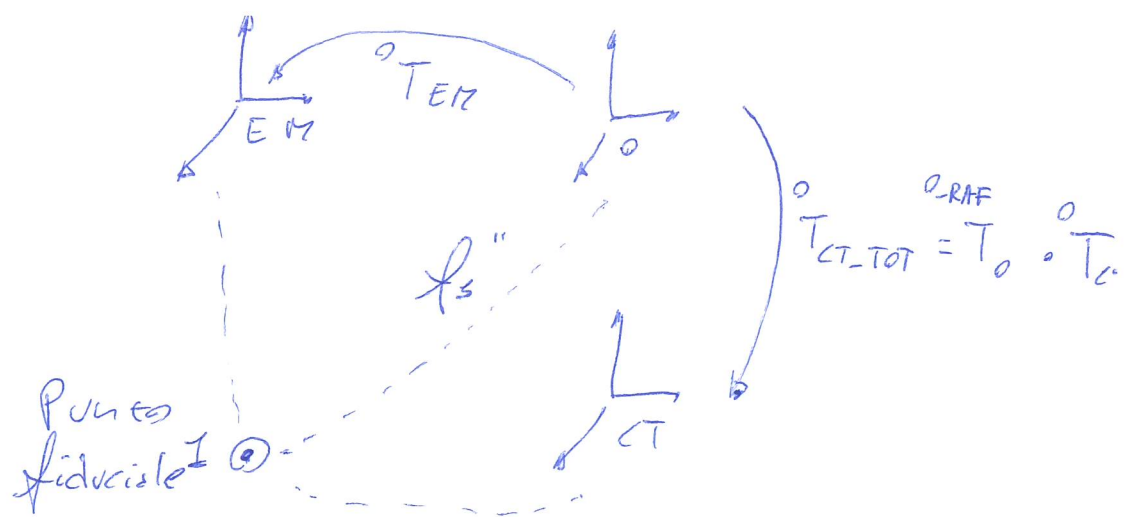
$$x_2'' = \begin{bmatrix} 0 \\ 24 \\ 0 \\ 1 \end{bmatrix} \quad x_3'' = \begin{bmatrix} 0 \\ 3 \\ 0 \\ 1 \end{bmatrix}$$

$$FRE_2 = 2.5 \text{ mm}$$

$$FRE_1 = \|x_1'' - x_{01}\| = \left\| \begin{pmatrix} 0 \\ 24 \\ 0 \end{pmatrix} - \begin{pmatrix} 0 \\ 26.5 \\ 0 \end{pmatrix} \right\| = 2.5 \text{ mm} \quad FRE_3 = 2 \text{ mm}$$

$$FRE = \sqrt{\frac{1}{3} (2.5^2 + 2.5^2 + 2^2)} = 2.3 \text{ mm}$$

### Quesito 3

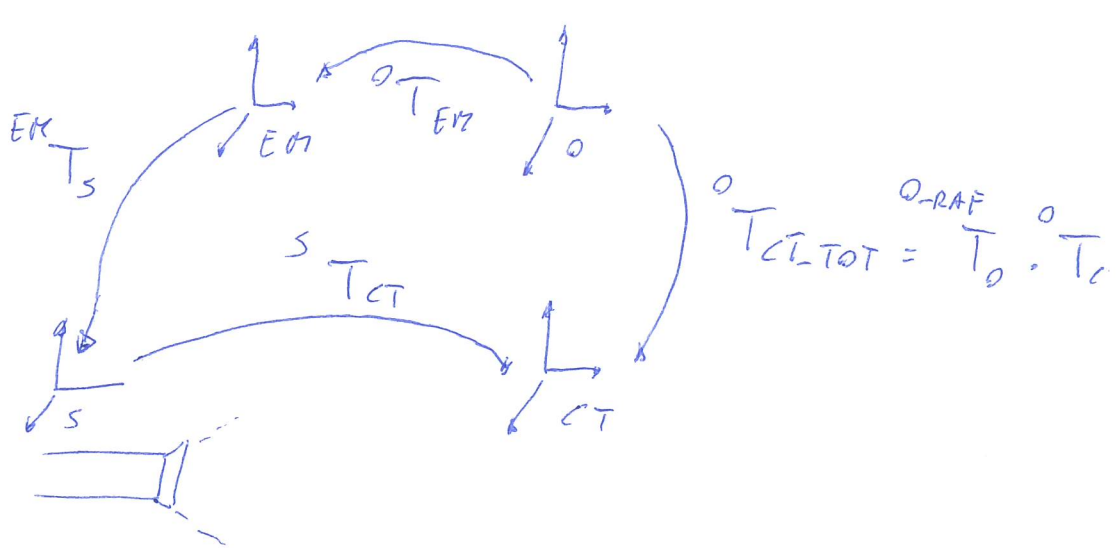


Al punto ~~pre~~ precedente è stato determinato  $x_1''$  che rappresenta il punto  $x$  in  $O$  dopo la registrazione di superficie.

Calcolando l'errore in  $O$ :

$$TRE = \left\| {}^O T_{EM} x_{EM_1} - x_1'' \right\| = \left\| \begin{pmatrix} 0 \\ 26 \\ 1 \end{pmatrix} - \begin{pmatrix} 0 \\ 26 \\ 0 \end{pmatrix} \right\| = \sqrt{5} \text{ mm}$$

Quesito 4



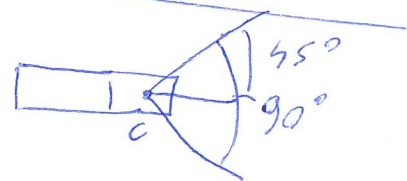
$$T_{CT} = T_S^{-1} \cdot T_{EM}^{-1} \cdot T_0 \cdot T_C =$$

$$= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & -10 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & -1000 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 2.5 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 21.5 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} =$$

$$= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 14 \\ 0 & 1 & 0 & -1000 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Quesito 5

$$\vec{Ct} = t_{EM} - C = \begin{pmatrix} 0 \\ 0 \\ 50 \end{pmatrix}$$



$$\vec{Ct} \cdot \hat{V}_{EM} = |\vec{Ct}| |\hat{V}_{EM}| \cos \alpha$$

$$\alpha = \arccos \left( \frac{\vec{Ct} \cdot \hat{V}_{EM}}{|\vec{Ct}| \cdot 1} \right) = \arccos \left( \frac{0 + 0 + \frac{50}{\sqrt{3}}}{50} \right) =$$

$$= \arccos \left( \frac{1}{\sqrt{3}} \right) = 54.7^\circ$$

Il target non è visibile poiché  $54.7^\circ > 45^\circ$