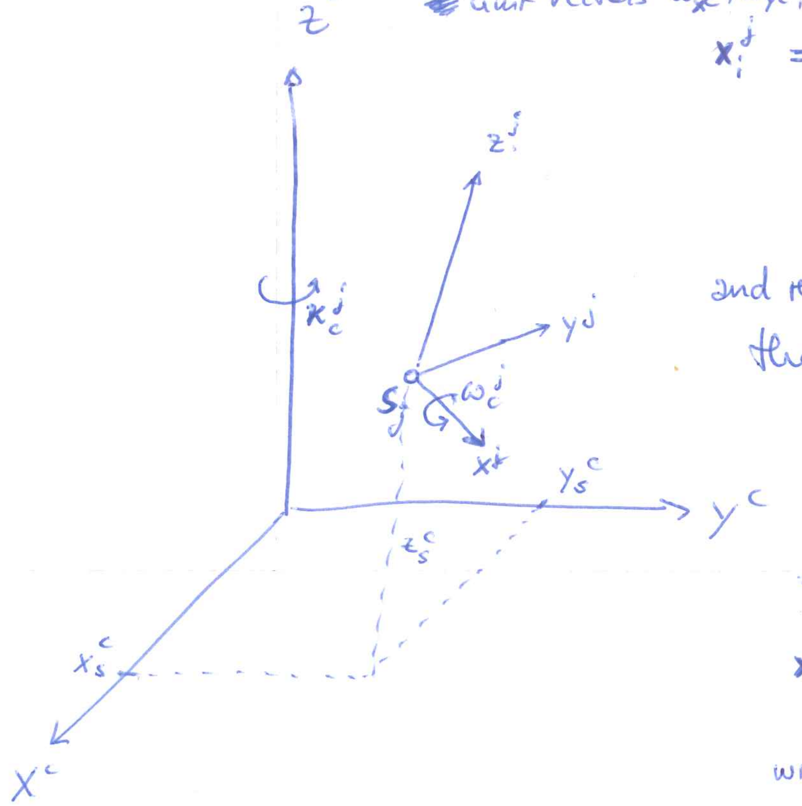
Ass: • all coordinate systems right handed

- positive rotation = counter-clockwise
- orientation of superordinate system (c) in scanner system j described by unit vectors $u^j_{xc}, u^j_{yc}, u^j_{zc}$ with



$$x^j_i = R_1(\omega^j_c) R_2(\varphi^j_c) R_3(\kappa^j_c) \left[X^c_i - X^c_{Sj} \right]$$

$$U^j_c = \left[u^j_{xc} \,\vdots\, u^j_{yc} \,\vdots\, u^j_{zc} \right]$$

and represented by $\omega^j_c, \varphi^j_c, \kappa^j_c$ such that

$$U^j_c = R_1(\omega^j_c) \cdot R_2(\varphi^j_c) \cdot R_3(\kappa^j_c) = R^j_c$$

$\Rightarrow$

$$x^j_i = R^j_c \cdot \left(X^c_i - X^c_{Sj} \right)$$

with $X^c_i = \begin{bmatrix} X^c_i \\ Y^c_i \\ Z^c_i \end{bmatrix}$ and $x^j_i = \begin{bmatrix} x^j_i \\ y^j_i \\ z^j_i \end{bmatrix}$

where $R_3(\alpha) := \begin{bmatrix} \cos\alpha & +\sin\alpha & 0 \\ -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$ $\quad R_2(\alpha) := \begin{bmatrix} \cos\alpha & 0 & -\sin\alpha \\ 0 & 1 & 0 \\ \sin\alpha & 0 & \cos\alpha \end{bmatrix}$

$$R_1(\alpha) := \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\alpha & \sin\alpha \\ 0 & -\sin\alpha & \cos\alpha \end{bmatrix}$$

$$R_2(\varphi) \cdot R_3(\kappa) = \begin{bmatrix} \cos\varphi & 0 & -\sin\varphi \\ 0 & 1 & 0 \\ \sin\varphi & 0 & \cos\varphi \end{bmatrix} \cdot \begin{bmatrix} \cos\kappa & \sin\kappa & 0 \\ -\sin\kappa & \cos\kappa & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} \cos\varphi\cos\kappa & \cos\varphi\sin\kappa & -\sin\varphi \\ -\sin\kappa & \cos\kappa & 0 \\ \sin\varphi\cos\kappa & \sin\varphi\sin\kappa & \cos\varphi \end{bmatrix}$$

$$R_1(\omega) \cdot R_2(\varphi) \cdot R_3(\kappa) = \begin{bmatrix} \cos\varphi\cos\kappa & \cos\varphi\sin\kappa & -\sin\varphi \\ -\cos\omega\sin\kappa + \sin\omega\sin\varphi\cos\kappa & \cos\omega\cos\kappa + \sin\omega\sin\varphi\sin\kappa & \sin\omega\cos\varphi \\ \sin\omega\sin\kappa + \cos\omega\sin\varphi\cos\kappa & -\sin\omega\cos\kappa + \cos\omega\sin\varphi\sin\kappa & \cos\omega\cos\varphi \end{bmatrix}$$