



Forward KINEMATICS

$$\begin{aligned} P_x &= c_x + l \sin \theta \cos \varphi \\ P_y &= c_y + l \sin \theta \sin \varphi \\ P_z &= c_z + l \cos \theta \end{aligned}$$

$$q = \begin{bmatrix} \theta \\ \varphi \\ c_x \\ c_y \\ c_z \end{bmatrix}$$

JACOBIANS

$$J(q, c) = \begin{bmatrix} 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

$$J(q, P(c)) = \begin{bmatrix} l \cos \theta \cos \varphi & -l \sin \theta \sin \varphi & 1 & 0 & 0 \\ l \cos \theta \sin \varphi & l \sin \theta \cos \varphi & 0 & 1 & 0 \\ -l \sin \theta & 0 & 0 & 0 & 1 \end{bmatrix}$$

$T = \text{get Transform}(q)$

↳ φ rotates around z

↳ θ rotates around new y