R^3
$\mathbf{O}{-}xyz$
$\mathbf{x}$
$\mathbf{y}$
$\mathbf{z}$
$(p_x, p_y, p_z) \in$
R^3
$\mathbf{p}$
$\mathbf{p}(t) =$
$(p_x(t), p_y(t), p_z(t)) \in$
R^3
$\mathbf{p}$
$\mathbf{q}$
$\|\mathbf{p}(t) - \mathbf{q}(t)\| = \|\mathbf{p}(0) - \mathbf{q}(0)\| = K \forall t.$
(1)
??
??
$\mathbf{O}'$
$\mathbf{O}{-}xyz$
$\mathbf{o}' = o'_x\mathbf{x}{+}o'_y\mathbf{y}{+}o'_z\mathbf{z},$
(2)
o'_x
o'_y
o'_z
$\mathbf{o}'$

$$\mathbf{o}' = \begin{bmatrix} o'_x \\ o'_y \\ o'_z \end{bmatrix}.$$

(3)
$\mathbf{O}'{-}x'y'z'$
$\mathbf{x}'$
$\mathbf{y}'$
$\mathbf{z}'$
$\in$
R^3
$\mathbf{O}{-}xyz$
??

$$\mathbf{x}' = x'_x\mathbf{x} + x'_y\mathbf{z} + x'_z\mathbf{z},$$
$$\mathbf{y}' = y'_x\mathbf{x} + y'_y\mathbf{z} + y'_z\mathbf{z},$$
$$\mathbf{z}' = z'_x\mathbf{x} + z'_y\mathbf{z} + z'_z\mathbf{z}, \quad (4)$$

??
$\mathbf{R} = [\mathbf{x}'\mathbf{y}'\mathbf{z}'] = \left[x'_x y'_x z'_x x'_y y'_y z'_y x'_z y'_z z'_z\right] = \left[\mathbf{x}'^T\mathbf{x}\mathbf{y}'^T\mathbf{x}\mathbf{z}'^T\mathbf{x}\mathbf{x}'^T\mathbf{y}\mathbf{y}'^T\mathbf{y}\mathbf{z}'^T\mathbf{y}\mathbf{x}'^T\mathbf{z}\mathbf{y}'^T\mathbf{z}\mathbf{z}'^T\mathbf{z}\right],$
(5)
$\mathbf{P}$
$\mathbf{O}{-}xyz$
$\mathbf{P}$
$\mathbf{O}'{-}x'y'z'$

$$p = p'_x x' {+} p'_y y' {+} p'_z z' = [\mathbf{x}'\mathbf{y}'\mathbf{z}']\left[p'_x p'_y p'_z\right] = Rp'.$$

(6)
$\mathbf{R}^T\mathbf{R} =$
$\mathbf{I}_{3\times 3}$
$det\,\mathbf{R} =$
± 1
$det\,\mathbf{R} = \mathbf{x}'^T(\mathbf{y}'{\times}\mathbf{z}').$
(7)
$det\,\mathbf{R} =$
1
$SO(3) =$
$\{R \in$
$R^{3\times 3}:$
$R^T R =$
$I,\ det R =$
$1\}$
$\mathbf{R}_z(\alpha) = [c\,\alpha - s\alpha 0 s\alpha c\alpha 0001]; \mathbf{R}_y(\beta) = [c\,\beta 0 s\beta 010 - s\beta 0 c\beta]; \mathbf{R}_x(\gamma) = [1\,000 c\gamma - s\gamma 0 s\gamma c\gamma].$
(8)
$cv =$
$cos(v)$
$sv =$
$sin(v)$
$v =$
α, β, γ
?
$O_1{-}x_1y_1z_1$
$O_2{-}x_2y_2z_2$
T_{12}
$T_{12} = [R_{12}(p_{12})_1 0_{1\times 3} 1].$
(9)
$p_{12} \in$
R^3
$R_{12} \in$
$SO(3)$
$SE(3) =$