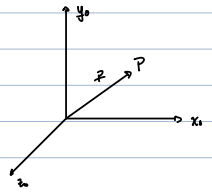
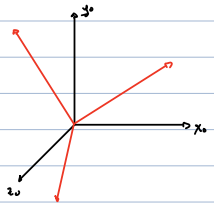
3D Transformations



$$\underline{P} = {}^0P_1\,\underline{x}_0 + {}^0P_2\,\underline{y}_0 + {}^0P_3\,\underline{z}_0$$

$$\underline{P} = P - O_0 \qquad {}^0\underline{P} = \begin{bmatrix} {}^0P_1 \\ {}^0P_2 \\ {}^0P_3 \end{bmatrix}$$

$$\underline{P} = {}^1P_1\,\underline{x}_1 + \qquad {}^0\underline{P} = {}^0_1\underset{\sim}{R}\,{}^1\underline{P}$$ ← SAME THING FROM BEFORE, JUST ONE MORE COLUMN/ENTRY



ROTATION ABOUT z

$${}^0_1\underset{\sim}{R} = \begin{bmatrix} C_\theta & -S_\theta & 0 \\ S_\theta & C_\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

ROTATION ABOUT y

$${}^0_1\underset{\sim}{R} = \begin{bmatrix} C_\theta & 0 & S_\theta \\ 0 & 1 & 0 \\ -S_\theta & 0 & C_\theta \end{bmatrix}$$

ROTATION ABOUT x

$${}^0_1\underset{\sim}{R} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & C_\theta & -S_\theta \\ 0 & S_\theta & C_\theta \end{bmatrix}$$

WE'LL USE ZYZ EULER ANGLES

$${}^0_1\underset{\sim}{R} = R_z(\phi)\,R_y(\theta)\,R_z(\psi)$$

$$R_{ZYZ}(\phi, \theta, \psi)$$

$${}^0_2\underset{\sim}{R} = {}^0_1\underset{\sim}{R}\;{}^1_2\underset{\sim}{R}$$

$$\left({}^0_1\underset{\sim}{R}\right)^T = \left({}^0_1\underset{\sim}{R}\right)^{-1} = {}^1_0\underset{\sim}{R}$$