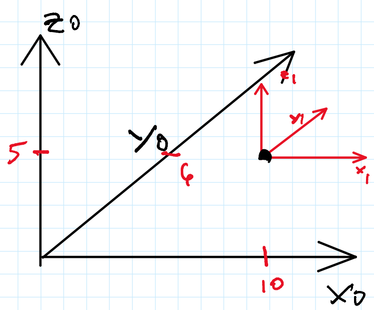
RM : How the rotation of F_n is projected on F_{n-1}.

$$ {}^{n-1}_{n}R = \begin{array}{c} \\ x_{n-1} \\ y_{n-1} \\ z_{n-1} \end{array} \begin{array}{c} \begin{array}{ccc} x_n & y_n & z_n \end{array} \\ \begin{bmatrix} \square & \square & \square \\ \square & \square & \square \\ \square & \square & \square \end{bmatrix} \end{array} $$

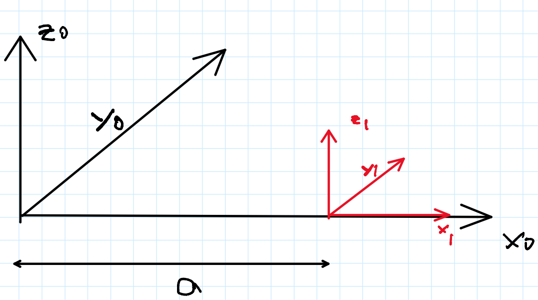
PV: How the translation of F_n is projected on F_{n-1}.

3×1

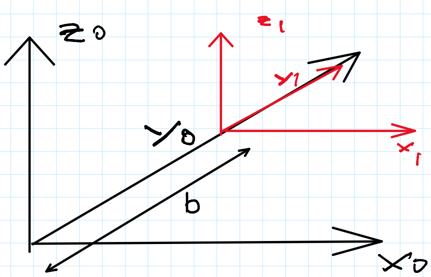
$$ {}^{n-1}_{n}d = {}^{n-1}_{n}P = \begin{bmatrix} \square \\ \square \\ \square \end{bmatrix} \begin{array}{c} {}^{n-1}_{n}X \\ {}^{n-1}_{n}Y \\ {}^{n-1}_{n}Z \end{array} $$



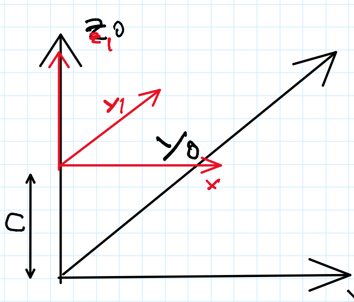
$$ {}^{0}_{1}P = \begin{bmatrix} 10 \\ 6 \\ 5 \end{bmatrix} $$



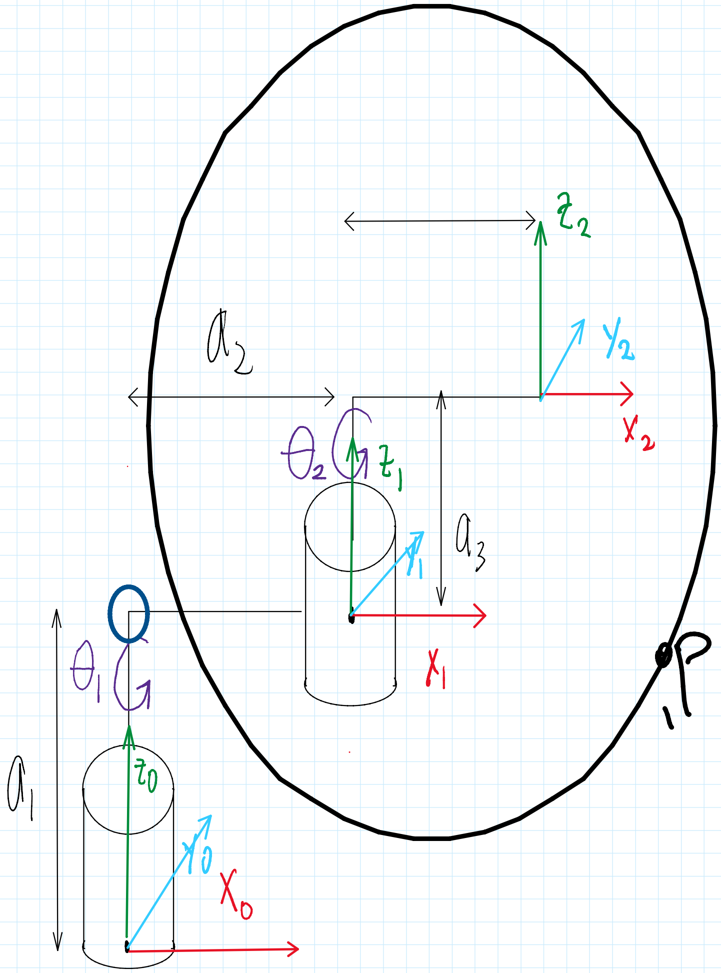
$$ {}^{0}_{1}P = \begin{bmatrix} a \\ 0 \\ 0 \end{bmatrix} $$



$$ {}^{0}_{1}P = \begin{bmatrix} 0 \\ b \\ 0 \end{bmatrix} $$



$$ {}^{0}_{1}P = \begin{bmatrix} 0 \\ 0 \\ c \end{bmatrix} $$



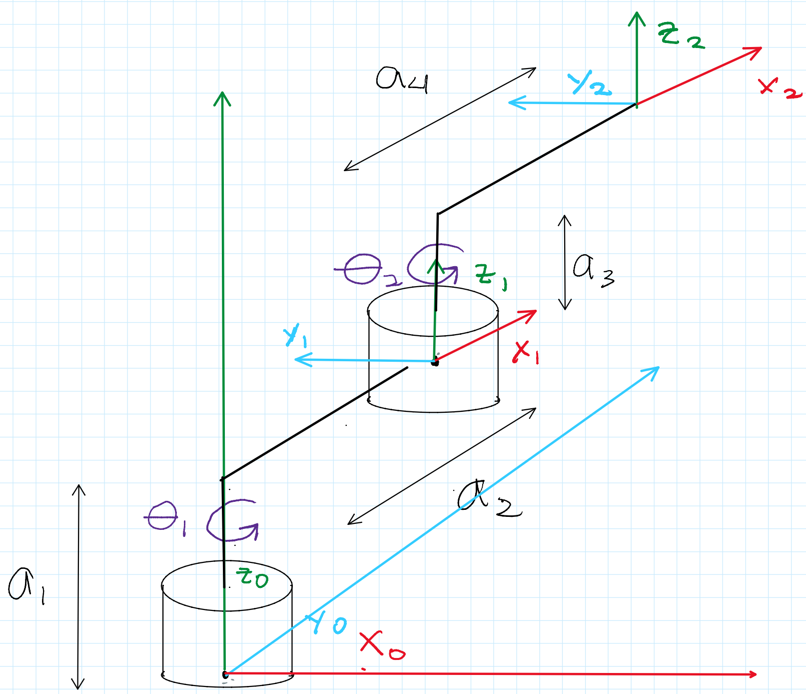
$${}^0_2R = {}^0_1R * {}^1_2R$$

$${}^0_2P \neq {}^0_1P * {}^1_2P$$

$${}^0_2P \neq {}^0_1P + {}^1_2P$$

$${}_1P = \begin{bmatrix} a_2 \\ 0 \\ a_1 \end{bmatrix}$$

However,



$$ {}^{0}_{1}P = \begin{bmatrix} 0 \\ a_2 \\ 0 \end{bmatrix} $$

Remember: We need to make sure that our position vector is correct no matter what the values of joint variables are.

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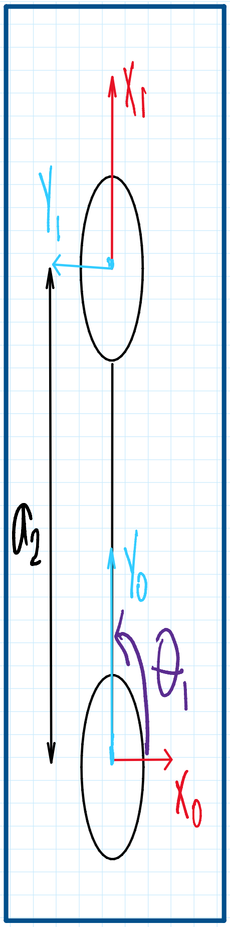
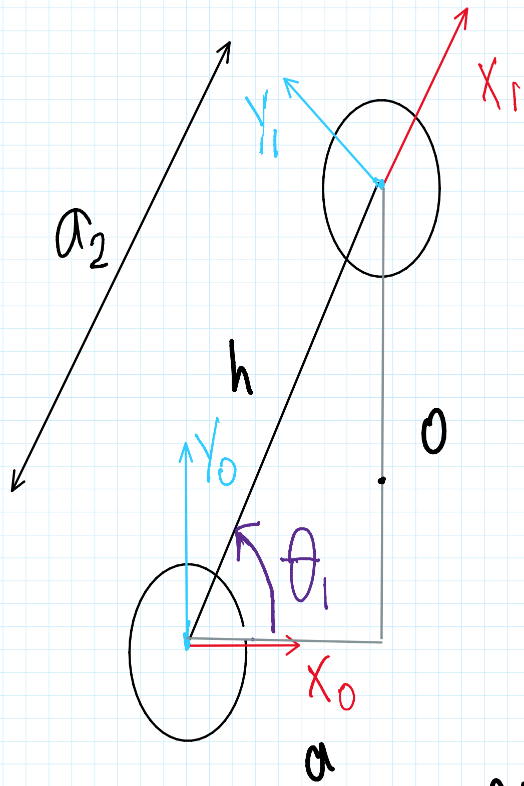
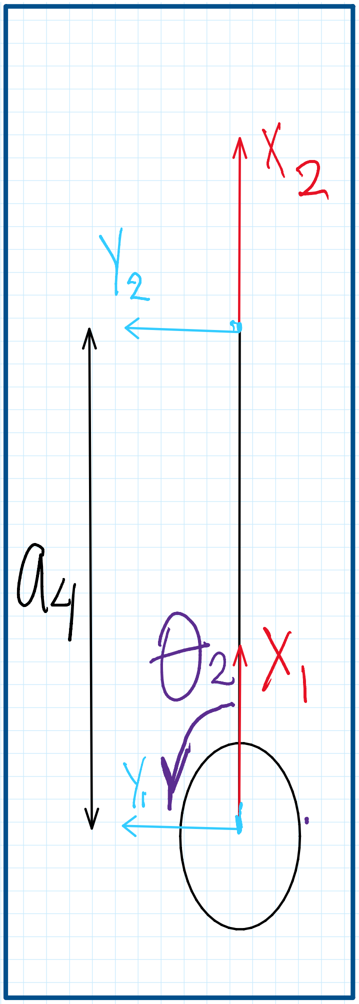


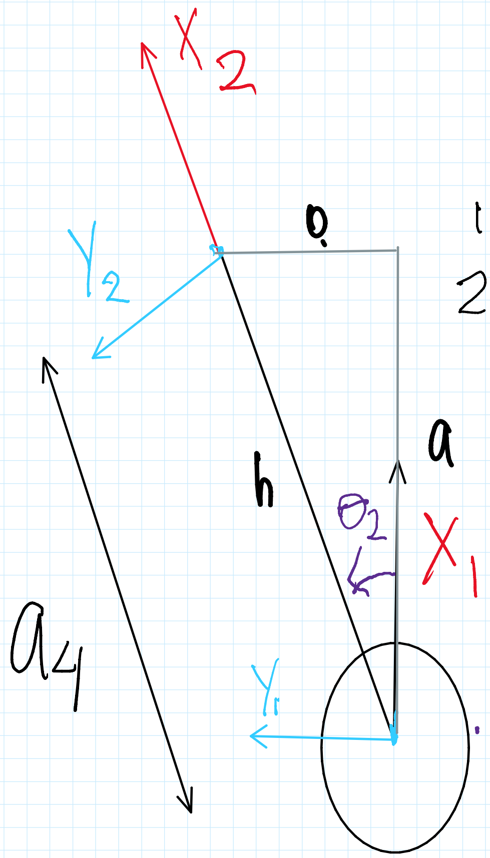


$$
{}^{0}_{1}P = \begin{array}{c|c} \begin{bmatrix} a_2\cos\theta_1 \\ a_2\sin\theta_1 \\ a_1 \end{bmatrix} & \begin{array}{c} {}^{0}_{1}X \\ {}^{0}_{1}Y \\ {}^{0}_{1}Z \end{array} \end{array}
$$

$$\cos\theta_1 = \frac{x_0}{a_2} \qquad \sin\theta_1 = \frac{y_0}{a_2}$$

$$a_2\cos\theta_1 = x_0 \qquad a_2\sin\theta_1 = y_0$$





$$
{}^1_2P = \begin{array}{c} \\ \\ \\ \end{array}\begin{bmatrix} a_4 C\theta_2 \\ a_4 S\theta_2 \\ a_3 \end{bmatrix}\begin{array}{l} {}^1_2X \\ {}^1_2Y \\ {}^1_2Z \end{array}
$$

$$\cos\theta_2 = \frac{X_1}{a_4}$$

$$a_4 \cos\theta_2 = X_1$$

$$\sin\theta_2 = \frac{Y_1}{a_4}$$

$$a_4 \sin\theta_2 = Y_1$$