# Direct kinematic solution

$$P1=\begin{bmatrix} L_1*\cos(\theta_1) \\ L_1*\sin(\theta_1) \\ 0 \end{bmatrix}$$

If P2proj is the projection of P2 on the (x, y) plan, and d12 is the distance between P1 and P2proj then :

$$P2=\begin{bmatrix} (L_1+d_{12})*\cos(\theta_1) \\ (L_1+d_{12})*\sin(\theta_1) \\ 0+L_2*\sin(\theta_2) \end{bmatrix}$$

With :
$d_{12}=L_2*\cos(\theta_2)$

=>
$$P2=\begin{bmatrix} P_1.x+\cos(\theta_1)*L_2*\cos(\theta_2) \\ P_1.y+\sin(\theta_1)*L_2*\cos(\theta_2) \\ P_1.z+L_2*\sin(\theta_2) \end{bmatrix}$$

If P3proj is the projection of P3 on the (x, y) plan, and d23 is the distance between P2proj and P3proj then :

$$P3=\begin{bmatrix} (L_1+d_{12}+d_{23})*\cos(\theta_1) \\ (L_1+d_{12}+d_{23})*\sin(\theta_1) \\ P_2.z+L_3*\sin(\theta_2+\theta_3) \end{bmatrix}$$

With :
$d_{23}=L_3*\cos(\theta_2+\theta_3)$

If we call :
$planContribution=L_1+d_{12}+d_{23}$
$planContribution=L_1+L_2*\cos(\theta_2)+L_3*\cos(\theta_2+\theta_3)$

Final result :

$$P3=\begin{bmatrix} planContribution*\cos(\theta_1) \\ planContribution*\sin(\theta_1) \\ L_2*\sin(\theta_2)+L_3*\sin(\theta_2+\theta_3) \end{bmatrix}$$