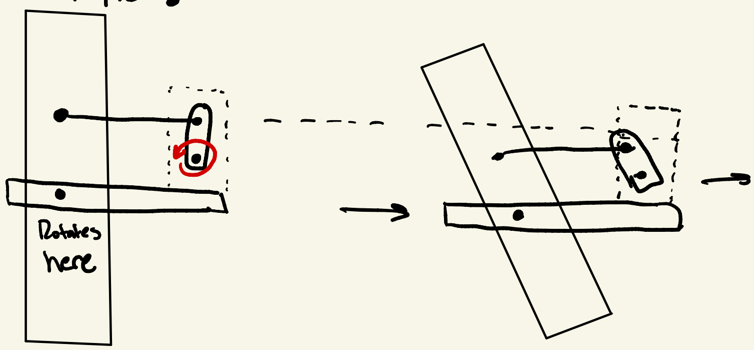
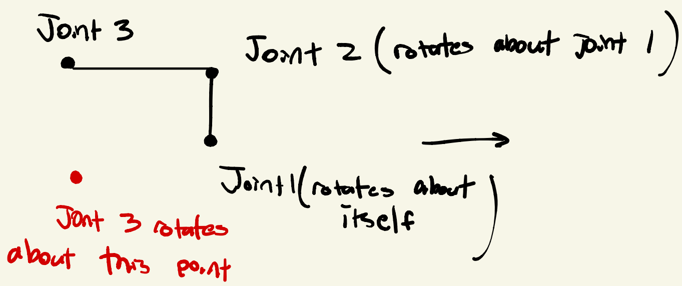
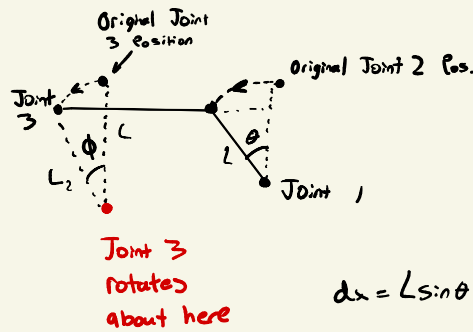
Linear Approximation Derivation

X-axis rotation:

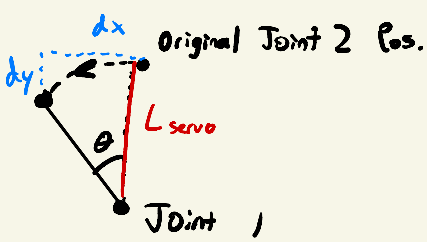






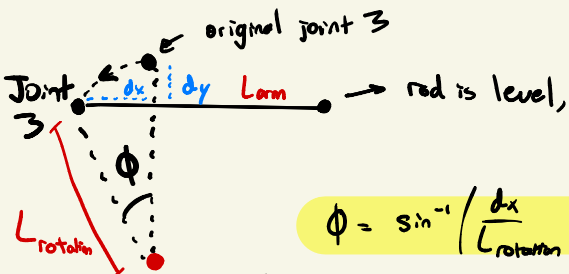
$dx = L\sin\theta$

$\sin^{-1}\left(L\sin\theta\right.$



$$dx = L_{servo} \cdot \sin\theta$$

$$dy = L_{servo}\left(1 - \cos\theta\right)$$



$$\phi = \sin^{-1}\left(\frac{dx}{L_{rotation}}\right) = \sin^{-1}\left(\frac{L_{servo}\sin\theta}{L_{rotation}}\right)$$

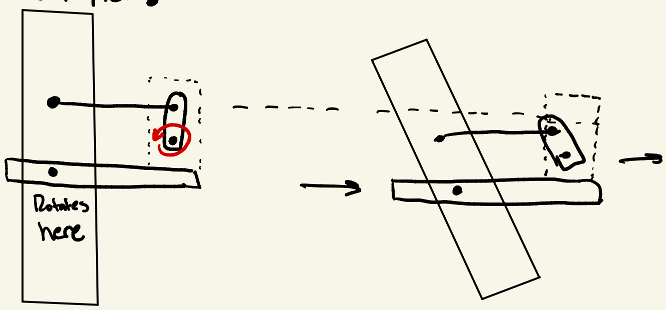
or

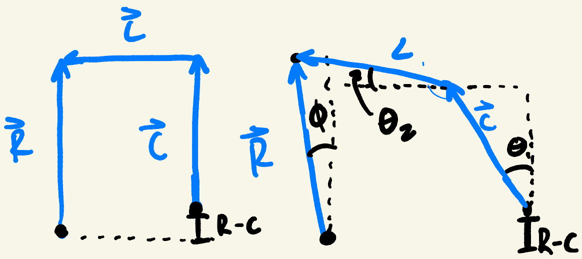
$$\phi = \cos^{-1}\left(\frac{L_{rotation} - dy}{L_{rotation}}\right) = \cos^{-1}\left(\frac{L_{rotation} - L_{servo}\left(1 - \cos\theta\right)}{L_{rotation}}\right)$$

$$= \cos^{-1}\left(1 - \frac{L_{servo}}{L_{rotation}}\left(1 - \cos\theta\right)\right)$$

Non linear System Derivation

X-axis rotation:

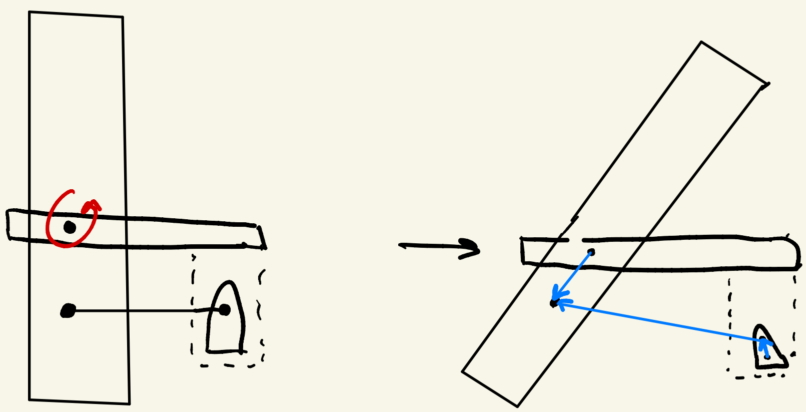


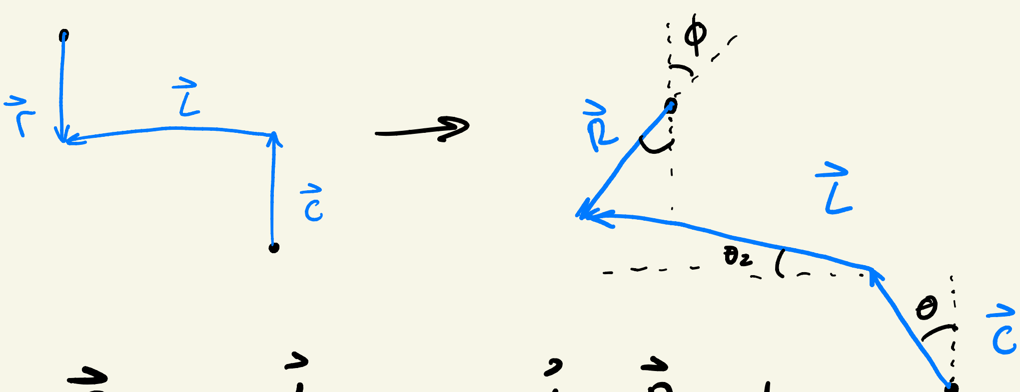


$$C\sin\theta_1 + L\cos\theta_2 = L + R\sin\phi$$

$$C\cos\theta_1 + L\sin\theta_2 = R\cos\phi - (R-C)$$

Y-axis





$$\vec{C}\sin\theta + \vec{L}\cos\theta_2 = \vec{L} + \vec{R}\sin\phi$$

$$\vec{C}\cos\theta + \vec{L}\sin\theta_2 = R + C - \vec{R}\cos\phi$$