Lever Arm Equations in Platform Frame

$$\vec{L}^P = C_B^P \vec{L}^B$$

$$\Rightarrow \quad \dot{\vec{L}}^P = \dot{C}_B^P \vec{L}^B + C_B^P \dot{\vec{L}}^B \qquad (\dot{\vec{L}}^B = 0)$$

$$\dot{C}_B^P = C_B^P(\omega_{PB}^B \mathrm{X}) \quad \rightarrow \quad \dot{C}_B^P = (\omega_{PB}^P \times) C_B^P$$

$$\dot{\vec{L}}^P = (\omega_{PB}^P \times L^P)$$

$$\dot{\vec{L}}^P = (\omega_{PB}^P \times)(C_B^P L^B) = (\omega_{PB}^P \times L^P)$$

$$\Rightarrow \quad \ddot{\vec{L}}^P = (\dot{\omega}_{PB}^P \times L^P) + (\omega_{PB}^P \times \dot{L}^P)$$

P = Platform frame (local level tangent frame) computed

$$\ddot{\vec{L}}^P = \dot{\omega}_{PB}^P \times L^P + \omega_{PB}^P \times (\omega_{PB}^P \times L^P)$$

$$\vec{A}x\vec{B}x\vec{C} = \vec{B}(\vec{A} \bullet \vec{C}) - \vec{C}(\vec{A} \bullet \vec{B})$$

$$\omega x \omega x L = \omega(\omega \bullet L) - L(\omega \bullet \omega) = \vec{\omega}_{PB}^P(\omega_{PB}^P \bullet L^E) - \omega_{PB}^{P\,2} \vec{L}^P$$

$$\ddot{\vec{L}}^P = \dot{\omega}_{PB}^P \times L^P + \vec{\omega}_{PB}^P(\omega_{PB}^P \bullet L^P) - (\omega_{PB}^P)^2 L^P$$

$$\ddot{\vec{L}}^P = \dot{\vec{\omega}}_{PB}^P \times \vec{L}^P + \vec{\omega}_{PB}^P(\omega_{PB}^P \bullet L^P) - (\omega_{PB}^P)^2 \vec{L}^P$$