Lever Arm Equations

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

$$\dot{\vec{L}}^E = \dot{C}_B^E \vec{L}^B + C_B^E \dot{\vec{L}}^B$$

0

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

$$\dot{\vec{L}}^E = (\omega_{EB}^E \times)(C_B^E L^B) = (\omega_{EB}^E \times L^E)$$

$$\dot{\vec{L}}^E = (\omega_{EB}^E \times L^E)$$

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

SMALL ~ a/Re

$$\omega_{EB}^E = \omega_{EP}^E + \omega_{PB}^E$$

P = Platform frame (local level tangent frame) computed

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

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

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

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

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